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DOCKET
08-AFC-2
DATE JUN 01 2010
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June 1, 2010

California Energy Commission
Attn: Docket No. 08-AFC-2
1516 Ninth Street, MS 4
Sacramento, CA 95814-5512

Re: 08AFC2 Beacon Solar Energy Project

Dear Docket Clerk:

Enclosed are an original and one copy of: Brief of California Unions for Reliable Energy in Response to Committee Order for Limited Re-Opening of the Record. Please process this document and return a conformed copy in the envelope provided.

Thank you.

Sincerely,

/s/

Tanya A. Gulesserian

TAG:bh
Enclosures

2162-114a

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STATE OF CALIFORNIA
California Energy Commission

In the Matter of: The Application for Certification for the BEACON SOLAR ENERGY PROJECT	Docket No. 08-AFC-2

BRIEF OF CALIFORNIA UNIONS FOR RELIABLE ENERGY IN RESPONSE TO COMMITTEE ORDER FOR LIMITED RE-OPENING OF THE RECORD

June 1, 2010

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2162-113a

On May 13, 2010, the Committee issued a Notice of Evidentiary Hearing and Order in Response to Staff Motion for Limited Re-Opening of the Record for Beacon Solar, LLC's ("Applicant") Beacon Solar Energy Project ("Project"). The Committee's Order allowed the evidentiary record to reopen for "the limited purpose" of hearing evidence on the following:

1. The environmental review of the expansion of the Rosamond Community Services District and California City water treatment facilities;
2. Kern County's request for development fees from the Beacon Solar Energy Project; and
3. The Project's qualification for funding under the American Recovery and Reinvestment Act of 2009 ("ARRA").

Subsequent emails from Hearing Officer Celli informed the parties that the Committee also requests the following information:

4. Clarification in the record as to exactly which nearby projects were analyzed in the cumulative impacts analysis in Soils and Water, and if none, an explanation supporting the conclusion that there were no nearby projects to analyze;[1] and
5. A response to the April 20, 2010 comment from Ranch Seco Inc. recommending that the Project Applicant pay for testing of groundwater contaminants since the Project will be using recycled

[1] May 21, 2010 Email from Ken Celli to Tanya Gulesserian, Jared Babula and Jane Luckhardt, Subject: Further evidence in BSEP.

water and other hazardous chemicals that may affect the drinking water.[2]

The Committee Order directed the parties to file and serve any new testimony and any briefs on these issues no later than June 1, 2010 and noticed an evidentiary hearing for June 8, 2010.

CURE files this brief in response to the Committee Order.

1. CEQA Requires the Commission to Provide Public Notice, a 30-day Public Comment Period and Responses to Comments on Staff's Environmental Review of the Upgrades and Expansions of Wastewater Treatment Facilities Needed to Provide Recycled Water to the Proposed Project.

The Committee Order states that one of the purposes of re-opening the record is to take evidence limited to "the environmental review" of the expansion of the Rosamond Community Services District and California City water treatment facilities. This "environmental review" under CEQA has not yet occurred and was the subject of CURE's extensive post-evidentiary hearing briefing in this proceeding. This "environmental review" is apparently just now being prepared by Staff, as explained in Staff's motion to reopen the record.[3] Specifically, if the record is re-opened, "staff would anticipate submitting brief evaluations of the upgrades to

[2] May 14, 2010 Email from Ken Celli to Tanya Gulesserian, Jared Babula and Jane Luckhardt, Subject: 08-AFC-2 Beacon –Corporation Letter from D. Martin.
[3] Staff's Reply Brief, In the Matter of Application for Certification for the Beacon Solar Energy Project, (08-AFC-2), p. 9.

identify possible impacts and potential mitigation."[4] Staff also stated that "staff could opine as to the potential for impacts and the need, if any, for mitigation."[5]

CEQA requires the California Energy Commission to provide public notice of the availability of Staff's environmental review document, an opportunity for public comment on the environmental assessment, and responses to public comments. Specifically, Public Resources Code section 21092 requires the Commission to provide public notice that specifies the period during which comments will be received, a description of the proposed project and its significant effects, and the address where copies of all documents referenced in the environmental review document are available for review.[6] Public Resources Code section 21091(a) provides that the Commission's public review period may not be less than 30 days. Public Resources Code section 21091(d) provides that the Commission shall consider comments it receives on the draft assessment and shall prepare a written response. The Commission is not exempt from any of these mandatory CEQA requirements.

a. CEQA Does Not Exempt The Commission From Providing Notice, Public Comment and Responses to Comments

Under Public Resources Code section 21080.5, a certified regulatory program is "exempt from Chapters 3 (commencing with Section 21100), Chapter 4 (commencing with Section 21150), and Section 21167, except as provided in Article

[4] Id.
[5] Id.
[6] Pub. Res. Code § 21092(a), (b)(1).

2 (commencing with Section 21157) of Chapter 4.5."[7] However, the regulatory program must require that approval of a project be preceded by the preparation of written environmental documentation that:

1) Includes a description of the proposed activity and mitigation measures to minimize any significant adverse environmental impacts and

2) "Is available for a reasonable time for review and comment by other public agencies and the general public."[8]

Furthermore, a regulatory program is ***not exempt*** from any other procedural and substantive requirements of CEQA, if such requirements are found outside of Chapters 3 and 4 of the Act, outside of section 21167 of the Public Resources Code or within section 21080.5 itself.[9] In fact, the CEQA Guidelines themselves provide that "[a] certified regulatory program [under section 21080.5] remains subject to other provisions of CEQA…"[10]

When certifying the California Energy Commission's regulatory program as "functionally equivalent" under section 21080.5, the Secretary of the Resources Agency confirmed "that the program continues to meet the criteria for certification under Public Resources Code section 21080.5."[11] Therefore, the Commission may "continue to process any…application for certification…under its current regulatory

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[7] Pub. Res. Code §21080.5(c); *Environmental Protection Information Center, Inc. v. Johnson* (1st Dist. 1985) 170 Cal.App.3d 604, 616-618.
[8] Pub. Res. Code § 21080.5(a), (d)(3).
[9] *Environmental Protection Information Center, Inc. v. Johnson* (1st Dist. 1985) 170 Cal.App.3d 604, 616-618.
[10] 14 Cal. Code Reg. § 15250.
[11] Letter from Mary D. Nichols, Secretary for Resources, to Mr. William J. Keese, Chairman, California Energy Commission, Subject: Review of the Energy Commission's Certified Program for Siting Power Plants (December 29, 2000).

program without preparing an environmental impact report."[12] The secretary did not use language exempting the program from CEQA, only from preparing an environmental impact report. "Under the maxim *expressio unius est exclusio alterius*, exemptions specified in the statute prevent additional exemptions from being implied or presumed, absent clear legislative intent to the contrary."[13]

The courts have been clear that certified regulatory agencies are not exempt from other requirements of CEQA.[14] In *Ultramar v. South Coast Air Quality Management District*, the court considered whether the air quality management district was required to comply with section 21091(a) of the Public Resources Code, which provides that "[t]he public review period for a draft [EIR] may not be less than 30 days."[15] In finding that the 30-day public comment period applies to public review of the air district's environmental assessment ("EA") under its certified regulatory program, the court stated that "[t]he fact that this section refers to EIR's, rather than EA's, is of ***no consequence***."[16] The court noted that the Supreme Court emphasized that "[t]he foremost principle under CEQA is that the Legislature intended the act 'to be interpreted in such manner as to afford the fullest possible protection to the environment within the reasonable scope of the statutory

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[12] Letter from Mary D. Nichols, Secretary for Resources, to Mr. William J. Keese, Chairman, California Energy Commission, Subject: Review of the Energy Commission's Certified Program for Siting Power Plants (December 29, 2000).
[13] *Environmental Protection Information Center, Inc. v. Johnson* (1st Dist. 1985) 170 Cal.App.3d 604, 617.
[14] *Environmental Protection Information Center, Inc. v. Johnson* (1st Dist. 1985) 170 Cal.App.3d 604.
[15] *Ultramar v. South Coast Air Quality Management District* (2nd Dist. 1993) 17 Cal.App.4th 689, 698-699.
[16] *Ultramar v. South Coast Air Quality Management District* (2nd Dist. 1993) 17 Cal.App.4th 689, 698-699 (emphasis added).

language."[17] Section 21091, which specifies a public review period of not less than 30 days, is a part of chapter 2.5[18] and, thus, certified regulatory agencies are not exempt from its mandate.

i. 30-Day Public Comment Period

In this case, the period for public review of Staff's upcoming environmental review document on upgrades and expansions of wastewater treatment facilities to provide recycled water to the Project "may not be less than 30 days."[19]

In April 2009, Staff released its preliminary staff assessment for the proposed Project. That same month, CURE submitted comments on the preliminary staff assessment, including comments that dry cooling is economically and environmentally feasible for this Project. In October 2009, Staff released its final staff assessment with responses to CURE's and others' comments. Staff agreed with CURE's comments that dry cooling is economically and environmentally feasible for this Project. The Committee subsequently ordered the parties to file testimony and prepare for evidentiary hearings.

In November 2009, CURE submitted testimony that dry cooling was economically and environmentally feasible for this Project. Neither the Applicant nor Staff disputed CURE's testimony. Instead, in November 2009, the Applicant proposed to use recycled water from either California City expanding its sewer system and wastewater treatment plant in California City or expanding and

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[17] Id. at pp. 699-700, citing *Laurel Heights Improvement Assn. v. Regents of University of California* (1988) 47 Cal.3d 376, 390.
[18] Id. at 700.
[19] Pub. Res. Code §21091.

upgrading a wastewater treatment plant in Rosamond and building from 10 to over 40 miles of pipeline to deliver reclaimed water for cooling.

Since December 2009, CURE has pointed out that the Staff Assessment contains ***no*** analysis of impacts of a new reclaimed water network and has been urging Staff to analyze the impacts and provide Staff's analysis to the public for review. CURE's advice was ignored and the parties spent a significant amount of time preparing testimony on other issues. It was not until CURE's post-evidentiary hearing opening and reply briefs pointed out that the Commission does not have the authority, consistent with the Warren-Alquist Act and the California Constitution, to approve the use of recycled water for power plant cooling in this case that Staff agreed with CURE that the record is deficient. The Committee Order similarly recognizes that reopening the record is necessary to complete the record on the Project.

Staff's required environmental review of the expansion of the wastewater treatment facilities has ***not yet been prepared*** in this proceeding. The Final Staff Assessment is admittedly incomplete because it does even attempt to analyze impacts from the expansion and upgrade of wastewater treatment facilities that are proposed to deliver recycled water to the Project. Even if the Final Staff Assessment had reviewed these facilities, CEQA requires re-notice and recirculation of an environmental review document for public review and comment when significant new information is added to the environmental review document

following public review but before certification.[20] The CEQA Guidelines clarify that new information is significant if "the EIR is changed in a way that deprives the public of a meaningful opportunity to comment upon a substantial adverse environmental effect of the project or a feasible way to mitigate or avoid such an effect," such as the proposed upgrades and expansions of wastewater treatment facilities (and sewering of California City) to deliver recycled water to the proposed Project.[21] Regardless, Staff acknowledged it lacked evidence of environmental review and requested that the record be re-opened to submit environmental review after it is prepared. The Committee ordered a limited re-opening of the record for additional environmental review. Therefore, the record is undisputed that Staff has never before released its assessment of portions of the Project now under consideration. June 1, 2010 would be the first time that Staff will provide any analysis of these expansions. The Commission is required to provide a public review period on Staff's upcoming environmental review for at least 30 days.[22]

ii. Public Notice and Comment

Section 21092 of the Public Resources Code sets forth specific requirements for public notice. Section 21092(a) requires the lead agency preparing an environmental review document to provide public notice that specifies the period during which comments will be received, a description of the proposed project and its significant effects, and "***the address where copies of…all documents***

[20] Pub. Res. Code, § 21092.1.
[21] CEQA Guidelines, § 15088.5.
[22] Pub. Res. Code §21091.

referenced in the environmental impact report… are available for review."[23] The purpose of this requirement is to ensure that an agency's decision regarding a project's impacts on the environment and mitigation measures required to reduce those impacts is supported by substantial evidence. "The requirement of public review has been called the strongest assurance of the adequacy of the EIR."[24]

The Committee's Order directed ***all*** parties to file and serve any new testimony and any briefs on "environmental review" of the recycled water expansions, and other limited issues, no later than June 1, 2010 and noticed an evidentiary hearing on June 8, 2010. Although CURE does not carry the Applicant's burden to submit information in support of the Applicant's Project, as required by Section 1723.5(a) and Section 1748(d) of the Commission's regulations, or to prepare Staff's environmental review of the Applicant's Project, as required by sections 1723.5(d) and 1742 of the Commission's regulations or CEQA, CURE has been attempting to obtain information in order to prepare the testimony requested by the Committee.

Specifically, CURE requested documents under the California Public Records Act – the same day that the Committee's Order was issued – from the Rosamond Community Services District and California City.[25] We sought to obtain data and information required for environmental review of the expansions intended to provide recycled water to the proposed Project. However, both agencies have, thus

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[23] Pub. Res. Code § 21092(a), (b)(1).
[24] *Ultramar v. South Coast Air Quality Management District* (2nd Dist. 1993) 17 Cal.App.4th 689, 703, citing *Mountain Lion Coalition v. Fish & Game Com.* (1989) 214 Cal.App.3d 1043 (internal quotations omitted).
[25] Exh. 640.

far, refused to provide the requested records.[26] In fact, California City stated on May 27, 2010 that it would take the City at least a month to provide CURE with approximately 4,000 pages of public records.[27] CURE is not aware whether the public agencies are providing Staff with documents necessary to conduct environmental review, but no documents have been docketed in this proceeding since the Committee's Order.[28]

Therefore, CURE has no independent basis – without an environmental review document and supporting documents – to prepare CURE's own environmental review.

Until Staff prepares its environmental review of the wastewater treatment plant upgrades and expansions (and sewering of California City), CURE is unable to submit comments, testimony or briefs on Staff's environmental review of these aspects of the Project. However, CEQA provides ***CURE***, as a member of the public, with an opportunity to ***review and comment on Staff's independent environmental assessment*** of the Project's potentially significant environmental impacts and proposed mitigation for those impacts before the Project is approved. The Commission must provide a 30-day public comment period on Staff's environmental review document and solicit meaningful public input on its

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[26] Exh. 641.
[27] 4,000 pages is approximately 8 reams of paper, which would be about 20 inches high.
[28] The declaration from California City states that the City is preparing an Upgrade Feasibility Plan for the California City Tertiary Waste Water Treatment Plant. (Bevins Declaration, para. 13.) If complete and/or if relied upon for environmental review, this document must be made available for public review.

environmental document ***before*** the Project is recommended for approval or denial.[29]

Finally, the Commission is required to consider comments it receives on a draft environmental review document and prepare a written response, pursuant to Section 21091(d) of the Public Resources Code. Under the Commission's regulations, "the presiding member's ***proposed decision*** shall contain the committee's responses to significant environmental points raised during the application proceeding."[30] Without a public comment period prior to the presiding member's proposed decision, the proposed decision will not be able to incorporate the required responses to comments.

The Commission's obligation to provide notice and comment on the Staff Assessment is not a novel idea – it is an obligation faithfully observed in most Commission proceedings. For example, in the Abengoa Mojave Solar proceeding (09-AFC-5), the Commission published notice of a 30-day public comment period on a Staff Assessment in March 2010.[31] Then, on May 12, 2010, the Commission published notice of a 30-day public comment period on Part A of a Supplemental Staff Assessment ("SSA").[32] More recently, on May 25, 2010, the Commission published notice of a 30-day public comment period on Part B of the SSA.[33] The

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[29] *Ultramar, Inc. v. South Coast Air Quality Management Dist.* (2d Dist. 1993) 17 Cal.App.4th 689, 698-700; *Mountain Lion Coalition Foundation v. Fish and Game Commission* (1st Dist. 1989) 214 Cal.App.3d 1043; Pub. Res. Code § 21080.5.
[30] 20 Cal. Code. Reg. § 1752.5.
[31] Exh. 642 (http://www.energy.ca.gov/sitingcases/abengoa/notices/2010-03-17_Notice_of_Availability_of_SA+Public_Workshop_TN-55956.PDF)
[32] Exh. 642 (http://www.energy.ca.gov/sitingcases/abengoa/notices/2010-05-20_Notice_of_Availability_of_the_SSA_Part_A_TN-56731.pdf)
[33] Exh. 642.

notice explains that Commission Staff will also publish notice of Part C of the SSA before the end of June.

While we understand the Committee's desire to have the Staff Assessment of recycled water facility expansions required by CEQA, along with CURE's testimony on the environmental impacts of those expansions filed on the same day, it is impossible for CURE to prepare testimony prior to reviewing Staff's analysis, particularly absent cooperation of the public agencies with control of records related to these expansions. More importantly, it is not legally required or permissible under CEQA.

Despite these requirements, CURE will submit exhibits regarding matters it hopes Staff will have considered in Staff's concurrent filing of its assessment, and with respect to other issues which are the subject of the Committee's order.

We trust that the Committee will promptly establish a new schedule for providing notice and public comment on Staff's environmental review of the recycled water facility expansions, which are part of the proposed Project under CEQA, and for providing responses to comments, all of which must be included in the evidentiary record for this proceeding.

2. Significant Project and Cumulative Impacts On Soil and Water Resources

According to Kern County, at least three other solar power plants are proposed within a few miles of the Beacon Project, and several others are proposed in the region, none of which have been analyzed by Commission Staff. (Exh. 643 and Exh. 646.) First, Global Real Estate Investment Partners proposes the Ridge

Rider Solar Park, a 38 MW photovoltaic solar power plant on non-contiguous parcels totaling 475 acres immediately ***adjacent*** to the Beacon Project. (Exh. 644.) Two other solar power plants are proposed approximately four miles south of the Beacon Project on Neuralia Road (the recycled water pipeline route).[34] (Exh. 645.) EnXco proposes a 100 MW photovoltaic solar power plant called the Barren Ridge Solar Project on one square mile totaling approximately 647 acres at the southeast corner of Neuralia Road and Harriet Avenue. EnXco also proposes a second photovoltaic solar power plant called the Cal City Solar Project on one square mile totaling approximately 638 acres just south of the Barren Ridge project at the corner of Neuralia Road and Washburn.

The proposed Beacon Project, including the proposed upgrades to the wastewater treatment facilities, will result in a significant cumulative impact on soil and water resources that was not analyzed by Staff and that requires mitigation to reduce impacts to a less than significant level. Specifically, **the proposed Project in combination with three other solar power plants, one of which is *adjacent* to the Beacon Project site, will result in a significant cumulative impact on water resources, hydrology, water quality, surface waters and associated habitat** – none of which has been analyzed by Commission Staff.

Under CEQA, the Commission must analyze and mitigate significant impacts from the whole of the Project, which, according to the Applicant's current proposal,

[34] The notices of preparation of Draft EIRs for these projects were mailed to the California Energy Commission. (Exh. 644 and 645.)

includes either California City's development of a centralized sewer system and expansion of a wastewater treatment facility or Rosamond's expansion of its wastewater treatment facility.[35] The definition of "project" is "given a broad interpretation in order to maximize protection of the environment."[36] The Commission must also evaluate cumulative impacts, which includes at least one solar power plant adjacent to the Beacon Project and two other solar power plants within a few miles of the Beacon Project site.[37] Like every aspect of CEQA, "[t]he requirement for a cumulative impact analysis must be interpreted so as to afford the fullest possible protection of the environment within the reasonable scope of the statutory and regulatory language."[38] In *Citizens to Preserve the Ojai*, the court explained:

> It is vitally important that an EIR avoid minimizing the cumulative impacts. Rather, it must reflect a conscientious effort to provide public agencies and the general public with adequate and relevant detailed information about them. [Citation.] A cumulative impact analysis which understates information concerning the severity and significance of cumulative impacts impedes meaningful public discussion and skews the decisionmaker's perspective concerning the environmental consequences of a project, the necessity for mitigation measures, and the appropriateness of project approval. [Citation.] An inadequate cumulative impact analysis does not demonstrate to an apprehensive citizenry that the governmental decisionmaker has in

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[35] *Laurel Heights Improvement Assn. v. Regents of the University of California* (1988) 47 Cal.3d 376; *San Joaquin Raptor/Wildlife Rescue Center v. County of Stanislaus* (1994) 27 Cal.App.4th 713; *Tuolumne County Citizens for Responsible Growth, Inc. v. City of Sonora* (2007) 155 Cal.App.4th 1214; *Communities for a Better Environment v. City of Richmond*, 2010 WL 1645906 (Cal.App. 1 Dist.) (April 26, 2010).

[36] *Lighthouse Field Beach Rescue v. City of Santa Cruz* (2005) 131 Cal.App.4th 1170, 1180 (internal quotation omitted); see also, *Muzzy Ranch Co. v. Solano County Airport Land Use Com.* (2007) 41 Cal.4th 372, 381-83; *Fullerton Joint Union High Sch. Dist. v. State Bd. of Educ.* (1982) 32 Cal.3d 779, 796-97; *Bozung v. Local Agency Formation Com.* (1975) 13 Cal.3d 263, 277-81.

[37] Pub. Res. Code § 2183; Cal. Code Reg. §§ 15130, 15355(a).

[38] *Citizens to Preserve the Ojai v. County of Ventura* (2nd Dist. 1985) 176 Cal.App.3d 421, 431-432.

> fact analyzed and considered the environmental consequences of its actions.[39]

CEQA also requires a separate and distinct analysis of growth-inducing impacts. The requirement to assess "growth-inducing impacts" must include the following:

> [T]he ways in which the proposed project could foster economic or population growth, or the construction of additional housing, either directly or indirectly, in the surrounding environment. Included in this are projects which would remove obstacles to population growth (***a major expansion of a waste water treatment plant might, for example, allow for more construction in service areas***). Increases in the population may tax existing community service facilities, requiring construction of new facilities that could cause significant environmental effects. Also discuss the characteristic of some projects which may encourage and facilitate other activities that could significantly affect the environment, either individually or cumulatively. It must not be assumed that growth in any area is necessarily beneficial, detrimental, or of little significance to the environment.[40]

The Applicant's proposal to use recycled water from either California City or Rosamond, in combination with at least three other solar power plants proposed between these cities and the Beacon Project, will result in significant project and cumulative impacts on water resources in the region, which have not been analyzed by Commission Staff.

California City greatly underestimates significant impacts to growth and water resources as a result of expanding its facilities to provide water to the Beacon

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[39] *Citizens to Preserve the Ojai v. County of Ventura*, (2nd Dist. 1985) 176 Cal.App.3d 421, 431 (quoting *San Franciscans for Reasonable Growth v. City and County of San Francisco* (1st Dist. 1984) 151 Cal.App.3d 61, 79).
[40] 14 Cal. Code Regs. § 15126.2(4) (emphasis added).

Project. Michael Bevins, Director of Public Works in California City, states that the City proposes to expand and add sewer mains and connections to residences and businesses currently on septic and to expand its wastewater treatment facility ("WWTF") production capacity from 1.5 million gallons per day (mgd) to 3.0 mgd. (Bevins Declaration, para. 5.) Currently, the City is limited to permitting only two dwelling units per acre on lots without a connection to the City's sewer system, pursuant to the City's 1989 Memorandum of Understanding ("MOU") with the Lahontan Regional Water Quality Control Board. (Bevins Declaration, para. 7.) Mr. Bevins states:

> The proposed WWTF expansion includes a sewer main expansion, which would bring an additional **2,500** septic tanks onto the City's sewer system. This added infrastructure would allow existing lots to connect to the sewer system. This would bring these lots into compliance with the MOU, and would allow these lots to be developed as planned rather than limited to a density of two dwelling units per acre.

(Bevins Declaration, para. 10.) Mr. Bevins substantially underestimates the significant Project and cumulative impacts on growth and water resources.

According to California City's Sanitary Sewer System Master Plan, there are approximately 5,706 acres on which development shall not exceed two dwelling units per acre, pursuant to the MOU. (Applicant Reply Brief, Attachment G (Sewer Master Plan), p. 1-2.)[41] According to the Sewer Master Plan, "[t]he City's records indicate…that the Memorandum of Understanding's 5,706 acres have the potential

[41] CURE intends to include as CURE exhibits all documents referenced herein that either the Applicant or Staff attached to their Reply Briefs in this proceeding, if the Applicant and/or Staff decline to do so. In order to reduce paper, CURE will only refer to these documents at this time.

to serve an additional **9,750** dwelling units on septic tanks." (Applicant Reply Brief, Attachment G (Sewer Master Plan), p. 1-2 (emphasis added).) Therefore, California City in its declaration largely underestimates significant Project and cumulative impacts on growth and water resources.

California City's proposed WWTF expansion would also result in further residential, commercial and industrial growth within the City and outside of the Sewer Master Plan study area. According to Mr. Bevins, developing a sewer system would allow the City to ***discontinue growth restrictions*** pursuant to the MOU and allow the City to increase residential density and "add the corresponding urban commercial opportunities" within the City. (Bevins Declaration, para. 9.) According to the Sewer Plan, the sewer would be sized, designed and located in order to accommodate "community development" as "if all lots within the study area were occupied and connected to the sewer system." (Applicant Reply Brief, Attachment G (Sewer Master Plan), p. 2-5.) Finally, the Sewer Master Plan is designed "to accommodate potential industrial growth and, to a limited degree, to accommodate growth in areas bordering the study area." (Applicant Reply Brief, Attachment G (Sewer Master Plan), pp. 2-3, 2-4.) This significant growth, reduction in recharge to the groundwater basin and increase in water use must – but has not been – evaluated.

California City's General Plan 2009-2028 does not include any provision to expand the City's wastewater treatment facility to 3.0 MGD and admits that future water demands "will be met by the construction of five new water wells and through

additional purchase" of State Water Project water. (Applicant Reply Brief, Attachment E (California City General Plan, p. 5-32.) Currently, the City's water supply is pumped from groundwater or is purchased from the Antelope-Valley Eastern Kern Water Agency ("AVEK"), a wholesale importer of State Water Project water. (Applicant Reply Brief, Attachment E (California City General Plan, p. 5-30.) AVEK is contractually allowed to receive 141,400 AFY of SWP water. (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report, p. 2-4.) California City has a 1,000 acre-foot limit for water purchase from AVEK. California City's General Plan explains that AVEK is currently in an adjudication process, which "could have the potential to affect deliveries of water in the future or result in changes to the cost per acre feet of water delivered." (Applicant Reply Brief, Attachment E (California City General Plan), p. 5-31.) According to the General Plan, future large developments may need to negotiate with AVEK for supplemental water supplies. (Applicant Reply Brief, Attachment E (California City General Plan), p. 5-31.) Since the General Plan does not include any provision to expand the City's wastewater treatment facility to 3.0 MGD, the City's Negative Declaration for General Plan 2009-2028 does not evaluate an expansion of the wastewater treatment facility or sewering of the City. (Applicant Reply Brief, Attachment E (California City General Plan, App. 8.) Moreover, even though the General Plan admits that future water demands will be met by the construction of five new water wells, the City's Negative Declaration concludes for every single resource that "[a]ll projects are reviewed on a case-by-case basis within the City"

and, thus, the impacts are less than significant. (Id.) Clearly, California City's potential for significant growth and increase in water use must – but has not been – evaluated.

Rosamond also greatly underestimates significant project and cumulative impacts from growth and on water resources as a result of expanding its facilities to provide water to the Beacon Project. Dennis LaMoreaux, Assistant General Manager/District Engineer in Rosamond, states that Rosamond proposes to increase the facility's tertiary wastewater treatment capacity to ***2.5 mgd***. (LaMoreaux Declaration, para. 2.) This expansion was not analyzed in the City's 1999 Negative Declaration and, in fact, the project description to the State Clearinghouse only explained that the facilities will be expandable to an ultimate capacity of 1.0 mgd. (Exh. 647.) This expansion was also not analyzed in the City's most recent July 2008 Recycled Water Facilities Plan Final Report or in the Negative Declaration for the report. (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report), pp. 3-7, 5-9.) The 2008 Recycled Facilities Plan explains that the Rosamond facility is designed for tertiary treatment of 0.5 mgd to be constructed in 2009 with provisions for expansion to ***1.0 mgd*** by 2018. (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report), pp. 1-2, 3-1.)

The 2008 Recycled Facilities Plan shows that "Rosamond has a lot of room to grow…" (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report), p. 2-1), that potential uses of recycled water include parks, schools and residential developments (Id., p. 2-7), and that development of recycled water is necessary to

enable growth. As recently as 2008, the City only planned to expand its wastewater treatment facility to 1.0 mgd to address water supply needs for expected growth. According to Rosamond's 2008 Recycled Facilities Plan, "[i]n response to the expected population growth, [Rosamond] is developing alternative water sources including recycled water facilities to help meet its water supply needs." (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report), p. 1-1.) The Recycled Facilities Plan Report explains that development of recycled water is necessary to reduce dependence on groundwater and State Water Project ("SWP") water.

Like California City, Rosamond's two sources of water include groundwater and State Water Project water from AVEK. AVEK is contractually allowed to receive 141,400 AFY of SWP water. (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report, p. 2-4).) Over the last five years, Rosamond has imported 1,197 AFY of AVEK SWP water and, even for that amount, Rosamond finds that SWP water "is especially unreliable during dry years." (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report, p. 2-4.) Rosamond explains that "[e]nvironmental issues also cast doubt on the reliability of SWP supplies, including pending litigation that threatens to shut down the Delta export pumps until the Department of Water Resources complies with the California Endangered Species Act for endangered fish populations." (Applicant Reply Brief, Attachment D (Recycled Facilities Plan Report), p. 2-4.) Thus, the purpose of Rosamond expanding its wastewater treatment plant is to reduce dependence on groundwater and SWP water. With less constraints on groundwater and SWP water, more water

may be available to enable residential, commercial and industrial growth in the City and the region.

It is against this backdrop that the Energy Commission's analysis of project and cumulative impacts on water resources must be analyzed. According to Kern County's Notice of Preparation of a Draft Environmental Impact Report for the Ridge Rider Solar Park ("Ridge Rider NOP"), water used during construction on 475 acres adjacent to the Beacon project would be "brought to the site by truck." (Exh. 644, p. 35.) The Ridge Rider NOP does not explain how much water would be used during construction, the source of water, or potential impacts. For operation, the Ridge Rider NOP states that approximately 1.5 acre feet per year ("AFY") of water would be needed, which would also be brought to the site by truck. (Id.) The Ridge Rider NOP does not resolve the discrepancy in water needed for the Barren Ridge and Cal City photovoltaic solar projects (19.5 AFY) or the source of the water and summarily concludes that the impacts would be less than significant.

According to Kern County's Notice of Preparation of a Draft EIR for the Barren Ridge Solar Project and the Cal City Solar Project ("Barren Ridge and Cal City NOP"), water used during construction on 1,273 acres would also be brought to the site "by truck from a local water delivery provider." (Exh. 645, p. 40.) The Barren Ridge and Cal City NOP does not explain how much water would be used during construction, the source of water, or potential impacts. For operation, the Barren Ridge and Cal City NOP states that approximately 19 acre feet of water would be needed, which would also be "trucked in to the sites…" (Id., p. 40.) Again,

the Barren Ridge and Cal City NOP does not explain the source of water and summarily concludes that the impacts would be less than significant.

If the Beacon Project uses recycled water, California City or Rosamond would be required to expand their facilities to serve the Project. Beacon would be required to construct a recycled water pipeline along Neuralia road, right past the Barren Ridge and Cal City solar projects towards the Beacon Project site and the Ridge Rider project site. The availability of recycled water would eliminate a significant hurdle to development of these other power plants by either providing access to recycled water along Neuralia Road, or by reducing competition for water from the State Water Project (and groundwater). Expanding facilities to provide additional tertiary treated water would foster further development of the region. The significant cumulative impacts on growth and water resources could not be clearer.

The Project's proposal to use recycled water from either California City or Rosamond, in combination with at least three other solar power plants proposed between these cities and the Beacon Project, would result in significant project and cumulative impacts on water resources in the region, which have not been analyzed by Commission Staff.

3. Wastewater Treatment Facility Expansions and Cumulative Impacts On Hydrology, Water Quality, Biological and Other Resources

The Applicant's proposal to use recycled water, which requires an expansion and upgrade from either California City or Rosamond, would result in significant impacts on biological resources. In combination with at least three other solar

power plants proposed between these cities and the Beacon Project, the Project's proposal would also result in significant cumulative impacts on nearly every resource area, none of which has been analyzed by Commission Staff.

According to the California Department of Fish and Game ("CDFG"), expanding California City's wastewater treatment plant, including proposed ponds, sludge drying beds, or other facilities, may require a take permit. (Exh. 648.) In fact, as recently as 2006, CDFG found that a project proposed approximately 0.5 miles away from California City's wastewater treatment facility (Exh. 650 and Exh. 651) had the potential to impact desert tortoise, Mohave ground squirrel, burrowing owl, Le Conte's thrasher, Alkali mariposa lily, Barstow wooly sunflower and desert cymopterus, all special status species under State law. (Exh. 649.) The Biological Resources Assessment prepared for that project also identified several special status species and, according to CDFG, conflicted with California City's negative declaration. (Exh. 649 and Exh. 651.) Finally, CDFG explained that appropriately-timed plant surveys and protocol-level surveys for desert tortoise and Mohave ground squirrel had not been conducted and recommended that the City require them. (Exh. 649, p. 6; Exhs. 652, 653, 654, 655, 656, 657 (desert tortoise), Exhs. 658, 659, 660 (Mohave ground squirrel), Exhs. 661 and 662 (plants).)

Expanding Rosamond's wastewater treatment plant, which involves a new 20 acre pond, among numerous other components may also require a take permit. (Exh. 663.) Specifically, Rosamond's proposed site overlaps with occurrence, or is within the range, of alkali mariposa lily, western snowy plover, tricolored blackbird,

Mohave ground squirrel, and burrowing owl. (Id.) Rosamond admits that its expansion may also impact threatened desert tortoise. (La Moreaux Declaration, para. 7.)

Both Rosamond's and California City's existing wastewater treatment facilities emit pollutants that are subject to air permits from the Kern County Air Pollution Control District (Exh. 664) and any proposal to expand the facilities and add equipment would necessarily increase those emissions. Both Rosamond's and California City's existing wastewater treatment facilities also result in waste discharges to groundwater which are subject to waste discharge requirements ("WDRs") from the Lahontan Regional Water Quality Control Board. (Exh. 665.) Expanding the wastewater treatment facilities and adding new ponds, sludge drying beds and/or other facilities may increase those discharges, requiring new WDRs from the Regional Board.

Kern County's Ridge Rider NOP identifies significant adverse impacts on hydrology and water quality (Exh. 644, p. 34-36), and biological resources, including, but not limited to, riparian habitat, wetlands, streams and washes (Exh. 644, pp. 23-24, 52). The Ridge Rider NOP also explains that the project may result in significant adverse impacts on aesthetics (Exh. 644, p. 16), air quality (pp. 20-21), cultural resources (p. 25), geology and soils (p. 26), and traffic (p. 46). Furthermore, the Ridge Rider NOP states that the Ridge Rider project has the potential to contribute to cumulative impacts on aesthetics, biological resources, agricultural resources, biological resources, land use and planning, and transportation and

traffic. (Exh. 644, p. 52.) The Ridge Rider Project proposes to interconnect to the grid through LADWP's Barren Ridge Substation (Exh. 644, p. 4), which was the subject of CURE's extensive testimony and briefing in the Beacon proceeding.

Kern County's Barren Ridge and Cal City NOP identifies significant adverse impacts on hydrology and water quality (Exh. 645, pp. 39-40) and biological resources, including, but not limited to, riparian habitat, wetlands, streams and washes (Exh. 645, pp. 28-29). The Barren Ridge and Cal City NOP also explains that the projects may result in significant adverse impacts on aesthetics (Exh. 645, p. 21), air quality (p. 25), cultural resources (p. 30), geology and soils (p. 31), and traffic (p. 51). Furthermore, the Barren Ridge and Cal City NOP states that the projects have the potential to contribute to cumulative impacts on aesthetics, air quality, biological resources, cultural resources, geology, greenhouse gas emissions, hydrology and water quality, public services, and transportation and traffic. (Exh. 645, p. 57.) Like the Ridge Rider project, the Barren Ridge and Cal City projects propose to interconnect to the grid through LADWP's Barren Ridge Substation. (Exh. 645, p. 4.)

The Commission has a mandatory duty to analyze significant project and cumulative impacts from the Project's proposal to use recycled water, which requires an expansion and upgrade from either California City or Rosamond. To date, there is no evidence in the record that this assessment has been done. In combination with at least three other solar power plants proposed between these cities and the Beacon Project, the Project's proposal would result in significant

cumulative impacts on nearly every resource area, none of which has been analyzed by Commission Staff.

4. Kern County's Request for Development Fees from the Beacon Solar Energy Project

CURE generally supports Kern County's January 15, 2010 and subsequent requests that the Commission include a Condition of Certification on the Project that would require the project owner to pay an annual public services mitigation fee for the specific categories of countywide public protection, sheriff patrol and investigation and fire protection to the County. (March 22, 2010 Tr., p. 386; Exh. 666.) However, prior to determining the appropriate fee amount, the Commission must prepare an adequate evaluation of the Beacon Project's significant cumulative impacts on public services.

The proposed Project will result in a significant cumulative impact on public services in Kern County that was not analyzed by Staff and that requires mitigation to reduce impacts to a less than significant level. Specifically, **the proposed Project in combination with three other solar power plants, one of which is *adjacent* to the Beacon Project site, will result in a significant cumulative impact on public services**, not to mention significant cumulative impacts on aesthetics, traffic, biological resources, land use, soil, water, and transmission engineering – none of which has been analyzed by Commission Staff.

According to Kern County's Ridge Rider NOP, the Ridge Rider Solar Park may result in significant adverse impacts associated with the need for new governmental facilities, such as fire protection and police protection. (Exh. 644, p.

43.) Similarly, according to Kern County's Barren Ridge and Cal City NOP, the projects may result in significant adverse project and cumulative impacts associated with the need for new governmental facilities, such as fire protection and police protection. (Exh. 645, pp. 48 and 57.)

CURE submitted extensive testimony regarding the Beacon Project's significant impacts from the use of HTF and submitted numerous exhibits showing reliance on local agencies for emergency response. (See CURE's Opening and Reply Briefs and Exhs. 612-615, 625-631.) Combined with the other solar power plants proposed in the immediate vicinity (Exhs. 643, 644, 645, 646), the Beacon Project would result in an unmitigated significant cumulative impact on public services. Therefore, Kern County's request for a condition of certification that would require the project owner to pay an annual public services mitigation fee for the specific categories of countywide public protection, sheriff patrol and investigation and fire protection to the County is reasonable. In order to determine the appropriate fee amount, the Commission should first prepare an adequate evaluation of the Beacon Project's significant cumulative impacts on public services and then identify required mitigation to reduce the impact to less than significant.

5. Conclusion

CURE appreciates Staff's acknowledgement that it must provide the public with an analysis of the whole of the Beacon Project, including the Applicant's proposal to use recycled water, which would require major expansions of either California City or Rosamond's wastewater treatment facilities. However, these

small desert towns would experience significant growth from the development of recycled water and, hence, significant impacts on water, biological and other resources in the region. These impacts must be fairly and fully disclosed in a conscientious effort to provide the Commission and the general public with adequate and relevant detailed information about the environmental consequences of the project, the necessity for mitigation measures, and the appropriateness of project approval.

Staff's failure to identify numerous solar power plants in the immediate vicinity, including a power plant adjacent to the Beacon Project site, is a significant oversight. The Committee cannot ignore these projects or their impacts. The law requires it, and we know that the Commission cares about the ever increasing demands on the state's finite resources.

CURE urges the Committee to establish a new schedule for providing notice and public comment on Staff's environmental review of the recycled water facility expansions, which are part of the proposed Project under CEQA, and the cumulative impacts of the Beacon Project along with the three neighboring solar power plants, and for providing responses to comments, all of which must be

included in the evidentiary record and reflected in the presiding member's proposed decision for this proceeding.

Respectfully submitted,

/s/

Tanya A. Gulesserian
Marc D. Joseph

Attorneys for CALIFORNIA UNIONS FOR RELIABLE ENERGY

STATE OF CALIFORNIA

Energy Resources Conservation and Development Commission

In the Matter of: The Application for Certification for the BEACON SOLAR ENERGY PROJECT	Docket No. 08-AFC-2

PROOF OF SERVICE

I, Bonnie Heeley, declare that on June 1, 2010 I served and filed copies of the attached **BRIEF OF CALIFORNIA UNIONS FOR RELIABLE ENERGY IN RESPONSE TO COMMITTEE ORDER FOR LIMITED RE-OPENING OF THE RECORD.** The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at www.energy.ca.gov/sitingcases/beacon. The document has been sent to both the other parties in this proceeding as shown on the Proof of Service list and to the Commission's Docket Unit via email and by U.S. Mail with first-class postage thereon, fully prepaid and addressed as provided on the Proof of Service list to those addresses NOT marked "email preferred." An original paper copy and one electronic copy, mailed and emailed respectively, were sent to the Docket Office.

I declare under penalty of perjury that the foregoing is true and correct. Executed at South San Francisco, CA on June 1, 2010.

_____/s/_____
Bonnie Heeley

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May 13, 2010

VIA FACSIMILE AND U.S. MAIL

Mr. Jack Stewart
General Manager
Rosamond Community Services District
3179 35th Street West
Rosamond, CA 93560
Fax: (661) 256-2557

Ms. Lizette Guerrero
Board Secretary
Rosamond Community Services District
3179 35th Street West
Rosamond, CA 93560
Fax: (661) 256-2557

Re: Public Records Act Request – Rosamond Community Services District Wastewater Treatment Plant Upgrades

Dear Mr. Stewart and Ms. Guerrero:

We are writing on behalf of the California Unions for Reliable Energy to request access to any and all records related to Rosamond Community Services District's phase I and phase II wastewater treatment plant upgrades.

This request includes, but is not limited to, any and all correspondence, analyses, memos, notes, electronic mail messages, files, charts, maps, and/or other documents by, to or from the District or its consultants referring or relating to the upgrades.

This request is made pursuant to the California Public Records Act. (Government Code §§ 6250, et seq.) This request is also made pursuant to Article I,

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section 3(b) of the California Constitution, which provides a Constitutional right of access to information concerning the conduct of government. Article I, section 3(b) provides that any statutory right to information shall be broadly construed to provide the greatest access to government information and further requires that any statute that limits the right of access to information shall be narrowly construed.

We will pay for any reasonable direct costs associated with fulfilling this request. However, please contact me at (650) 589-1660 with a cost estimate before copying the requested materials. Please forward the copied materials to the following address/email:

Janet Laurain
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080-7037
jlaurain@adamsbroadwell.com

Thank you for your assistance with this matter.

Sincerely,

Janet Laurain C.h H

Janet Laurain
Environmental Paralegal

JML:cnh

2162-100d

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May 13, 2010

VIA FACSIMILE AND U.S. MAIL

Mr. Tom Weil
City Manager
California City
21000 Hacienda Blvd
California City, CA 93505
Fax: (760) 373-7511

VIA U.S. MAIL AND EMAIL

Ms. Denise Hilliker
City Clerk
California City
21000 Hacienda Blvd
California City, CA 93505
cityclerk@californiacity.com

Re: Public Records Act Request – California City's Wastewater Treatment Plant Upgrades

Dear Mr. Weil and Ms. Hilliker:

We are writing on behalf of the California Unions for Reliable Energy to request a copy of any and all records related to California City's proposed expansion of the City's wastewater treatment facility, including, but not limited to, the addition of sewer mains and connections.

This request includes, but is not limited to, any and all correspondence, analyses, memos, notes, electronic mail messages, files, charts, maps, and/or other documents by, to or from the City or its consultants relating to the expansion.

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This request is made pursuant to the California Public Records Act. (Government Code §§ 6250, et seq.) This request is also made pursuant to Article I, section 3(b) of the California Constitution, which provides a Constitutional right of access to information concerning the conduct of government. Article I, section 3(b) provides that any statutory right to information shall be broadly construed to provide the greatest access to government information and further requires that any statute that limits the right of access to information shall be narrowly construed.

We will pay for any reasonable direct costs associated with fulfilling this request up to $200. However, please contact me at (650) 589-1660 with a cost estimate before copying the requested materials. Please forward the copied materials to the following address/email:

Janet Laurain
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080-7037
jlaurain@adamsbroadwell.com

Thank you for your assistance with this matter.

Sincerely,

Janet Laurain C.L.A.

Janet Laurain
Environmental Paralegal

JML:cnh

2162-099d

THE LAW OFFICES OF
Young Wooldridge
A LIMITED LIABILITY PARTNERSHIP • EST. 1939
PHILLIP W. HALL, ATTORNEY AT LAW

May 27, 2010

Janet Laurain
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080-7037

RE: Public Records Request Dated 5-13-10

Dear Mrs. Laurain:

This office serves as General Counsel to the Rosamond Community Services District ("District") and it is within that capacity that I am providing you with this written response to your public records request of May 13, 2010, which was received by the District on May 17, 2010. In that request, you seek numerous types of documents and records which will likely lead to a voluminous amount of separate and distinct records. As a result, it will take the District some time to search out, collect and appropriately examine those records before they will be prepared for your review. Therefore, in accordance with the provisions of the Public Records Act ("Act"), this letter will serve to notify you that the District is invoking the 14 day extension provided for in Government Code section 6253(c).

Additionally, please note that under the provisions of the Act, the District is entitled to reimbursement for its costs. In briefly examining your request, the District estimates the duplication and mailing costs to be roughly $500.00, or more. Kindly send us a deposit of $500.00 and upon receipt we will begin the duplication process.

In the event the deposit does not cover the entirety of the costs associated with your request, the District will inform you of this issue and send you a billing for the additional costs. However, if the deposit exceeds the entirety of the costs associated with your request, the District will promptly refund the excess portion of your deposit.

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If you have any questions or concerns, please do not hesitate to contact me at the above captioned number.

Respectfully yours,

Phillip W. Hall, Esq.
of Young Wooldridge, LLP

cc: Rosamond Community Services District

Rosamond Community Services District

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Lizette Guerrero
Board Secretary

May 20, 2010

Janet Laurain
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080-7037

RE: Public Records Act Request – Rosamond Community Services District Wastewater Treatment Plant Upgrades

Dear Ms. Laurain:

Rosamond Community Services District ("District") received your Public Records Act request for "[c]opies of all records related to Rosamond Community Services District's phase I and phase II wastewater treatment plant upgrades. We are in the process of determining if there are documents responsive to your request.

As you may be aware, the District is required under the Public Records Act to assist you with making a focused and effective request for records. (Gov. Code § 6253.1.) At the outset, we note that the California Public Records Act pertains to existing records and documents; it does not provide for copying and inspection of documents that are not in the possession of a public agency at the time a request for records is made. We believe this is evident in the language of the Public Records Act's definitions of "public records" and "writing," as we elaborate below.

The definition of "public records" in the Public Records Act specifically states that a public record includes "any **writing** relating to the conduct of the public's business prepared, owned, used or retained by any state or local agency...." (Emphasis added). (Gov. Code § 6252, subd. (e).) The Public Records Act further defines "writing" as "handwriting, typewriting, printing, photostating, photographing, photocopying, transmitting by electronic mail or facsimile, and every other means of recording upon any **tangible** thing any form of communication or representation, including letters, words, pictures, sounds, or symbols, or combination thereof, and any record thereby created, regardless of the manner in which **the record has been stored**." (Emphasis added). (Gov. Code § 6252, subd. (g).)

We believe the language of the Public Records Act cited above clearly refers to records and documents that are currently in existence and are stored in some form by the District. Furthermore, other provisions of the Public Records Act, such as the requirement for a public

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entity to determine within ten (10) days after receipt of a records request whether it can provide specific documents under the Act (clearly implying that the public entity must review such documents first), would be rendered meaningless if a requesting party could submit a request for possible future records that the public entity has no ability to review at the time of the current records request.

The District desires to accommodate Adams Broadwell Joseph & Cardozo, Attorneys at Law, need for information, but would like to accomplish this reasonably within the framework of the Public Records Act and the Ralph M. Brown Act. As we see it, part of the District's obligation to assist you in making a focused and effective request for records is to provide suggestions for overcoming any practical basis for denying access to the information you seek.

Please be advised that there is a twenty five cents copying charge (.25) per page. The payment of fees is required in advance of delivery of any requested records.

Sincerely,

Lizette Guerrero
Administrative Services Manager/Board Secretary
Rosamond Community Services District

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May 25, 2010

Via Facsimile and U.S. Mail

Mr. Tom Weil
City Manager
California City
21000 Hacienda Blvd.
California City, CA 93505
Fax: (760) 373-7511

Via Email and U.S. Mail

Ms. Denise Hilliker
City Clerk
California City
21000 Hacienda Blvd.
California City, CA 93505
cityclerk@californiacity.com

Re: May 13, 2010 Public Records Request

Dear Mr. Weil and Ms. Hilliker:

We are writing regarding our May 13, 2010 request for copies of any and all records related to California City's proposed expansion of the City's wastewater treatment facility, pursuant to the California Public Records Act. On May 24, 2010, Janet Laurain, a paralegal from our office, spoke with Ms. Hilliker and asked when the records would be available for review. Ms. Hilliker informed Ms. Laurain that it would take "weeks" to provide responsive documents. Ms. Hilliker also stated that the City is in the process of creating an inventory of such records and preparing a letter in response to our May 13th Public Records Act request. As of today, we have not received a response.

2162-111a

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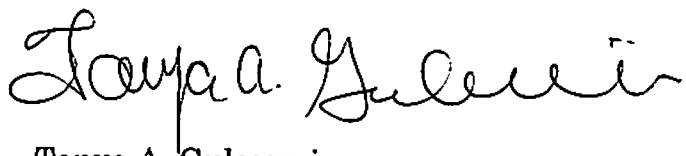
Please let us know as soon as possible when the City is prepared to provide us with public records in response to our request.

Sincerely,



Tanya A. Gulesserian

TAG:bh

2162-111a

CITY COUNCIL

Mayor
Larry Adams

Mayor Pro Tem
Mike Edmiston

Councilmember
Nick Lessenevitch

Councilmember
Cathy Strong

Councilmember
William Smith

May 24, 2010

Janet Laurain
Environmental Paralegal
Adams Broadwell Joseph & Cardozo
601 Gateway Blvd, Suite 1000
South San Francisco, CA 94080-7037

RE: Public Records Act Request - California City's Wastewater Treatment Plant Upgrades

Ms. Laurain,

California City will provide the records you have described in your letter dated May 13, 2010.

I have asked the city's Public Works Director to prepare an inventory. I will use the inventory to provide you with an estimate of reproduction costs. I will contact you when the estimate is available. I have been informed by the Public Works Director that his list will be competed by the end of this week.

The Director's inventory will also be used to provide an estimate of how long the work will take. I will give you my time estimate when I contact you about the costs.

Kind Regards,

Denise Hilliker
City Clerk
City of California City

CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512
www.energy.ca.gov

March 16, 2010

DOCKET	
09-AFC-5	
DATE	MAR 16 2010
REC'D	MAR 17 2010

NOTICE OF AVAILABILITY
STAFF ASSESSMENT FOR THE PROPOSED
ABENGOA MOJAVE SOLAR PROJECT
(09-AFC-5)

NOTICE OF PUBLIC WORKSHOPS

Tuesday, April 6, 2010
Starting at 10:15 am

California Energy Commission
Fourth Floor North Conference Room A
1516 9th Street
Sacramento, CA 95814-5512
(Wheelchair Accessible)
(Map Attached)

To participate in the meeting by telephone,
please call: 800-369-2193 (toll-free in the U.S. and Canada)
Enter passcode: 54011

Wednesday, April 7, 2010
Starting at 1:00 pm

Barstow City Hall
220 E. Mountain View Street
Barstow, California 92311

(Wheelchair Accessible)
(Map Attached)

To participate in the meeting by telephone,
please call: 800-369-2193 (toll-free in the U.S. and Canada)
Enter passcode: 54011

TO: MEMBERS OF THE PUBLIC

This notice is to inform you of the availability of the Staff Assessment (SA) for the Abengoa Mojave Solar project Application for Certification (09-AFC-5). The SA was published on **March**

PROOF OF SERVICE (REVISED 03/04/10) FILED WITH
COPIES MAILED FROM SACRAMENTO ON 03/17/10
AA

16, 2010. The SA contains the California Energy Commission staff's engineering and environmental evaluation of the proposed Abengoa Mojave Solar project.

This notice is also to inform you that the Energy Commission staff will hold a workshop to discuss the SA and to further encourage public participation, regarding the proposed Abengoa Mojave Solar project and the Energy Commission's permitting process. The workshop will provide an opportunity for agencies, the public and other interested parties to present questions and comments on the SA. All interested agencies and members of the public are invited to participate. **The workshops will be held on Tuesday, April 6, 2010 starting at 10:15 am in Sacramento at the California Energy Commission's Fourth Floor North Conference Room A, 1516 9th Street and Wednesday, April 7, 2010 at 1:00 pm in Barstow at the Barstow City Hall, 220 E. Mountain View Street.**

Based on the workshop dialogue, written comments received regarding the SA, and additional information that will be gathered, the Energy Commission staff will revise the SA where appropriate and issue a Supplemental Staff Assessment (SSA).

The California Energy Commission encourages public participation in the review of the Abengoa Mojave Solar Application for Certification (09-AFC-5). **The public comment period for this SA is from Tuesday March 16, 2010 to Thursday, April 15, 2010.** Written comments on the SA should be provided to Craig Hoffman, Siting Project Manager, no later than 5:00 p.m., Thursday, April 15, 2010 at the address on this letterhead or by email to choffman@energy.state.ca.us. Technical or project schedule questions should be directed to Craig Hoffman at (916) 654-4781 or by email.

Following a 30-day public comment period on the Staff Assessment, a Supplemental Staff Assessment will be prepared and published based on Staff Assessment workshops and written comments, staff may refine its analysis, correct errors, and finalize conditions of certification to reflect areas where agreements have been reached with the parties and will then publish a Supplemental Staff Assessment (SSA). The SSA will be a limited document representing revisions and additions rather than a document including each technical section.

The Staff Assessment and Supplemental Staff Assessment will serve as staff's formal written testimony in evidentiary hearings to be held by the Energy Commission Committee assigned to hear this case. The Committee will hold evidentiary hearings and will consider the testimonies presented by staff, applicant, interveners, government agencies, and the public prior to preparing the Presiding Member's Proposed Decision. In the last step, the full Energy Commission will issue the final decision.

Summary of the Proposed Abengoa Mojave Solar

The proposed AMS project is a solar electric generating facility to be located on approximately 1,765 acres. The proposed project site is located approximately nine miles northwest of the Town of Hinkley in unincorporated San Bernardino County, approximately halfway between the City of Barstow and Kramer Junction (Highway 395 / Highway 58 junction). Project access is provided by Harper Lake Road, which is located approximately

twenty miles west of Barstow along the Highway 58 corridor. The project site is approximately six miles north of where Harper Lake Road intersects with Highway 58. The existing Solar Electric Generating Stations VIII and IX facilities, owned by NextEra™ Energy Resources, are located immediately northwest of the project site.

The project site is comprised of private property that was historically used as the Lockhart Ranch complex. The property has served as an agricultural and cattle center for over sixty years and, in that capacity, has utilized water from ground wells; farming activities have included flood irrigation and ultimately the pivot system of irrigation of quarter section areas. Currently there are no ranching or residential activities on the property, and there is only one active pivot irrigation field in production on the site.

The project would utilize solar parabolic trough technology to activate a heat transfer fluid. The proposed collector fields of parabolic trough solar collectors are modular in nature and comprise many parallel rows of solar collectors, aligned on a north-south axis. Each solar collector has a linear, parabolic-shaped reflector that focuses the sun's radiation on a linear receiver known as a heat collection element located at the focus of the parabola.

As heat transfer fluid is circulated through the solar field, light from the sun reflects off the solar collector's parabolic troughs and is concentrated on the heat collection elements located at the focal point of the parabola. This heat transfer fluid provides a high-temperature energy source which is used to generate steam in solar steam generators. As this steam expands through the steam turbine generators, electrical power is generated.

The project will have a combined nominal electrical output of 250 megawatts (MW) from twin, independently-operable solar fields, each feeding a 125-MW power island. The plant sites, identified as Alpha (the northwest portion of the Project area) and Beta (the southeast portion of the project area), will be 884 acres and 800 acres respectively and joined at an on-site transmission line interconnection substation to form one full-output transmission interconnection. This proposed substation, located at the southwest corner of the Beta solar field, is referred to as the "Hinkley" substation. An additional 81 acres shared between the plant sites will be utilized for receiving and discharging offsite stormwater drainage.

The applicant has a power purchase agreement with Pacific Gas and Electric.

Energy Commission Licensing Authority

The Energy Commission is responsible for reviewing and ultimately approving or denying all applications for construction and operation of thermal electric power plants, 50 MW and greater, proposed for construction in California. The Energy Commission's facility certification process carefully examines public health and safety, environmental impacts and engineering aspects of proposed power plants, and all related facilities such as electric transmission lines and natural gas and water pipelines. The Energy Commission is the lead agency under the California Environmental Quality Act (CEQA), and produces several environmental and decision documents rather than an Environmental Impact Report.

Summary of the California Energy Commission Staff's Conclusions

Based upon the information provided to date and the analysis completed to date for each technical section, staff has concluded that with implementation of staff's recommended mitigation measures described in the conditions of certification, all potential environmental impacts will be mitigated to a less than significant level. The project analysis complies with the requirements of the California Environmental Quality Act (CEQA). For a detailed review of potentially significant impacts and the related mitigation measures, please refer to each chapter of the SA.

Within the technical areas of **Air Quality, Biological Resources, Soil and Water Resources, Transmission System Engineering** and **Waste Management** additional analysis will be needed in regard to specific issues that are described in each section's summary of conclusions.

Staff also concludes that with implementation of staff's recommended mitigation measures described in the conditions of certification, the project would comply with all applicable laws, ordinances, regulations, and standards (LORS), with the exception of the **Soil and Water Resources** section.

The state has expressed a strong interest in developing its solar energy resources. However, the construction and operation of solar energy facilities requires the use of water, which state policy also protects. The Energy Commission must balance the state's interest in promoting solar energy development with its interest in conserving and protecting the state's water resources. Several projects currently proposed in the Mojave and Colorado deserts would use water for power plant cooling, which staff believes is contrary to the state's long term interest in maximizing solar power generation and minimizing adverse environmental impacts. This will be an especially critical issue in the renewable development areas that will be identified in the joint state/federal Renewable Energy Action Team's Desert Renewable Energy Conservation Plan (DRECP). Later this year, staff plans to file a request for an Energy Commission Order Instituting an Informational Proceeding to address the overall issue of water use by power plants. For a more detailed discussion of water policy and related LORS, see staff's technical analyses in the **Soil and Water Resources** section of the SA.

Public Resources, Contact Information and Additional Sources for Information

If you desire information on how to participate in the Energy Commission's review of the proposed project, please contact Jennifer Jennings, the Energy Commission's Public Adviser, at (916) 654-4489 or toll free in California at (800) 822-6228, or by email at: publicadviser@energy.state.ca.us.

To request special accommodations for those persons with disabilities, please contact Lourdes Quiroz, the Energy Commission's Equal Employment Opportunity Officer at lquiroz@energy.state.ca.us or by telephone (916) 654-5146. For those persons with limited English knowledge, request interpreter services by contacting the Project Manager, Craig Hoffman, at (916) 654-4781.

The status of the project, an electronic copy of the SA, copies of notices, and other relevant documents are also available on the Energy Commission's web site at: http://www.energy.ca.gov/sitingcases/abengoa.

News media inquiries should be directed to Assistant Director, Susanne Garfield, at (916) 654-4989, or by email at: mediaoffice@energy.state.ca.us.

The SA will be available for review at the following San Bernardino County local libraries:

Barstow Branch Library
304 E. Buena Vista St.
Barstow, CA 92311

Victorville City Library
15011 Circle Dr.
Victorville, CA 92395

Apple Valley Newton T. Bass
Branch Library
14901 Dale Evans Parkway
Apple Valley, CA 92307

Victor Valley College
18422 Bear Valley
Victorville CA 92392-5849

Adelanto Branch Library
11497 Bartlett Ave.
Adelanto, CA 92301

Kern County Library
Mojave Branch
16916 ½ Highway 14, Space D2
Mojave, CA 93501

Barstow Community College Library
2700 Barstow Road
Barstow, California 92311

Copies are also available at the Energy Commission's Library in Sacramento, the California State Library in Sacramento, and at public libraries in Eureka, San Francisco, Los Angeles, Fresno, and San Diego. In addition, this information has been shared with those public agencies that would normally have jurisdiction but for the Energy Commission's exclusive authority to certify sites and related facilities.

If you would like a paper copy or CD of the SA, please fill out the enclosed form and return it to California Energy Commission, Attention: April Albright, Siting Project Assistant, at (916) 653-1640, or by e-mail at aalbright@energy.state.ca.us.

Sincerely,

Date: 3/16/10

Original signed by E. Allen for:
TERRENCE O'BRIEN, Deputy Director
Siting, Transmission and Environmental
Protection Division

Enclosure
Mailed to lists:
7285 - General
7286 - Property Owners

Please send me a paper copy / CD (circle one) of the California Energy Commission staff's Staff Assessment for the Abengoa Mojave Solar Application for Certification (*09*-AFC-*5*).

Name:

Address:

City/State/Zip:

FOLD HERE

California Energy Commission
Attention: April Albright
1516 Ninth Street, MS-15
Sacramento, CA 95814-5512

FOLD HERE

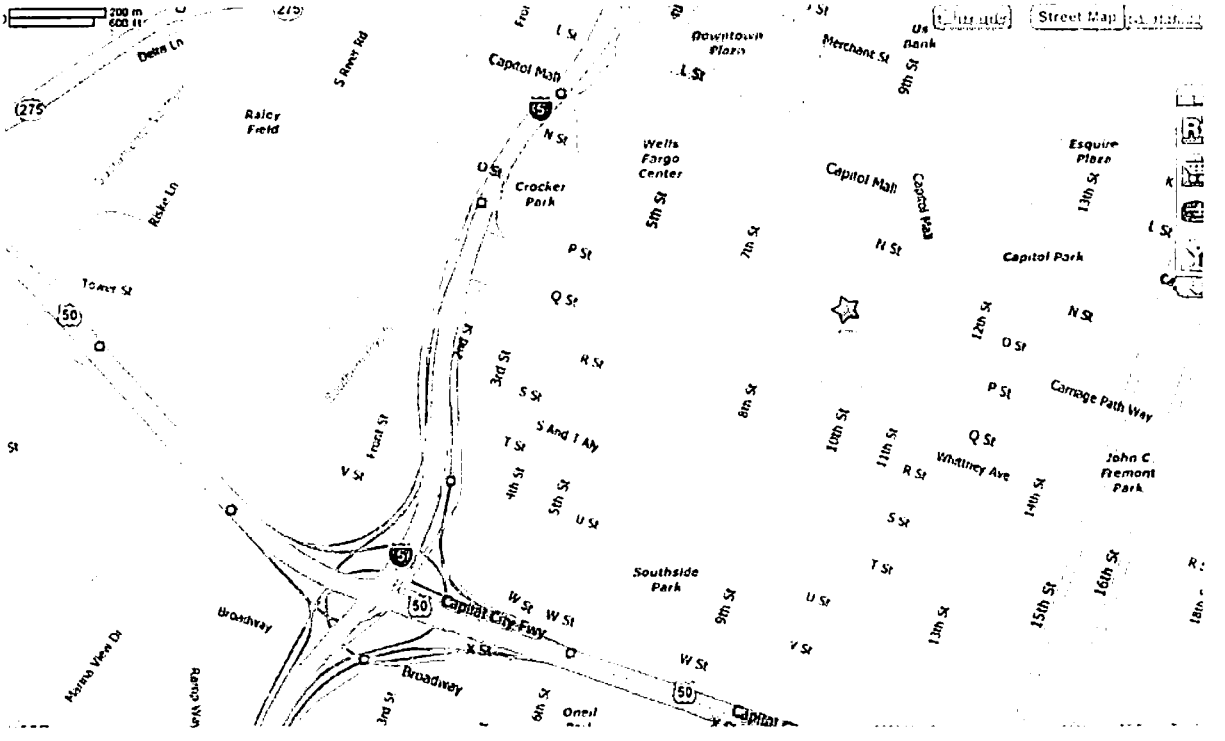
Staple or Tape closed.

SA WORKSHOP FOR ABENGOA MOJAVE SOLAR (*09*-AFC-*5*)

NOTICE OF PUBLIC WORKSHOP
Tuesday, April 6, 2010
Starting at 10:15 am

California Energy Commission
Fourth Floor North Conference Room A
1516 9th Street
Sacramento, CA 95814-5512

(Wheelchair Accessible)



SA WORKSHOP FOR ABENGOA MOJAVE SOLAR (*09*-AFC-*5*)

NOTICE OF PUBLIC WORKSHOP
Wednesday, April 7, 2010
Starting at 1:00 pm

Barstow City Hall
220 E. Mountain View Street
Barstow, California 92311

(Wheelchair Accessible)

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION
FOR THE ***ABENGOA MOJAVE SOLAR POWER PLANT***

Docket No. 09-AFC-5
PROOF OF SERVICE
(Revised 3/4/2010)

APPLICANT
Emiliano Garcia Sanz
General Manager
Abengoa Solar Inc.
11500 West 13th Avenue
Lakewood, CO 80215
emiliano.garcia@solar.abengoa.com

Scott D. Frier
Chief Operating Officer
Abengoa Solar Inc.
13911 Park Ave., Ste. 206
Victorville, CA 92392
scott.Frier@solar.abengoa.com

Tandy McMannes
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Berkeley, CA 94704
tandy.mcmannes@solar.abengoa.com

APPLICANT'S CONSULTANTS
Frederick H. Redell, PE
Engineering Manager
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COUNSEL FOR APPLICANT
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Ellison, Schneider & Harris
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Sacramento, CA 95816
cte@eslawfirm.com

INTERESTED AGENCIES
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E-mail Preferred
e-recipient@caiso.com

INTERVENORS
California Unions for Reliable Energy ("CURE")
Tanya A. Gulesserian
Marc D. Joseph
Elizabeth Klebaner
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
South San Francisco, CA 94080
E-mail Preferred
tgulesserian@adamsbroadwell.com
eklebaner@adamsbroadwell.com

Luz Solar Partners Ltd., VIII
Luz Solar Partners Ltd., IX
Jennifer Schwartz
700 Universe Blvd
Juno Beach, FL 33408
jennifer.schwartz@nexteraenergy.com

ENERGY COMMISSION
***ANTHONY EGGERT**
Commissioner and Presiding Member
aeggert@energy.state.ca.us

JAMES D.BOYD
Vice Chairman and Associate Member
jboyd@energy.state.ca.us

Paul Kramer
Hearing Officer
pkramer@energy.state.ca.us

Craig Hoffman
Project Manager
choffman@energy.state.ca.us

Christine Hammond
Staff Counsel
chammond@energy.state.ca.us

Jennifer Jennings
Public Adviser's Office
publicadviser@energy.state.ca.us

*indicates change

DECLARATION OF SERVICE

I, April Albright, declare that on March 17, 2010, I served and filed copies of the attached Library Letter for; Request for Agency Comments on; and Notice of Availability of the Staff Assessment. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: [http://www.energy.ca.gov/sitingcases/abengoa/index.html].

The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

For service to all other parties:

__✓__ sent electronically to all email addresses on the Proof of Service list;

__✓__ by personally delivery;

__✓__ by delivery on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses **NOT** marked "email preferred."

AND

For filing with the Energy Commission:

__✓__ **sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (preferred method);**

OR

_____ depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-5
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Original signed by: _____
April Albright

STATE OF CALIFORNIA — THE RESOURCES AGENCY

CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

DOCKET
09-AFC-5
DATE MAY 12 2010
REC'D MAY 19 2010

ARNOLD SCHWARZENEGGER, Governor

NOTICE OF AVAILABILITY
SUPPLEMENTAL STAFF ASSESSMENT PART A
FOR THE ABENGOA MOJAVE SOLAR PROJECT (09-AFC-5)

On August 10, 2009, Mojave Solar LLC filed an Application for Certification (AFC) to construct and operate the Abengoa Mojave Solar (AMS) project, proposed as a solar electric generating facility on approximately 1,765 acres. The project would have a combined nominal electrical output of 250 megawatts (MW) from twin, independently-operable solar fields, each feeding a 125-MW power island. The twin solar fields would be 884 acres and 800 acres, respectively, and joined at a transmission line interconnection substation to form one full-output transmission interconnection.

The proposed project site is located approximately nine miles northwest of the town of Hinkley in unincorporated San Bernardino County, approximately halfway between the city of Barstow and Kramer Junction (Highway 395 / Highway 58 junction). The project site is comprised of private property that was historically used as the Lockhart Ranch complex.

Energy Commission Licensing Authority

The Energy Commission is responsible for reviewing and ultimately approving or denying all applications for construction and operation of thermal electric power plants, 50 MW and greater, proposed for construction in California. The Energy Commission's facility certification process carefully examines public health and safety, environmental impacts and engineering aspects of proposed power plants, and all related facilities such as electric transmission lines and natural gas and water pipelines. The Energy Commission is the lead agency under the California Environmental Quality Act (CEQA), but produces several environmental and decision documents rather than an Environmental Impact Report.

Energy Commission Staff Documents and Hearings

Energy Commission staff published a Staff Assessment (SA) for the AMS project on March 15, 2010. This document included staff's analysis, conclusions, and recommendations for the project. Staff publically noticed the SA for a 30-day comment period that lasted from Tuesday March 16, 2010 to Thursday, April 15, 2010.

During this comment period, public workshops were held on Tuesday, April 6, 2010 in Sacramento at the Energy Commission and on Wednesday, April 7, 2010 at the Barstow City Hall to discuss staff's findings, proposed mitigation, and proposed compliance-monitoring requirements. Based on the workshops and written comments, staff has refined its analysis and prepared a Supplemental Staff Assessment.

The Supplemental Staff Assessment (SSA) has been prepared based upon discussions at the SA workshops and written comments provided by the applicant, agencies and public. This SSA is a limited document representing revisions and additions to various technical sections that were commented upon. This document does not include each technical section. For a complete project description and all the technical sections please see the original SA document with the complete engineering, environmental, public health and safety analysis of the AMS project. The SSA only includes sections that were revised or had public comments.

PROOF OF SERVICE (REVISED 05/17/10) FILED WITH
CD COPIES MAILED FROM SACRAMENTO ON 05/19/10
AA

The AMS SSA is being published in two parts. SSA Part A contains the Energy Commission staff's final environmental and engineering evaluation of the project in the following technical sections: Hazardous Materials, Noise and Vibration, Public Health, Traffic and Transportation, Visual Resources, Waste Management and Worker Safety and will serve as staff's testimony during evidentiary hearings. SSA Part B will be published on May 21, 2010 and will contain the Energy Commission staff's final environmental and engineering evaluation of the project in the following technical sections: Air Quality, Biological Resources, Cultural Resources, Land Use, Soils and Water Resources and Transmission System Engineering and will serve as staff's testimony during evidentiary hearings.

Staff's testimony that will be provided at the Energy Commission's Evidentiary Hearings on the AMS project will encompass the technical sections not modified in the SA and revisions to sections included in the SSA Part A and the SSA Part B.

Written comments on the SSA Part A, which you would like to have entered into the record before the Energy Commission's Evidentiary Hearing, should be provided to Craig Hoffman, Energy Commission Siting Project Manager, no later than 5:00 p.m., June 11, 2010 at the address on this letterhead or by email to choffman@energy.state.ca.us.

Public Resources, Contact Information and Additional Sources for Information

The SSA is **not** the Energy Commission's final decision on the proposed AMS project. The Energy Commission's Committee assigned to the project will conduct one or more hearings to consider and weigh the testimony or comments or recommendations of all interested parties, including Energy Commission staff, the applicant, intervenors, public, and other local, state and federal agencies. The Committee will then issue the Presiding Member's Proposed Decision (PMPD) for consideration by the full Energy Commission. The public, intervenors, local, state and federal agencies are encouraged to participate in these hearings. The Energy Commission will issue notices at least 10 days prior to these hearings. If you are not currently receiving these notices and want to be placed on the mailing list, please sign up on the List Server (electronic interest list) for this project from the website or contact April Albright, Project Assistant, at (916) 653-1640 or by e-mail at aalbright@energy.state.ca.us.

Persons wanting information on how to participate in the Energy Commission's review of the project should contact Jennifer Jennings, the Energy Commission's Public Adviser, at (916) 654-4489 or toll free in California at (800) 822-6228, or by email at: publicadviser@energy.state.ca.us.

Technical or project schedule questions should be directed to Craig Hoffman, Siting Project Manager, at (916) 654-4781 or by email at choffman@energy.state.ca.us. The SSA and other relevant documents are available on the Energy Commission's Internet web site at: www.energy.ca.gov/sitingcases/abengoa. News media inquiries should be directed to the media office at (916) 654-4989 or via email at mediaoffice@energy.state.ca.us.

DATE: 5/12/10

Original signed by:
Roger Johnson
Siting Office Manager

Please send me a copy of the California Energy Commission staff's Supplemental Staff Assessment Part A for the Abengoa Mojave Solar, Application for Certification (09-AFC-5).

Name:

Address:

City/State/Zip:

Check Format

☐ **Paper Copy**

☐ **CD**

FOLD HERE

California Energy Commission
Attention: April Albright
1516 Ninth Street, MS-15
Sacramento, CA 95814-5512

FOLD HERE

Staple or Tape closed.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION
FOR THE ***ABENGOA MOJAVE SOLAR POWER PLANT***

Docket No. 09-AFC-5
PROOF OF SERVICE
(Revised 5/17/2010)

APPLICANT
Emiliano Garcia Sanz
General Manager
Abengoa Solar Inc.
11500 West 13th Avenue
Lakewood, CO 80215
emiliano.garcia@solar.abengoa.com

Scott D. Frier
Chief Operating Officer
Abengoa Solar Inc.
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scott.Frier@solar.abengoa.com

Tandy McMannes
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tandy.mcmannes@solar.abengoa.com

APPLICANT'S CONSULTANTS
Frederick H. Redell, PE
Engineering Manager
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frederick.redell@solar.abengoa.com

COUNSEL FOR APPLICANT
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INTERVENORS
California Unions for Reliable Energy ("CURE")
Tanya A. Gulesserian
Marc D. Joseph
Elizabeth Klebaner
Adams Broadwell Joseph & Cardozo
601 Gateway Boulevard, Suite 1000
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E-mail Preferred
tgulesserian@adamsbroadwell.com
eklebaner@adamsbroadwell.com

Luz Solar Partners Ltd., VIII
Luz Solar Partners Ltd., IX
Jennifer Schwartz
700 Universe Blvd
Juno Beach, FL 33408
jennifer.schwartz@nexteraenergy.com

ENERGY COMMISSION
ANTHONY EGGERT
Commissioner and Presiding Member
aeggert@energy.state.ca.us

JAMES D.BOYD
Vice Chairman and Associate Member
jboyd@energy.state.ca.us

***Kourtney Vaccaro**
Hearing Officer
kvaccaro@energy.state.ca.us

Craig Hoffman
Project Manager
choffman@energy.state.ca.us

Christine Hammond
Staff Counsel
chammond@energy.state.ca.us

Jennifer Jennings
Public Adviser's Office
publicadviser@energy.state.ca.us

*indicates change

DECLARATION OF SERVICE

I, April Albright, declare that on May 19, 2010, I served and filed copies of the attached Notice of Availability of the Supplemental Staff Assessment Part A; and Document Handling for the Supplemental Staff Assessment Part A. The original document, filed with the Docket Unit, is accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: [http://www.energy.ca.gov/sitingcases/abengoa/index.html].

The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(*Check all that Apply*)

For service to all other parties:

__✓__ sent electronically to all email addresses on the Proof of Service list;

__✓__ by personal delivery;

__✓__ by delivering on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses NOT marked "email preferred."

AND

For filing with the Energy Commission:

__✓__ **sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (preferred method);**

OR

__✓__ depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-5
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Original signed by: _____
April Albright

CALIFORNIA ENERGY COMMISSION
1516 NINTH STREET
SACRAMENTO, CA 95814-5512

DOCKET
09-AFC-5
DATE 05/26/10
RECD. 05/27/10

NOTICE OF AVAILABILITY
SUPPLEMENTAL STAFF ASSESSMENT PART B
FOR THE ABENGOA MOJAVE SOLAR PROJECT (09-AFC-5)

On August 10, 2009, Mojave Solar LLC filed an Application for Certification (AFC) to construct and operate the Abengoa Mojave Solar (AMS) project, proposed as a solar electric generating facility on approximately 1,765 acres. The project would have a combined nominal electrical output of 250 megawatts (MW) from twin, independently-operable solar fields, each feeding a 125-MW power island. The twin solar fields would be 884 acres and 800 acres, respectively, and joined at a transmission line interconnection substation to form one full-output transmission interconnection.

The proposed project site is located approximately nine miles northwest of the town of Hinkley in unincorporated San Bernardino County, approximately halfway between the city of Barstow and Kramer Junction (Highway 395 / Highway 58 junction). The project site is comprised of private property that was historically used as the Lockhart Ranch complex.

Energy Commission Licensing Authority

The Energy Commission is responsible for reviewing and ultimately approving or denying all applications for construction and operation of thermal electric power plants, 50 MW and greater, proposed for construction in California. The Energy Commission's facility certification process carefully examines public health and safety, environmental impacts and engineering aspects of proposed power plants, and all related facilities such as electric transmission lines and natural gas and water pipelines. The Energy Commission is the lead agency under the California Environmental Quality Act (CEQA), but produces several environmental and decision documents rather than an Environmental Impact Report.

Energy Commission Staff Documents and Hearings

Energy Commission staff published a Staff Assessment (SA) for the AMS project on March 15, 2010. That document included staff's analysis, conclusions, and recommendations for the project. Staff publically noticed the SA for a 30-day comment period that lasted from Tuesday March 16, 2010 to Thursday, April 15, 2010.

During this comment period, public workshops were held on Tuesday, April 6, 2010 in Sacramento at the Energy Commission and on Wednesday, April 7, 2010 at the Barstow City Hall to discuss staff's findings, proposed mitigation, and proposed conditions of certification and compliance-monitoring requirements.

The Supplemental Staff Assessment (SSA) has been prepared based upon discussions at the SA workshops and written comments provided by the applicant, agencies and public. This SSA is a limited document representing revisions and additions to various technical sections that were commented upon. This document does not include each technical

PROOF OF SERVICE (REVISED 5/27//2010) FILED WITH
ORIGINAL MAILED FROM SACRAMENTO ON 5/27/10
MS

section. For a complete project description and all the technical sections please see the original SA document with the complete engineering, environmental, public health and safety analysis of the AMS project. The SSA only includes sections that were revised or had public comments.

The AMS SSA will be published in three parts. SSA Part A was published on May 12, 2010 and contained the Energy Commission staff's final environmental and engineering evaluation of the project in the following technical sections: Hazardous Materials, Noise and Vibration, Public Health, Traffic and Transportation, Visual Resources, Waste Management and Worker Safety and will serve as staff's testimony during evidentiary hearings.

SSA Part B contains the Energy Commission staff's final environmental and engineering evaluation of the project in the following technical sections: Air Quality, Biological Resources, Cultural Resources, Land Use, Soils and Water Resources and Transmission System Engineering and will serve as staff's testimony during evidentiary hearings.

Staff is currently preparing the Transmission System Engineering - Appendix A that is an environmental review of downstream transmission and telecommunication facilities. These are facilities that are past the first point of interconnection, the Lockhart substation, and are required for the AMS project to connect to Southern California Edison Company's (SCE) Kramer-Cool Water 230-kV transmission line. That document will be SSA Part C and will be published on or before June 30, 2010. That document will conclude staff's analysis of the project.

Staff's testimony that will be provided at the Energy Commission's Evidentiary Hearings on the AMS project will encompass the technical sections not modified in the SA and revisions to sections included in SSA Part A, SSA Part B and SSA Part C.

Written comments on the SSA Part B, which you would like to have entered into the record before the Energy Commission's Evidentiary Hearing, should be provided to Craig Hoffman, Energy Commission Siting Project Manager, no later than 5:00 p.m., June 24, 2010 at the address on this letterhead or by email to choffman@energy.state.ca.us.

Public Resources, Contact Information and Additional Sources for Information

The SSA is **not** the Energy Commission's final decision on the proposed AMS project. The Energy Commission's Committee assigned to the project will conduct one or more hearings to consider and weigh the testimony or comments or recommendations of all interested parties, including Energy Commission staff, the applicant, intervenors, public, and other local, state and federal agencies. The Committee will then issue the Presiding Member's Proposed Decision (PMPD) for consideration by the full Energy Commission. The public, intervenors, local, state and federal agencies are encouraged to participate in these hearings. The Energy Commission will issue notices at least 10 days prior to these hearings. If you are not currently receiving these notices and want to be placed on the mailing list, please sign up on the List Server (electronic interest list) for this project from the

website or contact April Albright, Project Assistant, at (916) 653-1640 or by e-mail at aalbright@energy.state.ca.us.

Persons wanting information on how to participate in the Energy Commission's review of the project should contact Jennifer Jennings, the Energy Commission's Public Adviser, at (916) 654-4489 or toll free in California at (800) 822-6228, or by email at: publicadviser@energy.state.ca.us.

Technical or project schedule questions should be directed to Craig Hoffman, Siting Project Manager, at (916) 654-4781 or by email at choffman@energy.state.ca.us. The SA, SSA Part A, SSA Part B and other relevant documents are available on the Energy Commission's Internet web site at: www.energy.ca.gov/sitingcases/abengoa. News media inquiries should be directed to the media office at (916) 654-4989 or via email at mediaoffice@energy.state.ca.us.

DATE:_____ _____

Roger Johnson
Siting Office Manager

Please send me a copy of the California Energy Commission staff's Supplemental Staff Assessment Part B for the Abengoa Mojave Solar, Application for Certification (09-AFC-5).

Name:

Address:

City/State/Zip:

Check Format

☐ **Paper Copy**

☐ **CD**

FOLD HERE

California Energy Commission
Attention: April Albright
1516 Ninth Street, MS-15
Sacramento, CA 95814-5512

FOLD HERE

Staple or Tape closed.

BEFORE THE ENERGY RESOURCES CONSERVATION AND DEVELOPMENT COMMISSION OF THE STATE OF CALIFORNIA
1516 NINTH STREET, SACRAMENTO, CA 95814
1-800-822-6228 – WWW.ENERGY.CA.GOV

APPLICATION FOR CERTIFICATION
FOR THE ***ABENGOA MOJAVE SOLAR POWER PLANT***

Docket No. 09-AFC-5
PROOF OF SERVICE
(Revised 5/27/2010)

APPLICANT
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cte@eslawfirm.com

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E-mail Preferred
e-recipient@caiso.com

INTERVENORS
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bbrizzee@cc.sbcounty.gov

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Luz Solar Partners Ltd., IX
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ENERGY COMMISSION
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aeggert@energy.state.ca.us

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jboyd@energy.state.ca.us

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*indicates change

Christine Hammond
Staff Counsel
chammond@energy.state.ca.us

Jennifer Jennings
Public Adviser's Office
publicadviser@energy.state.ca.us

*indicates change

DECLARATION OF SERVICE

I, Maria Santourdjian, declare that on May 27, 2010, I served and filed copies of the attached Notice of Availability for Supplemental SA Part B, dated May 26, 2010. The original documents, filed with the Docket Unit, are accompanied by a copy of the most recent Proof of Service list, located on the web page for this project at: **[http://www.energy.ca.gov/sitingcases/abengoa/index.html]**. The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

The document has been sent to both the other parties in this proceeding (as shown on the Proof of Service list) and to the Commission's Docket Unit, in the following manner:

(C*heck all that Apply*)

For service to all other parties:

__x__ sent electronically to all email addresses on the Proof of Service list;

_____ by personal delivery;

__x__ by delivering on this date, for mailing with the United States Postal Service with first-class postage thereon fully prepaid, to the name and address of the person served, for mailing that same day in the ordinary course of business; that the envelope was sealed and placed for collection and mailing on that date to those addresses NOT marked "email preferred."

AND

For filing with the Energy Commission:

__x__ **sending an original paper copy and one electronic copy, mailed and emailed respectively, to the address below (preferred method);**

OR

_____depositing in the mail an original and 12 paper copies, as follows:

CALIFORNIA ENERGY COMMISSION
Attn: Docket No. 09-AFC-5
1516 Ninth Street, MS-4
Sacramento, CA 95814-5512
docket@energy.state.ca.us

I declare under penalty of perjury that the foregoing is true and correct, that I am employed in the county where this mailing occurred, and that I am over the age of 18 years and not a party to the proceeding.

Originally Signed by
Maria Santourdjian

NOTICE OF PREPARATION

The Kern County Planning Department as Lead Agency (per CEQA Guidelines Section 15052) has required that Environmental Impact Reports (per CEQA Guidelines Section 15161) be prepared for the following Solar projects:

Antelope Valley Solar by Renewable Resources Group (1.49 MB)
Desert Solar Projects by enXco (4.44 MB)
Lost Hills Solar Project by NexLight (2.2 MB)
Maricopa Sun Solar Project by Maricopa Sun, LLC (16 MB)
Monte Vista Solar Array by First Solar, Inc. (1.5 MB)
Ridge Rider Solar Park by Global Real Estate, LLC (2.62 MB)
Rosamond Solar Array by First Solar, Inc (1.54 MB)
Rosamond Solar Project by SGS Antelope Valley (1.6 MB)
Valley Solar Projects by enXco (6.04 MB)
Weldon Solar Project by Renewable Resources (14.9 MB)
Willow Springs Solar Array by First Solar, Inc. (1.54 MB)

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PUBLIC NOTICES

NOTICES OF PREPARATION

Notices stating that Environmental Impact Reports will be prepared for various Solar projects.

PUBLIC HEARING NOTICES (663 KB)

Notices for current and future hearings for the Planning Commission and Director's Hearing.

Planning Commission

- Meets every 2nd and 4th Thursday of the month, at 7:00 p.m. at the Board of Supervisors Chambers
- Advisory to the Board of Supervisors on adoption and amendments related to: General Plans, specific plans, zone changes, the Zoning Ordinance (PDF 91 KB), the Land Division Ordinance, agricultural preserve inclusions and exclusions, and Williamson Act contract cancellations not involving cancellations for homesite purposes
- Considers and takes action on: Conditional Use Permits and Tract Maps
- Planning Commission Members: Supervisorial District 1 - Peter Belluomini; Supervisorial District 2 - Chris Babcock; Supervisorial District 3 - Brandon Martin; Supervisorial District 4 - Ron Sprague; Supervisorial District 5 - Leticia Perez

Director's Hearing

- Meets every Thursday at 10:00 a.m. at the Public Services Building 1st floor conference room
- Conducted by the Planning Director as Hearing Officer
- Considers and takes action on: Parcel Maps, Modifications, Precise Development Plans and Zone Variances

NOTICES OF OPPORTUNITY FOR PUBLIC HEARING

- Hearing notices for discretionary actions that do not automatically require a hearing, but a Director's hearing will be conducted upon request
- Applications for Parcel Maps, Lot Line Adjustments with Variances

The notices provided on this web site are displayed as PDFs (portable document format) and require the use of a PDF Reader to view them. If you do not have a PDF Reader, you may download the free Adobe Acrobat Reader now by clicking the button at the bottom of the page. The use of Adobe Reader 8.0 or higher is required for optimal viewing of the PDFs on this site.

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Declaration

I, Janet M. Laurain, declare as follows:

1. I am a paralegal at Adams Broadwell Joseph & Cardozo. I make this declaration from my personal knowledge. If called as a witness, I could testify competently to facts stated in this declaration.

2. Attached is a true and correct copy of the Kern County Planning Department's list of Notices of Preparation of Draft Environmental Impact Reports for various solar projects, which I downloaded and printed on June 1, 2010 from http://www.co.kern.ca.us/planning/pubntces.asp and http://www.co.kern.ca.us/planning/noticeprep.asp, a website purporting to be maintained by Kern County, California.

3. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct. Executed this 1 day of June, 2010, at South San Francisco, California.

Janet M. Laurain

Janet M. Laurain

PLANNING DEPARTMENT

TED JAMES, AICP, Director
2700 "M" STREET, SUITE 100
BAKERSFIELD, CA 93301-2323
Phone: (661) 862-8600
FAX: (661) 862-8601 TTY Relay 1-800-735-2929
E-Mail: planning@co.kern.ca.us
Web Address: www.co.kern.ca.us/planning

RESOURCE MANAGEMENT AGENCY

Ted James, AICP, *Interim,* ***RMA DIRECTOR***
Community & Economic Development Department
Engineering & Survey Services Department
Planning Department
Roads Department

NOTICE OF PREPARATION

DATE: March 8, 2010

To: See Attached Mailing List

FROM: Kern County Planning Department
Attn: Sara Kopp
2700 "M" Street, Suite 100
Bakersfield, CA 93301
(661) 862-8793

SUBJECT: NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT

The Kern County Planning Department as Lead Agency (per CEQA Guidelines Section 15052) has required that an Environmental Impact Report (per CEQA Guidelines Section 15161) be prepared for the project identified below. The Planning Department solicits the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval of projects.

Due to the limits mandated by State law, your response must be received by **April 7, 2010 at 5 pm.** In addition, comments can be submitted at a **scoping meeting** that will be held at the Kern County Planning Department on **March 26, 2009 at 1:30 pm** at the address shown above.

PROJECT TITLE: Ridge Rider Solar Park by Global Real Estate Investment Partners, LLC; Conditional Use Permit No. 10, Map 152; (PP10240)

PROJECT LOCATION: Along both sides of Highway 14, approximately three miles north of California City.

PROJECT DESCRIPTION: The proposed project includes a conditional use permit to allow for the construction of a 38 megawatt photovoltaic solar facility. The project consists of approximately 475 acres. Water and sewer service is not required.

Signature:
Title: Planner II

Eirssk08-10.Nop

U.S. Department of Interior
Bureau of Land Management
Ridgecrest Field Office
300 South Richmond Road
Ridgecrest, CA 93555

U.S. Fish & Wildlife Service
Attn: Ashleigh Blackford
2493 Portola Road, Suite B
Ventura, CA 93003

China Lake Naval Weapons Center
Commanding Officer Code
Environmental Managment (O'Gara)
Mail Stop 4014
China Lake, CA 93555-6108

Edwards Air Force Base
AFFTC/XRX Bldg 0001, Rm 110
#1 South Rosamond Boulevard
Edwards AFB, CA 93524-1936

U.S. Environmental Protection Agency
Region IX Office / Attn: David Tomsovic
75 Hawthorn Street /Mail CMD -2
San Francisco, CA 94105

U.S. Department of Agriculture
Natural Resources Conservation Service
5000 California Avenue, Suite 100
Bakersfield, CA 93309-0711

Eastern Kern Resource
Conservation District
1525 North Norma Street, Suite C
Ridgecrest, CA 93555

Kern County Agriculture Department

Kern County Air Pollution Control District

Community Development

Kern County Administrative Officer

Kern County Engineering & Survey Svs/
Floodplain

Kern County Engineering & Survey Svs/
Survey

Kern County Env Health Services Department

Kern County Fire Department

Kern County Library/Diane Duquette

Kern County Parks and Recreation

Resource Management Agency
Special Projects/Fiscal Analysis

Kern County Sheriff's Department
Administration

Kern County Roads Department

Kern County Waste Management Department

Mojave Unified School Dist.
3500 Douglas
Mojave, CA 93501

Kern County Superintendent of Schools
Attention Mary Baker
1300 - 17th Street
Bakersfield, CA 93301-4533

KernCOG

Local Agency Formation Commission
5300 Lennox Avenue, Suite 303
Bakersfield, CA 93309

Antelope Valley-East Kern
Water Agency
6500 West Avenue N
Palmdale, CA 93551

Kern County Water Agency
P.O. Box 58
Bakersfield, CA 93302-0058

Verizon California, Inc.
Attention Engineering Department
520 South China Lake Boulevard
Ridgecrest, CA 93555

Desert Tortoise Preserve Committee
4067 Mission Inn Avenue
Riverside, CA 92501

Native American Heritage Council
of Kern County
P.O. Box 1507
Bakersfield, CA 93302

Sierra Club/Kern Keaweah Chapter
Arthur Unger

****PUT IN BUCKET ***

Smart Growth Coalition
302 South Mojave Street
Mojave, CA 93561

California Farm Bureau Federation
2300 River Plaza Drive, NRED
Sacramento, CA 95833

Stationary Resource Division
(California Air Resources Board)
Attention Barbara Fry
P.O. Box 2815
Sacramento, CA 95812

Southern San Joaquin Valley
Archaeological Information Center
California State University
9001 Stockdale Highway
Bakersfield, CA 93311

Caltrans/Dist. 9
Planning Department
500 South Main Street
Bishop, CA 93514

State Mining and Geology Board
801 "K" Street, MS 20-15
Sacramento, CA 95814

State Dept. of Conservation
Division of Oil & Gas
4800 Stockdale Highway, Ste 417
Bakersfield, CA 93309

State Clearinghouse
Office of Planning and Research
P.O. Box 3044
Sacramento, CA 95812-3044 - CERTIFIED MAIL

California Energy Commission
1516 Ninth Street, Room 200
Sacramento, CA 95814

State Dept. of Fish & Game
1234 East Shaw Avenue
Fresno, CA 93710

California Regional Water Quality
Control Board/Lahontan Region
14440 Civic Drive, Suite 200
Victorville, CA 92392-2306

California Food and Agriculture
1220 "N" Street
Sacramento, CA 95814

California Highway Patrol
Planning and Analysis Division
P.O. Box 942898
Sacramento, CA 94298-0001

Integrated Waste Management
Attention Sue O'Leary, MS #15
P.O. Box 4025
Sacramento, CA 95812-4025

Public Utilities Commission
Energy Division
505 Van Ness Avenue
San Francisco, CA 94102

Kern Valley Tribal Council
P.O. Box 168
Kernville, CA 93238

Tejon Indian Tribe
Kathy Morgan, Chairperson
2234 4th Street
Wasco, CA 93280

Kitanemuk & Yowlumne Tejon Indians
Delia Dominguez
981 North Virginia
Covina, CA 91722

Chumash Council of Bakersfield
P.O. Box 902
Bakersfield, CA 93302

Santa Rosa Rancheria
Clarence Atwell, Chairperson
P.O. Box 8
Lemoore, CA 93245

Tule River Indian Tribe
Neal Peyron, Chairperson
P.O. Box 589
Porterville, CA 93258

Tubatulabals of Kern County
P.O. Box 226
Lake Isabella, CA 93240

U.S. Air Force
Western Regional Environmental Office
50 Fremont Street, Suite 2450
San Francisco, CA 94105-2230

U.S. Army
Dir of Public Works/Master Plan Div
P.O. Box 105097
Fort Irwin, CA 92310-5097

U.S. Army
Peter Rubin
B790 5th Street
Parks RFTA
Dublin, CA 94568

U.S. Navy
Sheila Donovan
1220 Pacific Highway
San Diego, CA 92132

U.S. Marine Corps
Patrick Christman
Building 1164/Box 555246
Camp Pendleton, CA 92055

Calif. Dept ofToxic Substances Control
1001 "I" Street
P.O. Box 806
Sacramento, CA 95812-0806

Center on Race, Poverty, & the Environment
Attention: Executive Director
47 Kearny Street, Suite 804
San Francisco, CA 94108-5528

Center on Race, Poverty, & the Environment
Attention Caroline Farrell
1302 Jefferson Street, Suite 2
Delano, CA 93215

Cuddy Valley Statistical
11667 Steinhoff Road
Frazier Park, CA 93222

Defenders of Wildlife
P.O. Box 953
Joshua Tree, CA 92252

Northcutt and Associates
P.O. Box 2893
Lake Isabella, CA 93240

Kern County Library
Mojave Branch
16916 ½ Highway 14, Space D2
Mojave, CA 93501

David Laughing Horse Robinson
P.O. Box 1547
Kernville, CA 93238

State Dept. of Conservation
Director's Office
801 "K" Street, MS 24-01
Sacramento, CA 95814-3528

Los Angeles Dept. of Water & Power
Attention Jodean M. Giese
111 North Hope Street, Rm 1121
Los Angeles, CA 90012

State Dept. of Public Health
Drinking Water Field Operations Branch
265 W Bullard Avenue, Suite 101
Fresno, CA 93704-1755

State Department of Health Services/Drinking Water
Jesse Dhaliwal
1200 Discovery Drive, Ste 100
Bakersfield, CA 93309

State Dept. of Conservation
Office of Land Conservation
801 "K" Street, MS 18-01
Sacramento, CA 95814

City of Arvin
P.O. Box 548
Arvin, CA 93203

City of Bakersfield
Planning Department
1715 Chester Avenue
Bakersfield, CA 93301

California City Planning
21000 Hacienda Boulevard
California City, CA 93515

City of Delano
P.O. Box 3010
Delano, CA 93216

City of Maricopa
P.O. Box 548
Maricopa, CA 93252

City of McFarland
401 West Kern Avenue
McFarland, CA 93250

City of Ridgecrest
100 West California Avenue
Ridgecrest, CA 93555

City of Shafter
336 Pacific Avenue
Shafter, CA 93263

City of Taft
Planning and Building
209 East Kern Street
Taft, CA 93268

City of Tehachapi
115 South Robinson Street
Tehachapi, CA 93561-1722

City of Wasco
764 "E" Street
Wasco, CA 93280-1930

Inyo County Planning Department
P.O. Drawer "L"
Independence, CA 93526

Kings County Planning Agency
Kings County Government Building #6
1400 West Lacey Boulevard
Hanford, CA 93230

Los Angeles County
Department of Regional Planning
320 West Temple Street, Room 1390
Los Angeles, CA 90012

San Bernardino County
Office of Planning
385 North Arrowhead Avenue, 1st Floor
San Bernardino, CA 92415-0182

San Luis Obispo County
Planning and Building Department
County Government Center
San Luis Obispo, CA 93408

Santa Barbara County
Planning and Development
123 East Anapamu Street
Santa Barbara, CA 93101

Tulare County
Planning & Development Dept.
Room 105-111
County Civic Center
Visalia, CA 93291-4503

Ventura County RMA Planning Div.
Attention Kim Rodriquez, Director
800 South Victoria Avenue, L1740
Ventura, CA 93009-1740

U.S. Department of Energy
Office of NEPA
Director Carol Borgstrom
1000 Independence Avenue, SW
Washington, D.C. 20585-0119

Office of Historical Preservation
Susan Stratton
P.O. Box 942896
Sacramento, CA 942896

Southern California Edison
Attn: Cathy Hart
42060 10th Street, West
Lanchester, CA 93534

San Diego Gas and Electric
P.O. Box 129831
San Diego, CA 92112-9831

California Department of Fish and Game
Dave Hacker
Region 4 Renewable Energy Projects
3196 South Higuera Street, Suite A
San Luis Obispo, CA 93401

Pacific Gas & Electric Co.
Shaw Office/Land Projects
650 "O" Street, First Floor
Fresno, CA 93760-0001

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P. O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # _____

Project Title: Ridge Rider Solar Park by Global Real Estate Partners

Lead Agency: Kern County Planning Department
Contact Person: Sara Kopp
Mailing Address: 2700 "M" Street, Suite 100
Phone: 661-862-8793
City: Bakersfield
Zip: 93301
County: Kern

Project Location: County: Kern
City/Nearest Community: California City
Cross Streets: Highway 14 and Phillips Road
Zip Code: Attached
Lat. / Long.: 34° 13′ 55.5″ N/ 118° 2′ 56″ W
Total Acres: 475
Assessor's Parcel No.: See Attached
Section: Attached
Twp.: 9N
Range: 14W
Base: SBB&M
Within 2 Miles: State Hwy #: 14
Waterways: _____
Airports: _____
Railways: _____
Schools: _____

Document Type:

CEQA:
- [x] NOP
- [ ] Early Cons
- [ ] Neg Dec
- [ ] Mit Neg Dec
- [ ] Draft EIR
- [ ] Supplement/Subsequent EIR (Prior SCH No.) _____
- Other _____

NEPA:
- [ ] NOI
- [ ] EA
- [ ] Draft EIS
- [ ] FONSI

Other:
- [ ] Joint Document
- [ ] Final Document
- [ ] Other _____

Local Action Type:

- [ ] General Plan Update
- [ ] General Plan Amendment
- [ ] General Plan Element
- [ ] Community Plan
- [ ] Specific Plan
- [ ] Master Plan
- [ ] Planned Unit Development
- [ ] Site Plan
- [ ] Rezone
- [ ] Prezone
- [x] Use Permit
- [ ] Land Division (Subdivision, etc.)
- [ ] Annexation
- [ ] Redevelopment
- [ ] Coastal Permit
- [ ] Other _____

Development Type:

- [ ] Residential: Units _____ Acres _____
- [ ] Office: Sq.ft. _____ Acres _____ Employees _____
- [ ] Commercial: Sq.ft. _____ Acres _____ Employees _____
- [ ] Industrial: Sq.ft. _____ Acres _____ Employees _____
- [ ] Educational _____
- [ ] Recreational _____
- [ ] Water Facilities: Type _____ MGD _____
- [ ] Transportation: Type _____
- [ ] Mining: Mineral _____
- [x] Power: Type Solar MW 38
- [ ] Waste Treatment: Type _____ MGD _____
- [ ] Hazardous Waste: Type _____
- [ ] Other: _____

Project Issues Discussed in Document:

- [x] Aesthetic/Visual
- [x] Agricultural Land
- [x] Air Quality
- [x] Archeological/Historical
- [ ] Biological Resources
- [ ] Coastal Zone
- [x] Drainage/Absorption
- [ ] Economic/Jobs
- [ ] Fiscal
- [ ] Flood Plain/Flooding
- [ ] Forest Land/Fire Hazard
- [ ] Geologic/Seismic
- [ ] Minerals
- [x] Noise
- [x] Population/Housing Balance
- [x] Public Services/Facilities
- [ ] Recreation/Parks
- [ ] Schools/Universities
- [ ] Septic Systems
- [ ] Sewer Capacity
- [x] Soil Erosion/Compaction/Grading
- [x] Solid Waste
- [x] Toxic/Hazardous
- [x] Traffic/Circulation
- [x] Vegetation
- [ ] Water Quality
- [ ] Water Supply/Groundwater
- [ ] Wetland/Riparian
- [x] Wildlife
- [ ] Growth Inducing
- [ ] Land Use
- [x] Cumulative Effects
- [ ] Other _____

Present Land Use/Zoning/General Plan Designation:

See Attached

Project Description: *(please use a separate page if necessary)*

Conditional Use Permit on 475 Acres to allow for the construction of a 38 MW photovoltaic solar facility on 475 acres.

Note: The state Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. Notice of Preparation or previous draft document) please fill in.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".
If you have already sent your document to the agency please denote that with an "**S**".

S Air Resources Board
___ Boating & Waterways, Department of
S California Highway Patrol
S Caltrans District # 9
___ Caltrans Division of Aeronautics
___ Caltrans Planning (Headquarters)
___ Coachella Valley Mountains Conservancy
___ Coastal Commission
___ Colorado River Board
S Conservation, Department of
___ Corrections, Department of
___ Delta Protection Commission
___ Education, Department of
S Energy Commission
S Fish & Game Region # Fresn
S Food & Agriculture, Department of
___ Forestry & Fire Protection
___ General Services, Department of
___ Health Services, Department of
___ Housing & Community Development
S Integrated Waste Management Board
S Native American Heritage Commission
___ Office of Emergency Services
___ Office of Historic Preservation
___ Office of Public School Construction
___ Parks & Recreation
___ Pesticide Regulation, Department of
S Public Utilities Commission
___ Reclamation Board
S Regional WQCB # Lah
___ Resources Agency
___ S.F. Bay Conservation & Development Commission
___ San Gabriel & Lower L.A. Rivers and Mtns Conservancy
___ San Joaquin River Conservancy
___ Santa Monica Mountains Conservancy
___ State Lands Commission
___ SWRCB: Clean Water Grants
___ SWRCB: Water Quality
___ SWRCB: Water Rights
___ Tahoe Regional Planning Agency
S Toxic Substances Control, Department of
___ Water Resources, Department of

___ Other _____
___ Other _____

Local Public Review Period (to be filled in by lead agency)

Starting Date March 8, 2010 Ending Date April 7, 2010

Lead Agency (Complete if applicable):

Consulting Firm: _____
Address: _____
City/State/Zip: _____
Contact: _____
Phone: _____

Applicant: _____
Address: _____
City/State/Zip: _____
Phone: _____

Signature of Lead Agency Representative: _____ **Date:** 3/5/10

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

Zip Code: 93519, 93501

Land Use: Vacant/A (Exclusive Agriculture), A GH (Exclusive Agriculture Geologic Hazard Combining), and A GH FPS (Exclusive Agriculture Geologic Hazard Combining Floodplain Secondary Combining)

INITIAL STUDY/NOTICE OF PREPARATION

Ridge Rider Solar Park

by Global Real Estate Investment Partners, LLC

CUP No. 10, Map 152

LEAD AGENCY:

Kern County Planning Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2370

Contact: *Sara Kopp*
(661) 862-8793

TECHNICAL ASSISTANCE BY:

ENVIRONMENTAL SCIENCE ASSOCIATES
707 WILSHIRE BOULEVARD, SUITE 1450
LOS ANGELES, CA 90017
(213) 599-4300

March 2010

1. Project Description

1.1 Location

The 475-acre undeveloped project site is located in unincorporated eastern Kern County, at the western edge of the Mojave Desert, along State Route 14 (SR 14) (see Figure 1) under the jurisdiction of the Kern County General Plan. This site is approximately 3.5 miles northwest of the northern boundary of California City, approximately 14 miles north of the Community of Mojave, and approximately 23 miles northeast of the City of Tehachapi. Other nearby landmarks include the Edwards Air Force Base (Edwards AFB), which is located 23 miles south of the project site; Desert Tortoise Natural Area which is approximately six miles east of the project site; Jawbone Canyon Off Highway Vehicle (OHV) Area which is about one mile to the north, and Red Rock Canyon State Park, which is approximately five miles to the north.

The project site consists of four parcels of various sizes for a total size of approximately 475 acres, with two parcels located on the east side of SR 14 and two on the west side of SR 14. These properties are identified as Assessor's Parcel Numbers (APNs) 469-290-07, 469-290-08, 469-290-10 and 469-040-03, located within a portion of Sections 17 and 18 of Township 31 South, Range 37 East, Mount Diablo Base and Meridian (MDB&M).

For the purposes of this Project Description, the four parcels are identified as Parcel 1, Parcel 2, Parcel 3 and Parcel 4, as follows:

Assessor's Parcel Number (APN)	EIR Identification Number	Location	Approximate Acreage
469-290-07	Parcel 1	West of SR 14	9.3
469-290-08	Parcel 2	West of SR 14	73.6
469-290-10	Parcel 3	East of SR 14	59.9
469-040-03	Parcel 4	East of SR 14	332.7
		Total Acreage	475.5 acres

1.2 Environmental Setting

The project site is undeveloped desert land covered by native vegetation traversed by dirt roads with SR 14 right-of-way (four lanes and a median) dividing the site in a north-south direction. Access to and from SR 14 is provided by an existing Caltrans turnout onto a dirt road. Parcel 4 is located east of Parcel 3 and not adjacent to any of the other parcels. Union Pacific Railroad tracks from the western boundary of Parcel 4, along a southwest-northeast axis. There is no public crossing at the railroad tracks to and from the project site. A public railroad crossing is available from Phillips Road, approximately two miles south of the project site. The applicant is in the process of negotiating a crossing with Union Pacific Railroad and the private land owner that would connect the southwest corner of Parcel 4 to the southeast corner of Parcel 3.

Parcels 1 and 2, on the west side of SR 14, are contiguous parcels that share a portion of their southern (Parcel 1) and northern (Parcel 2) border. Parcels 3 and 4, on the east side of SR 14 are non-contiguous, and are separated by another parcel that is not part of the project site. Parcel 4 is located east of Parcel 3. Most of the eastern boundary of Parcels 1 and 2 and the western boundary of Parcel 3 consist of the SR 14 right-of-way. The western boundary of Parcel 4 is formed by the Union Pacific Railroad right-of-way.

There are no residences or other structures located within more than two mile radius of the project site. The site is relatively flat but slopes approximately three percent from west to east. Portions of the project site are located within a 100-year flood plain; and the Garlock fault passes through portions of the project site. In addition, several easements affect the use of the site, including easements for water rights claims or title, and easements related to rights-of-way for ditches and canals and/or other drainage-related facilities.

According to the U.S. Department of Agriculture's Natural Resources Conservation Service, soils at the project site consist mainly of Arizo gravelly loamy sand and Cajon loamy sand, with a small percentage of the site consisting of Whitewolf loamy sand. The project site is not located within an agricultural preserve or under Williamson Act Contract, and is not located within the boundaries of any oilfield. As stated above, certain portions of Parcels 2 and 4 are located within a 100-year flood hazard zone; however, these areas are not planned for the development of PV arrays or any other project components due to their susceptibility to flooding.

The proposed project is located approximately 13 miles south of the nearest fire station (California City Fire Station) and approximately 15 miles south of the nearest Sheriff's station (Mojave Substation). The project site is not located within two miles of a public airport; the closest airport is the California City Municipal Airport, which is located approximately 5.5 miles south of the project site. There are four public schools located within ten miles of the project site including Red Rock Elementary School (Cantil), Hacienda Elementary School (California City), California City Middle School (California City), and Robert P. Ulrich Elementary School (California City). There are no parks or other recreational areas located within five miles of the project site.

According to the Kern County General Plan, the project site is currently designated 8.5 (Resource Management), 8.5/2.1 (Resource Management/Seismic Hazard), and 8.5/2.5 (Resource Management/Flood Hazard). The project site has a Kern County Zoning Ordinance classification of A (Exclusive Agriculture), A GH (Exclusive Agriculture Geologic Hazard Combining), A FPS (Exclusive Agriculture Floodplain Secondary Combining), and A GH FPS (Exclusive Agriculture Geologic Hazard Combining Floodplain Secondary Combining). The surrounding land use is all currently vacant (Refer to Table 1-1 Proposed Project Site and Surrounding Land Uses).

TABLE 1-1
Proposed Project Site and Surrounding Land Uses

Direction from Project Site	Existing Land Use	Existing Land Use Designation	Existing Zoning
Project Site	Vacant	8.5 (Resource Management); 8.5/2.1 (Resource Management/Seismic Hazard); 8.5/2.5 (Resource Management/Flood Hazard)	A (Exclusive Agriculture); A GH (Exclusive Agriculture Geologic Hazard Combining); A FPS (Exclusive Agriculture Floodplain Secondary Combining); A GH FPS (Exclusive Agriculture Geologic Hazard Combining Floodplain Secondary Combining)
North	Vacant	8.1 (Intensive Agriculture); 8.1/2.1 (Intensive Agriculture/Seismic Hazard); 8.5 (Resource Management); 8.5/2.1 (Resource Management/Seismic Hazard)	A (Exclusive Agriculture); A GH (Exclusive Agriculture Geologic Hazard Combining)

Direction from Project Site	Existing Land Use	Existing Land Use Designation	Existing Zoning
East	Vacant	8.5 (Resource Management); 8.5/2.5 (Resource Management/Flood Hazard)	A FPS (Exclusive Agriculture Floodplain Secondary Combining)
South	Vacant	8.5 (Resource Management); 8.5/2.1 (Resource Management/Seismic Hazard); 8.5/2.5 (Resource Management/Flood Hazard)	A (Exclusive Agriculture); A GH (Exclusive Agriculture Geologic Hazard Combining); A FPS (Exclusive Agriculture Floodplain Secondary Combining); A GH FPS (Exclusive Agriculture Geologic Hazard Combining Floodplain Secondary Combining); PL RS (Platted Land Residential Suburban Combining); Pl RS FPS (Platted Land Residential Suburban Combining Floodplain Secondary Combining)
West	Vacant	1.1 (State and Federal Land)	E (20) (Estate Residential 20 Acre Minimum)

1.3 Proposed Project

The project applicant is proposing a Conditional Use Permit (CUP) in order to facilitate the construction of a 32-megawatt alternating current (MW-AC) solar photovoltaic (PV) generating facility on an approximate 475-acre site in unincorporated Kern County. The net amount of land covered by the PV panels and associated structures would be approximately 101 acres. The applicant would direct this power via underground conduits and overhead lines to the Los Angeles Department of Water and Power's (LADWP's) Barren Ridge Switching facility, located on the west side of SR 14, approximately 4,000 linear feet northwest of the project site. An underground conduit would be installed under SR 14 and overhead lines would be required to cross the Union Pacific railroad tracks. Overhead lines would carry power from the site to the switching facility.

The proposed project would be designed to operate year round. Using an array of thin film PV modules to convert solar energy directly to electrical power for export to the electrical grid, the proposed project would generate electricity during daylight hours when electricity demand is at its peak. Under optimal conditions, the project would provide for the annual electricity needs of up to 20,854 households.

The proposed project would consist of the following project components, which are described in detail below.

(1) a solar field of PV panels mounted on steel and aluminum structures;

(2) an electrical collection system (transformer and invertor) that aggregates the output from the PV panels and converts the electricity from direct current (DC) to alternating current (AC);

(3) transmission to the LADWP's Barren Ridge Switching Station through underground conduits and overhead lines, and

(4) infrastructure including vehicle access to SR 14, improvements to existing dirt roads, crossing over the railroad tracks and six-foot chain link security fencing topped with barbed wire.

1.3.1 Project Characteristics

Project Facilities

The solar PV generating facility would consist of 15 square-foot PV modules (3 feet by 5 feet) or panels mounted in fixed tilt PV arrays that would face south to maximize the amount of solar radiation absorbed over the year. The PV modules are made of a cadmium telluride semiconductor material encapsulated in glass. Installation of the PV arrays would include installation of support beams, module rail assemblies, PV modules, inverters, transformers and buried electrical conductors. Concrete would be required for the footings, foundations and pads for the transformers and substation work. The rows would be aligned east to west, with each individual panel tilted 25 degrees and oriented to the south for maximum exposure. Modules would be placed on Parcels 2, 3 and 4, and not on Parcel 1.

PV modules would be organized into electrical groups referred to as "blocks" capable of producing one-MW. Each block, with a transformer and inverters, would typically encompass approximately 5.5 acres. Using the First Solar FS3 Series, all blocks would be aligned east to west, and would consist of four grids of panels that extend 300 feet by 190 feet, including a pad for one transformer and two inverters.

The electrical output from the PV modules would be low voltage DC power that would be collected and routed to a series of inverters and their associated pad-mounted transformers. Each 1-MW array would have two 500 kW inverters and one megavolt-ampere (MVA) transformer, which are collectively known as a Power Conversion Station (PCS) [A volt-ampere (VA) is defined as the amount of apparent power in a circuit equal to the product of voltage and current. A MVA is equivalent to 1,000 VA]. The inverters would convert the DC power generated by the panels to AC power and the pad mounted transformers step up the voltage to a nominal 34.5 KV voltage level. The 34.5 KV outputs from the transformers are grouped together in PV combining switchgear, which in turn supplies the switchyard, where the power is stepped up to 230KV for interconnection with the transmission system.

The proposed project would consist of 40 standard 1-MW DC arrays, which are located to avoid flood plains and undevelopable easements.

Interconnect with Statewide Grid

The electricity produced by the proposed project would be transmitted to LADWP's Barren Ridge Switching Station by means of underground conduits and overhead lines. The project would include two major crossings: (1) overhead lines above the Union Pacific Railroad tracks along the eastern border of Parcel 4; and (2) a crossing under SR 14, which separates Parcels 1 and 2 from Parcel 3. (As noted above, Parcel 4 is located east of Parcel 3 and is separated from Parcel 3 by a parcel that is not part of the project site.)

The applicant is in the process of submitting specifications and drawings for an overhead utility crossing across the Union Pacific tracks. The overhead lines, which would be mounted on wood or steel poles, would cross the tracks at the western edge of Parcel 4 to an easement that links Parcel 4 to Parcel 3.
Because the switching station is located on the west side of SR 14, another crossing would be required. This crossing would be installed under SR 14 by passing a 42-inch reinforced concrete pipe that would house the lines from the east side of SR 14 to the west side of SR 14. This would require creation of jacking pits on both sides of SR 14 (10 feet wide by 20 feet long by 10 feet deep) in accordance with California Department of Transportation (Caltrans) standards. Once the pipe is successfully installed, the jacking pits would be backfilled.

Access to the project site would be provided as noted on Figure 2. If vehicular crossing at the Union Pacific railroad tracks is granted, the proposed project would be required to conform to all requirements by the CPUC for this crossing, including California Public Utilities Commission (CPUC) safety standards. The site would be fenced with a six-foot high chain link security fence topped with barbed wire. Two gates would be located in each fenced area, consisting of a secured controlled main access gate at the entrance to each parcel, followed by a second gate.

Construction Activities

Construction of the proposed project, including site preparation and grading, is estimated to extend over a period of 7.5 months, and would include renovation of existing dirt roads and side streets. Access to the project site would be available from both sides of SR 14, in accordance with Caltrans H-20 loading requirements. An on-site staging area would include an temporary construction office, a first aid station and other temporary facilities including, but not limited to, sanitary facilities, worker parking, truck loading and unloading, and a designated area for assembling the support structures for placement of PV modules. The location of the staging area would change as construction progresses throughout the site. Temporary roadways may be established during construction for equipment and workers.

Project Operations and Maintenance

The project would not include a permanent office or ancillary structure, and the project facilities would be operated on an "unstaffed" basis with occasional on-site maintenance and system monitoring. No full-time staff would be required and the site would be monitored remotely. Maintenance is expected to be minimal because the PV panels produce electricity passively, and there are no moving parts.

Unplanned maintenance would be responded to on an as-needed basis, depending on the event. Preventive maintenance kits and certain critical spare parts would be available from a remote climate-controlled warehouse facility.

1.4 Project Objectives

The applicants' objectives are identified as the following:

- Construct, operate and maintain an efficient economic, reliable, safe and environmentally sound solar-powered electricity generating facility.
- Help meet California's Renewable Portfolio Standard (RPS) requirements, which require that by 2010, California's electric utilities to obtain 20 percent of the electricity they supply from renewable sources.
- Help meet Executive Order S-14-08, which established RPS targets, which require that by 2020, California's retail sellers of electricity serve 33 percent of their loads with renewable energy.
- Generate renewable solar-generated electricity from proven technology, at a competitive cost, with low environmental impact, and deliver it to markets as soon as possible.
- Develop, construct, own and operate Ridge Rider Solar Park, and sell its electricity and all renewable and environmental attributes to an electric utility purchaser under a long-term contract to meet California's RPS goals.
- Utilize a location that is in close proximity to an existing switching station and power lines.

1.5 Proposed Discretionary Actions/Required Approvals

Construction and operation of the proposed project may require the following discretionary actions and approvals:

Kern County

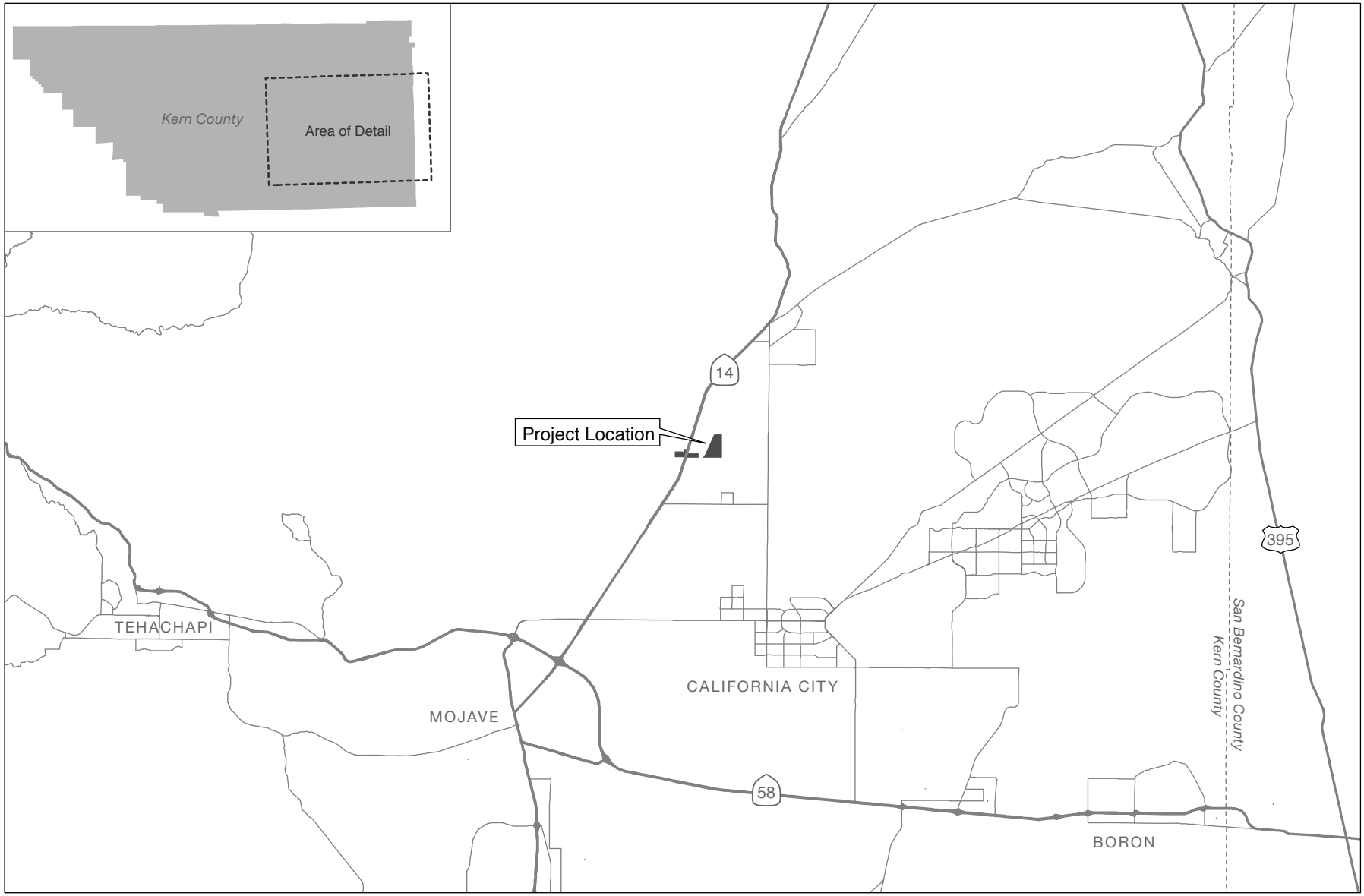
- Certification of a Final Environmental Impact Report with appropriate Findings and Mitigation Measure Monitoring Program, if applicable, by the Kern County Board of Supervisors.
- CUP.
- Grading Permit and Drainage Plan.
- Building Permit.

Other Responsible Agencies

- Approval by the Caltrans of an encroachment permit for an underground utility crossing at SR 14, between Parcel 2 and Parcel 3.
- Approval by the CPUC of a vehicular crossing across the Union Pacific Railroad right-of-way (adjacent to Parcel 4) between SR 14 and Parcel 4 (includes land outside of the project site boundaries).
- Approval by the CPUC of an overhead utility crossing for the Union Pacific Railroad right-of-way.
- State Water Resources Control Board – National Pollutant Discharge Elimination System (NPDES).
- Kern County Air Pollution Control District (KCAPCD).
- California Department of Fish and Game (CDFG).
- U.S. Fish and Wildlife Service (USFWS).

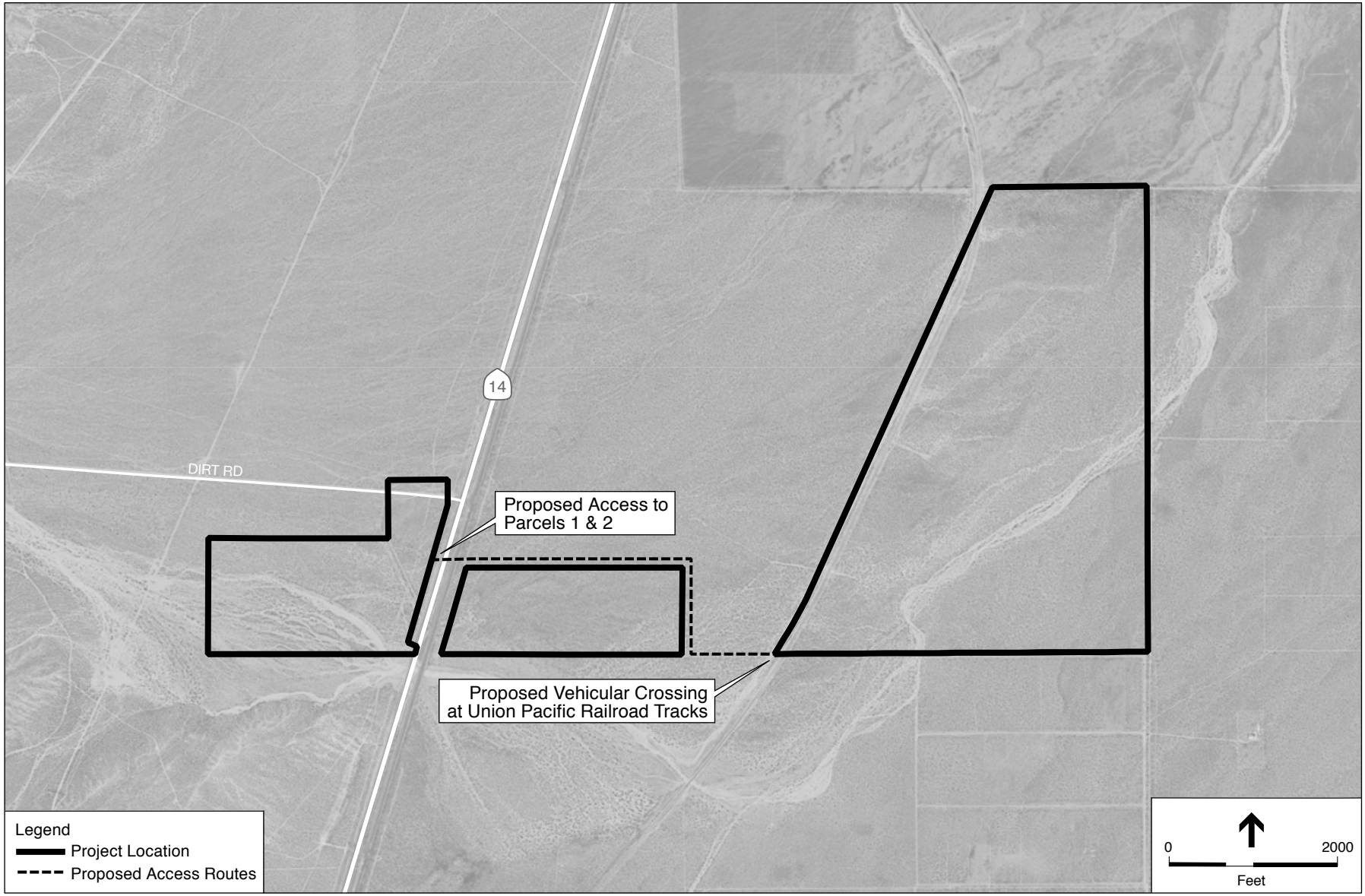
This project is contingent upon construction of a private means of access between Parcel 3 and Parcel 4, on land outside of the project area boundaries located between Parcel 3 and Parcel 4. The roadway would provide access from SR 14 to Parcels 3 and 4. This project is also contingent upon applicant obtaining a means of access from the project site to the Barren Ridge Switching Station, which is less than one mile northwest of the project site.

Other additional permits from responsible agencies may be required for the proposed project.



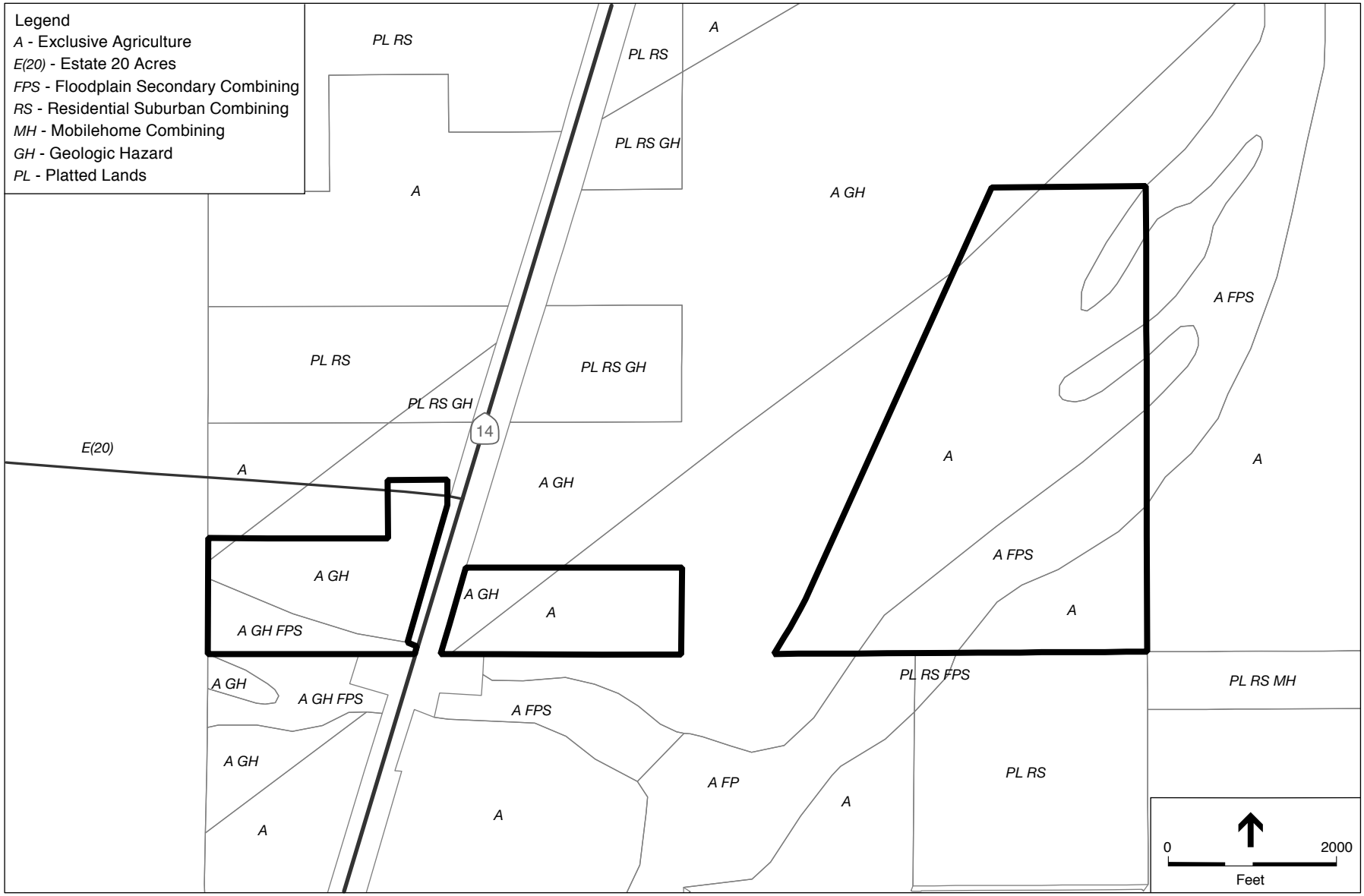
Source: ESRI; ESA, 2010.

Figure 1: SITE VICINITY MAP



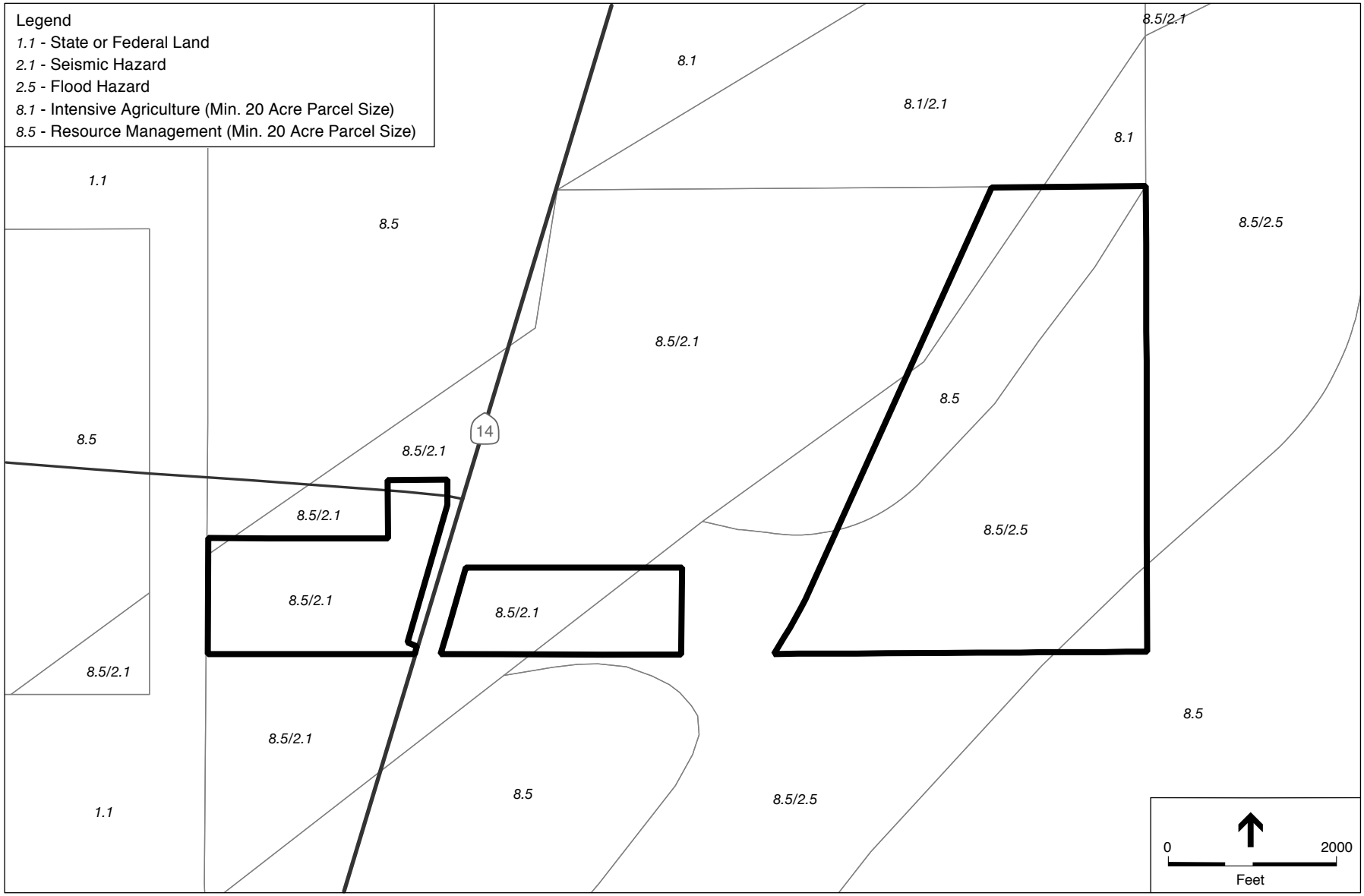
Source: ESRI; ESA, 2010.

Figure 2: PROJECT SITE BOUNDARY AND ACCESS MAP



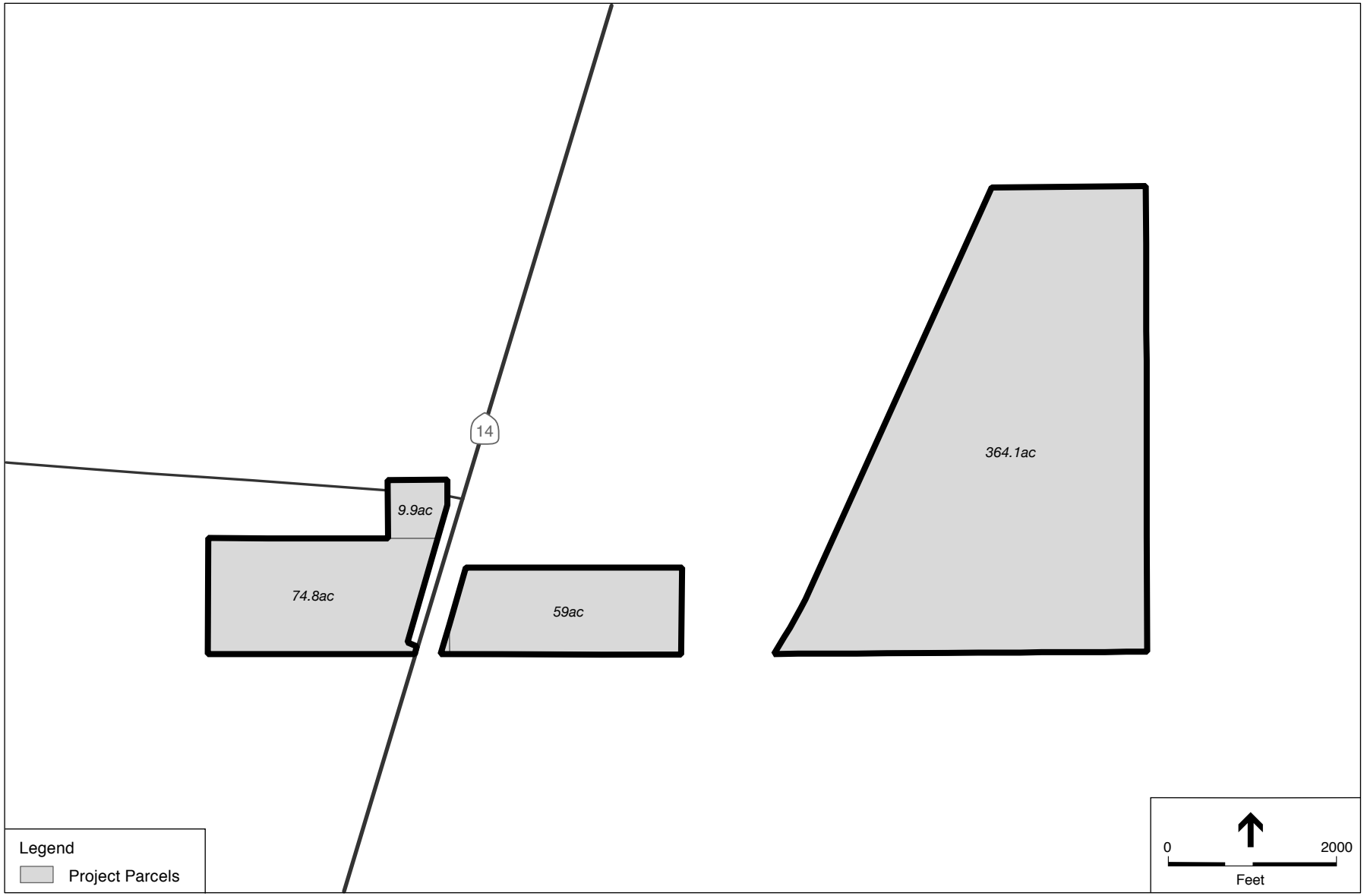
Source: ESRI; ESA, 2010.

Figure 3: EXISTING ZONING MAP



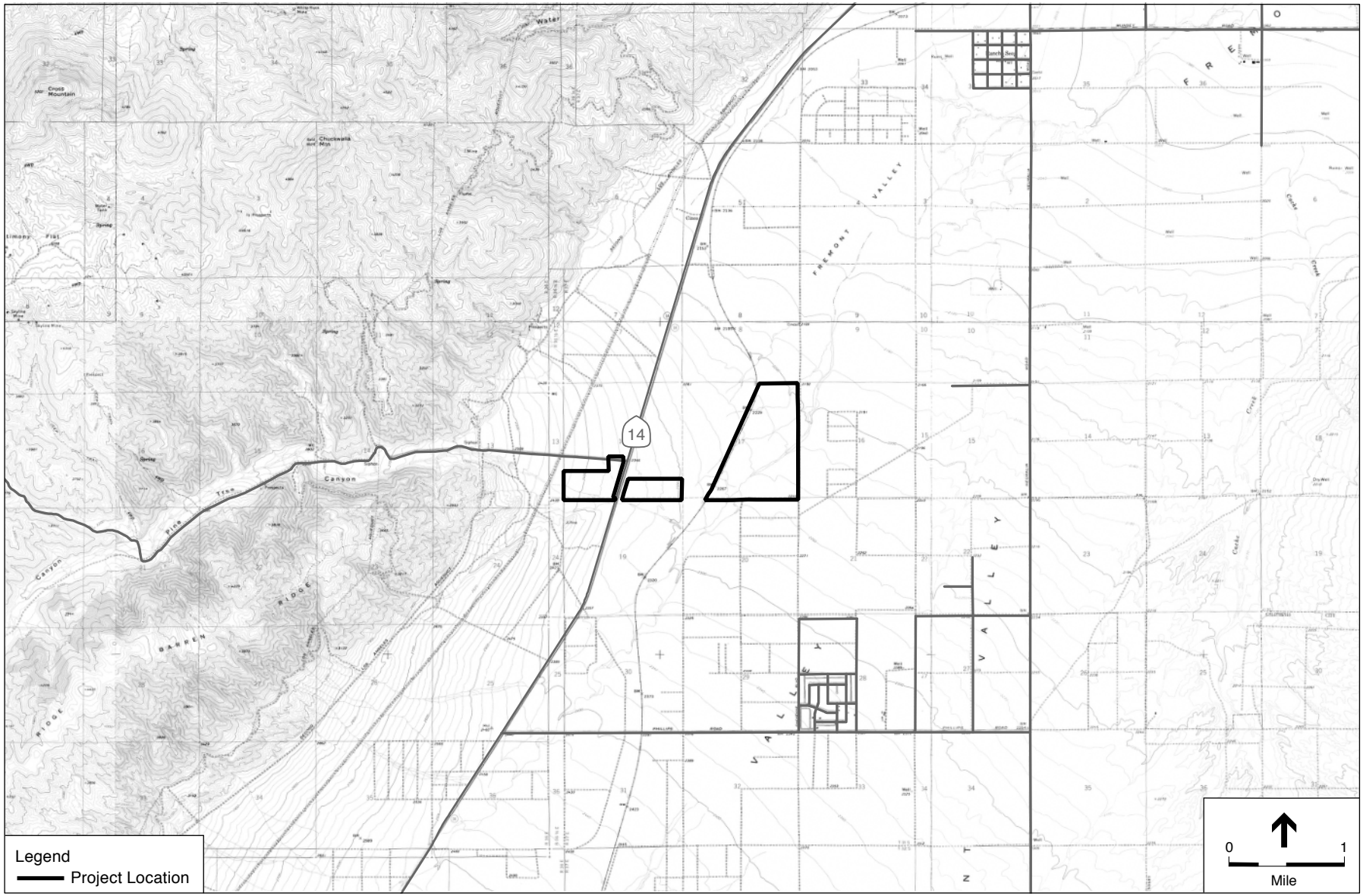
Source: ESRI; ESA, 2010.

Figure 4: LAND USE MAP



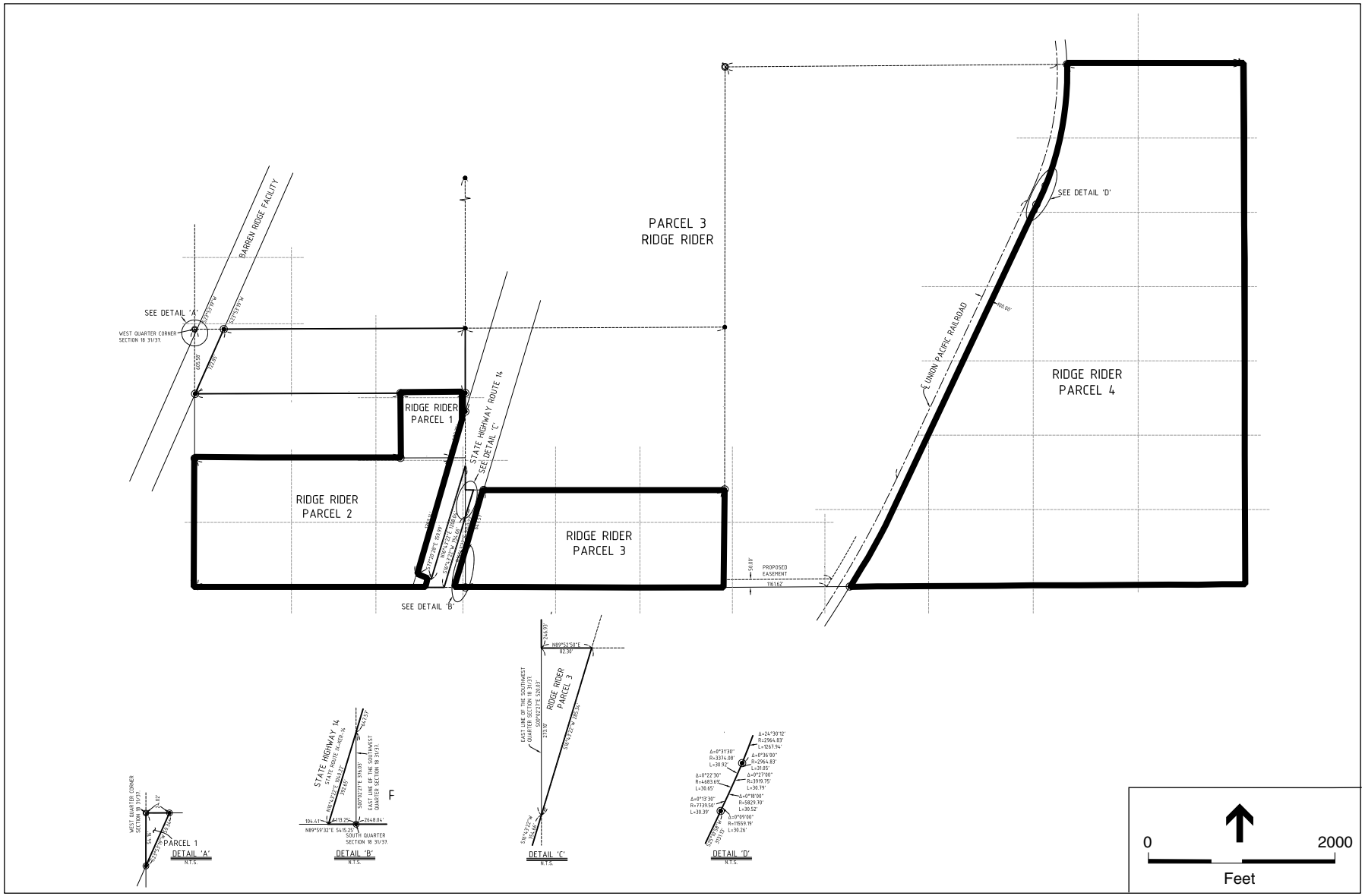
Source: ESRI; ESA, 2010.

Figure 5: APN MAP



Source: USGS; ESA, 2010.

Figure 6: USGS MAP



Source: ESRI; ESA, 2010.

Figure 7: SITE PLAN

KERN COUNTY ENVIRONMENTAL CHECKLIST FORM

Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "potentially significant impact" as indicated by the Kern County Environmental Checklist in Chapter 3.

☒ Aesthetics	☐ Agricultural Resources	☒ Air Quality
☒ Biological Resources	☒ Cultural Resources	☒ Geology and Soils
☒ Greenhouse Gas Emissions	☐ Hazards and Hazardous Materials	☒ Hydrology and Water Quality
☐ Land Use and Planning	☐ Mineral Resources	☐ Noise
☐ Population and Housing	☒ Public Services	☐ Recreation
☒ Transportation and Traffic	☐ Utilities and Service Systems	☒ Mandatory Findings of Significance

Determination

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☒ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect (a) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (b) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENT IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature	March 3, 2010 Date
Sara Kopp Printed Name	Kern County Planning Department For

Evaluation of Environmental Impacts

1. A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
2. All answers must take account of the whole action involved, including offsite as well as onsite, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
3. Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.
4. Negative Declaration: "Less than Significant with Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less-than-Significant Impact." The lead agency must describe the mitigation measure and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analyses," may be cross-referenced).
5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration, Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
   a. Earlier Analysis Used. Identify and state where they are available for review.
   b. Impacts Adequately Addressed. Identify which effects from the above checklist where within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
   c. Mitigation Measures. For effects that are "Less than Significant with Mitigation Incorporated," describe the mitigation measures that were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.
6. Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
7. Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.
8. This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.
9. The explanation of each issue should identify:
   a. the significance criteria or threshold, if any, used to evaluate each question; and
   b. the mitigation measure identified, if any, to reduce the impact to a less-than–significant level.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
I. AESTHETICS. Would the project:				
a. Have a substantial adverse effect on a scenic vista?	☐	☐	☒	☐
b. Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☒	☐	☐	☐
c. Substantially degrade the existing visual character or quality of the site and its surroundings?	☒	☐	☐	☐
d. Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	☒	☐	☐	☐

Discussion:

a. Placement of PV solar panels in the site area would alter the views of the project area. Persons traveling in passenger vehicles on nearby roads would observe alterations. No residents are located within a 2.0- to 2.25-mile radius from the project and none would have direct views of the project panels. The project site is not located within an area designated for or identified as having a scenic vista or scenic views. Impacts would be less than significant and no further analysis is warranted.

b. The segment of SR 14 that extends through Kern County is considered an Eligible Scenic Highway under California's Scenic Highways Program. However, it is not an officially designated scenic highway. The area surrounding the project site is mostly undeveloped land. The construction of photovoltaic solar panels would change the view shed from public roads. This project is located near the Jawbone Canyon OHV Area and Red Rock Canyon State Park. In a desert environment with little vegetation, this project may be seen from these areas. This impact will be further evaluated in the EIR.

c. There are no buildings or structures located on the project site. However, the project site is part of the overall desert scenery. The project would result in a complete change to the appearance of the project site. Most of the project site would be transformed from a large swath of undeveloped desert land to desert land interrupted by several hundred linear feet of solar panels on concrete foundations. In one instance, the panels would extend eastward for over a mile. The project site is located near existing rights-of-way, including SR 14 and the Union Pacific railroad tracks, and would be visible by passersby. This project is located near the Jawbone Canyon OHV Area and Red Rock Canyon State Park. In a desert environment with little vegetation, this project may be seen from these areas. This impact will be further evaluated in the EIR.

d. Nighttime lighting in the project site vicinity is provided by roadway lighting along SR 14; security lighting at the Barren Ridge Switching Station; occasional lighting along the Union Pacific Railroad tracks from trains or ancillary railroad facilities; and points of light in the distance from distant communities, scattered buildings, residences, roadways and communication towers; and the open expanse of sky. The lighting proposed for the project site is security lighting only. This type of lighting is regulated by the Kern County Zoning Ordinance. Further analysis of the specific lighting required and the effects of nighttime light on the area and impacts from glare from the project are warranted and will be further evaluated in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
II. AGRICULTURE AND FOREST RESOURCES. In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project, and the forest carbon measurement methodology provided in the Forest Protocols adopted by the California Air Resources Board. Would the project:				
a. Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to nonagricultural use?	☐	☐	☐	☒
b. Conflict with existing zoning for agricultural use or a Williamson Act Contract?	☐	☐	☐	☒
c. Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d. Result in the loss of forest land or conversion of forest land to non-forest use?	☐	☐	☐	☒
e. Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to nonagricultural use or forest land to non-forest use?	☐	☐	☒	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
f. Result in the cancellation of an open space contract made pursuant to the California Land Conservation Act of 1965 or Farmland Security Zone Contract for any parcel of 100 or more acres (Section 15205(b)(3) Public Resources Code)?	☐	☐	☐	☒

Discussion:

a. As shown in the California Department of Conservation, Division of Land Resource Protection's *Kern County Important Farmland 2008* map there is not any designated Unique Farmland, or Farmland of Statewide Importance within the proposed project area. The project site is comprised primarily of land classified as *Nonagricultural and Barren*, which not only applies to heavily wooded or riparian and wetland areas, but also applies to desert areas. The project site is barren with only natural desert type vegetation. The project site is not within the boundaries of an Agricultural Preserve. There would be no impact to agricultural lands and no further analysis is warranted.

b,f. The Kern County zone classifications for the project area are: A GH (Exclusive Agriculture, Geologic Hazard Combining) for Parcel 1; A, A GH, and A GH FPS for Parcel 2; A GH FPS for Parcel 3; and A, A FPS and A GH FPS for Parcel 4. The entire project site is therefore zoned A (Exclusive Agriculture), and agriculture is the primary use permitted by right. Solar energy electrical generators are a conditionally allowed use in an A Zone District. This project therefore does not conflict with the existing zoning and therefore no further analysis is warranted.

The project site is not within an agricultural preserve and is not under Williamson Act Contract and therefore no further analysis is warranted.

c,d. The project site is located in a desert environment and does not include any land zoned as forest or timberland. The project would have no impact on these resources and no further analysis is warranted.

e. The project site is entirely undeveloped and contains no forestland. There are no improvements on the project site, other than dirt roadways and there are no indications that the site has ever been developed, apart from the nearby development of SR 14 and the Union Pacific Railroad tracks. Although the project site is zoned for agricultural use, the use proposed by the project is conditionally permitted by the zoning. The use would not result in the permanent loss of potential crop land. The project would therefore have a less than significant impact on the potential use of the site for farmland, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
III. AIR QUALITY. Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a. Conflict with or obstruct implementation of the applicable air quality plan?	☒	☐	☐	☐
b. Violate any air quality standard as adopted in (c)i or (c)ii, or as established by EPA or air district or contribute substantially to an existing or projected air quality violation?	☒	☐	☐	☐
c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? Specifically, would implementation of the project exceed any of the following adopted thresholds:				
i. San Joaquin Valley Unified Air Pollution Control District:				
Operational and Area Sources				
Reactive organic gases (ROG) 10 tons per year.	☐	☐	☒	☐
Oxides of nitrogen (NO_X) 10 tons per year.	☐	☐	☒	☐
Particulate matter (PM_{10}) 15 tons per year.	☐	☐	☒	☐
Stationary Sources - as Determined by District Rules				
Severe nonattainment 25 tons per year.	☐	☐	☒	☐
Extreme nonattainment 10 tons per year.	☐	☐	☒	☐
ii. Kern County Air Pollution Control District.				

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
Operational and Area Sources				
Reactive organic gases (ROG) 25 tons per year.	☒	☐	☐	☐
Oxides of nitrogen (NO_X) 25 tons per year.	☒	☐	☐	☐
Particulate matter (PM_{10}) 15 tons per year.	☒	☐	☐	☐
Stationary Sources – as Determined by District Rules				
25 tons per year.	☒	☐	☐	☐
d. Expose sensitive receptors to substantial pollutant concentrations?	☒	☐	☐	☐
e. Create objectionable odors affecting a substantial number of people?	☐	☐	☒	☐

Discussion:

a. The project would be located entirely within the jurisdiction of the KCAPCD, in the Mojave Desert Air Basin (MDAB). The KCAPCD is designated nonattainment for both the state and federal ozone standards and the state particulate matter (PM_{10}) standard. Project construction would generate emissions of oxides of nitrogen (NO_X) and PM_{10} that could result in significant impacts to air quality in the area. Equipment usage and activities during construction of the proposed project would result in emissions of PM_{10} and ozone precursors, including NO_X and volatile organic compounds (VOCs), which could result in significant impacts to air quality in the area. The sources of emission would include heavy equipment used to excavate and grade the array pads and access areas, cranes, and on-road motor vehicles for equipment and material deliveries and workers commuting to and from the site. Grading and activity on unpaved roads and lay-down areas would contribute to PM_{10} emissions. This impact is potentially significant. Further analysis of air quality impacts is warranted to determine whether the project would conflict with or obstruct implementation of the applicable plans for attainment and, if so, to determine the reasonable and feasible mitigation measures that could be imposed. These issues will be evaluated in the EIR.

b. Short-term construction emissions could significantly contribute to an existing or projected air quality violation of PM_{10} or ozone standards, requiring the consideration of mitigation measures. This impact is potentially significant and will be evaluated further in the EIR.

c. The KCAPCD is a nonattainment area for the state and federal ozone standards and the state PM_{10} standard. The KCAPCD rules and regulations apply to all project activities. The air quality analysis will include a quantitative discussion of emissions created by this project regardless of the air basin. This will include activities such as truck trips to deliver panels or employees commuting to the site. Cumulative contributions to this basin could be potentially significant. Construction and operational emissions will be analyzed in the EIR.

d. No residential buildings are located within the boundaries of the project site. No residences have been identified within two miles of the project area. No schools or hospitals are located within a four-mile radius of the project site. Construction related activities would result in diesel exhaust emissions and dust that could adversely affect air quality for the nearest sensitive receptors. Mitigation measures for diesel equipment and dust control that are recommended by the KCAPCD will be evaluated as part of the EIR to avoid or reduce the impacts to construction workers and occupants of residences in the area.

e. Aside from odors associated with vehicle exhaust and fueling of equipment during construction, no odors would result from the proposed project. Because there are only a few potential residences in the vicinity, fueling odors during project construction would not result in impacts on a substantial number of people. Any vehicle exhaust odors that may already be produced in the area are from the vehicles traveling SR 14. Therefore, the proposed project is not expected to result in significant air quality impacts related to objectionable odors, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
IV. BIOLOGICAL RESOURCES. Would the project:				
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by the California Department of Fish and Game (CDFG) or U.S. Fish and Wildlife Service (USFWS)?	☒	☐	☐	☐
b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFG or USFWS?	☒	☐	☐	☐
c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐
d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☒	☐	☐	☐
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f. Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Discussion:

a,b. The project site is located within the Mojave Desert, an area that contains many endangered species such as the desert tortoise and the Mohave ground squirrel. Field surveys for special-status plant and animal species, and species listed as either threatened or endangered by either the state or federal government will be included in the EIR. Impacts to biological resources are potentially significant and will be analyzed in the EIR.

The project's impact to sensitive plant communities will be further evaluated in the EIR. In addition, project-related access roads and transmission lines may cross streams and washes that require evaluation for riparian habitat and may also require streambed alteration permits from California Department of Fish and Game.

c. Even though the project is in a desert region, wetlands, as defined by Section 404 of the Clean Water Act, may be present on the project site; therefore, the project's impacts on potential wetlands will be evaluated in the EIR.

d. The project site and surrounding area may be used for migration or dispersal by some avian species. Project construction and operations could potentially remove foraging habitat. This impact is potentially significant and will be evaluated in the EIR.

e. There is no local policy or ordinance protecting biological resources, and the site is not located within a habitat conservation plan boundary. No further analysis is warranted.

f. As stated above, the project site is undeveloped sandy desert land covered by native vegetation and dirt roads. There is no local policy or ordinance protecting biological resources, and the site is not located within a habitat conservation plan boundary. No further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
V. CULTURAL RESOURCES. Would the project:				
a. Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?	☒	☐	☐	☐
b. Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	☒	☐	☐	☐
c. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☒	☐	☐	☐
d. Disturb any human remains, including those interred outside of formal cemeteries?	☒	☐	☐	☐

Discussion:

a, b. The project site is undeveloped sandy desert land located in the Mojave Desert/Fremont Valley area. This area is rich in mining history. Native Americans lived and traveled in this area. Impacts to these resources may be potentially significant. A cultural and historic resources survey is being completed for the site to confirm the absence of resources on-site. This impact will be analyzed further in the EIR.

b, c. Neither an archaeological nor a paleontological records search has been completed within the project area. However, one will be completed for the project site to confirm the presence or absence of paleontological and archaeological resources. The area at the project site and in the surrounding area is mostly undeveloped land and does not contain any unique geological features. Potential impacts to paleontological resources will be evaluated in the EIR.

d. Development of the project will require some ground disturbance. Given the potential sensitivity of the project area, it is reasonably foreseeable that human remains main be uncovered in this area; this impact may be potentially significant. Further analysis will be conducted for the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
VI. GEOLOGY AND SOILS. Would the project:				
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☒	☐	☐	☐
ii. Strong seismic ground shaking?	☒	☐	☐	☐
iii. Seismic-related ground failure, including liquefaction?	☒	☐	☐	☐
iv. Landslides?	☐	☐	☒	☐
b. Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse?	☒	☐	☐	☐
d. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☒	☐	☐	☐
e. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

Discussion:

a.i., aii. The project area is located within a fault zone known as the Garlock fault, which runs through the project site. The project site could also be affected by the Sierra Nevada fault, located west of the project site. Surface rupture has occurred along this fault, since the Holocene. The last known event was in 1992. Construction of the proposed project would be subject to all applicable ordinances of the Kern County Building Code (Chapter 17.08). Kern County has adopted the

California Building Standards Code, 2007 Edition (CCR Title 24), which imposes substantially the same requirements as the International Building Code (IBC), 2006 Edition, with some modifications and amendments. The entire County is located in Seismic Zone 4, a designation previously used in the Uniform Building Code (UBC) (the predecessor to the IBC) to denote the areas of the highest risk to earthquake ground motion. Adherence to all applicable regulations would mitigate any potential impacts associated with the proposed project. The project would not include residences or staffing. Therefore, the proposed project would not have the ability to expose people to adverse impacts resulting from surface rupture of a known earthquake fault. Nonetheless, should strong seismic ground shaking occur at the project site, damage to the PV modules and other ancillary facilities could result from surface rupture. This issue will be further evaluated in the EIR.

Should strong seismic ground shaking occur at the project site, damage to the PV modules and other ancillary facilities would likely result. However, because the proposed project would not establish a permanent on-site population, damage to these on-site structures would not expose substantial numbers of people to potential adverse effects. Adherence to all applicable regulations would mitigate any potential impacts associated with seismic groundshaking at the project site. Adherence to all applicable regulations would help to mitigate any potential impacts associated with seismic groundshaking at the project site. The project would potentially be subject to moderate to strong ground shaking from local and regional earthquakes, particularly if the event occurs on the Garlock fault. This potential impact will be further evaluated in the EIR.

a.iii The potential for substantial adverse effects due to seismic-related ground failure, including liquefaction, will be examined in the preliminary geotechnical report being prepared for the project site and related potential impacts will be analyzed in the EIR.

a.iv Although the project site is not considered to be at high risk area for landslides, the potential for substantial adverse effects due to landslides will nevertheless be analyzed in the EIR.

b. Grading and excavation would be required for foundations for each photovoltaic panel. Construction activities could result in substantial soil erosion if the sites are not properly designed. The potential impacts of soil erosion will be minimized through implementation of Kern County Grading Code (Chapter 17.28) requirements. Specifically, the applicant would prepare a Stormwater Pollution Prevention Plan (SWPPP) in compliance with the requirements of the National Pollutant Discharge Elimination System (NPDES) General Construction Permit. The Regional Water Quality Control Board would administer the SWPPP. The SWPPP would prescribe temporary Best Management Practices (BMPs) to control wind and water erosion during and shortly after construction of the project. Permanent BMPs to control erosion and sedimentation would also be implemented once construction is complete (please refer to Question IX(c) for more information). The impact of soil erosion is therefore less than significant and no further analysis is warranted.

c. According to the U.S. Department of Agriculture's Natural Resources Conservation Service, soils at the project site consist mainly of Arizo gravelly loamy sand and Cajon loamy sand, with a small percentage of the site consisting of Whitewolf loamy sand. A preliminary soils characterization will be included as part of the project analysis to examine the current baseline stability of the soils that underlie the project area and the findings of that report will be evaluated in the EIR. Potential impacts will be evaluated in the EIR.

d. Expansive soils generally result from specific clay minerals that expand when saturated and shrink in volume when dry. The preliminary soils characterization will confirm the presence or absence of expansive soils within the project area, and those results will be evaluated in the EIR.

e. The proposed project would not involve treatment of either domestic or industrial wastewater, and therefore would not require a sewer system.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
VII. GREENHOUSE GAS EMISSIONS. Would the project:				
a. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☒	☐	☐	☐
b. Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

Discussion:

a. Greenhouse gas (GHG) emissions from human activity are implicated in global climate change or global warming. The principal GHGs are carbon dioxide (CO_2), methane (CH_4), NO_X, ozone, water vapor, and fluorinated gases. Fossil fuel consumption in the transportation sector (on-road motor vehicles, off-highway mobile sources, and aircraft) is the single largest source of GHG emissions, accounting for approximately one-half of GHG emissions globally. Construction activities associated with heavy equipment operation, truck deliveries, and construction worker commute trips would temporarily generate GHGs; however, operation of the project is intended to offset GHGs generated by traditional sources of electricity. Potential impacts will be further evaluated in the EIR.

b. California has passed several bills and the governor has signed at least three executive orders regarding GHGs. Assembly Bill (AB) 32 (the Global Warming Solutions Act) was passed by the California legislature on August 31, 2006. It requires the state's global warming emissions to be reduced to 1990 levels by 2020. The reduction will be accomplished through an enforceable statewide cap on GHG emissions that will be phased in starting in 2012.

In 2002, California established its RPS Program, with the goal of increasing the percentage of renewable energy in the state's electricity mix to 20 percent renewable energy by 2010. In 2006, under Senate Bill (SB) 107, the RPS program codified the 20 percent goal. The RPS program requires electric utilities and providers to increase procurement from eligible renewable energy resources by at least one percent of their retail sales annually until they reach 20 percent by 2010. On November 17, 2008, the governor signed Executive Order S-14-08, requiring California utilities to reach the 33 percent renewable goal by 2020. The proposed project is intended to: (1) reduce importation of power from fossil fuel power plants; and (2) contribute to a reduction in GHGs. Therefore, impacts are considered less than significant and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
VIII. HAZARDS AND HAZARDOUS MATERIALS.				
Would the project:				
a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐
c. Emit hazardous emissions or involve handling hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school?	☐	☐	☒	☐
d. Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e. Be located within an airport land use plan or, where such a plan has not been adopted, be within 2 miles of a public airport or public use airport, and result in a safety hazard for people residing or working in the project area?	☐	☐	☒	☐
f. Be located within the vicinity of a private airstrip and result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g. Impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
h. Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☒	☐
i. Generate vectors (flies, mosquitoes, rodents, etc.) or have a component that includes agricultural waste?				

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
Specifically, would the project exceed the following qualitative threshold: The presence of domestic flies, mosquitoes, cockroaches, rodents, and/or any other vectors associated with the project is significant when the applicable enforcement agency determines that any of the vectors:				
i. Occur as immature stages and adults in numbers considerably in excess of those found in the surrounding environment; and	☐	☐	☒	☐
ii. Are associated with design, layout, and management of project operations; and	☐	☐	☒	☐
iii. Disseminate widely from the property; and	☐	☐	☒	☐
iv. Cause detrimental effects on the public health or well being of the majority of the surrounding population.	☐	☐	☒	☐

Discussion:

a. The proposed project is not expected to result in impacts from hazards and hazardous materials with respect to creating a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials. This is because the proposed project would not involve the routine transport, use, or disposal of hazardous materials as defined by the Hazardous Materials Transportation Uniform Safety Act. During construction, the proposed project would involve the transport of general construction materials (i.e., concrete, wood, metal, fuel, etc.) as well as the materials necessary to construct the proposed PV arrays. Project-related infrastructure would not emit hazardous materials, or be constructed of acutely hazardous materials or substances, that could adversely impact the public or on-site workers. Wastes to be generated during construction of the proposed project would also be non-hazardous, and would consist of cardboard, wood pallets, copper wire, scrap steel, common trash and wood wire spools. Although field equipment used during construction activities could contain various hazardous materials (i.e., hydraulic oil, diesel fuel, grease, lubricants, solvents, adhesives, paints, etc.), these materials are not considered to be acutely hazardous and would be used in accordance with the manufacturers specifications and all applicable regulations. Impacts resulting from the transport, use or disposal of hazardous materials during construction of the proposed project would be less than significant and no further analysis is warranted.

Once operational, the proposed project would not require the routine transport of hazardous material to or from the project site. On occasion, maintenance activities may produce small amounts of waste associated with maintenance activities, including broken and rusted metal, defective or malfunctioning modules, electrical materials, empty containers and other miscellaneous solid wastes, including the typical refuse generated by workers. Most of these materials would be collected and returned to the manufacturers or given to recyclers. Any

occasionally defective or broken solar modules would be returned to the manufacturer for proper recycling, as required by the manufacturer. Operational activities could generate biodegradable dielectric fluid and mineral oil from the transformers and miscellaneous electrical equipment. Spent oil would be collected and delivered to a recycling company at the time it is removed from the equipment, and would not be stored on-site. Each transformer would be provided with full secondary containment. However, the mineral oil would not normally require replacement.

As needed, Material Safety Data Sheets for all applicable materials present on-site would be made readily available to on-site personnel during construction and once the project is operational, as required by the Kern County Environmental Health Services Department.

The solar modules themselves contain cadmium telluride, which acts as a semiconductor in solar panels. It has been used successfully in solar panels because it resists corrosion and chemicals, and has a high tolerance for high temperatures. It also has a low melting point and is an excellent conduit of electricity. Cadmium is a by-product of zinc, lead, and copper mining. Tellurium is a semi-metallic element, which when combined with cadmium produces the compound cadmium telluride or CdTe. A broken panel could result in exposure to CdTe; and improper handling of CdTe can result in respiratory-related health risks. According to the applicant, all workers would be trained to handle any hazardous wastes at the site. As described above, all broken panels would be recycled through a qualified recycling company.

There are no designated routes for the transport of hazardous materials located on or immediately adjacent to the proposed project; the closest route is SR 14, which is adjacent to Parcels 1, 2 and 3. (An easement from Parcel 3 across property outside of the project area would create access to Parcel 4.) Because the proposed project would be required to conform to all county, state and federal standards for the handling and transportation of hazardous materials, and exposure substantial amounts of hazardous materials would come in only rare instances in the form of a severely broken panel, therefore the project would not constitute a substantial hazard to the public. No further analysis is warranted.

b. Potential impacts that may result from construction and operation of the proposed project may include the accidental release of storage materials such as biodegradable dielectric fluid, mineral oil, hydraulic oil, diesel fuel, grease, lubricants, solvents, adhesives and paints. However, as discussed above, these materials would be used in limited quantities and, in most cases, are not considered to be acutely hazardous. The used biodegradable dielectric fluid and mineral oil from the transformers would be collected and delivered to a recycling company at the time it is removed from the equipment thus eliminating any potential hazards. The proposed project would be subject to all local, state and federal laws pertaining to the use of hazardous materials on-site, and would be subject to review by the Kern County Environmental Health Services Department. Through the review process, the proposed project would be required to submit a complete list of all materials used on-site, how the materials will be transported, and in what form they will be used, would be recorded to maintain safety and prevent possible environmental contamination or worker exposure. All on-site workers would be trained to properly identify and handle hazardous waste resulting from the proposed project. Therefore, with adherence to all applicable local, state and federal laws pertaining to the use and storage of hazardous materials, potential impacts would be less than significant and no further analysis is warranted.

c. The proposed project site is located in a predominantly rural and undeveloped area of Kern County, and there are four public schools, including Red Rock Elementary School (Cantil), Hacienda Elementary School (California City), California City Middle School (California City), and Robert P. Ulrich Elementary School (California City), all of which are located within ten miles of the site. (All of the schools are at least seven linear miles from the site.) Additionally, the proposed project is a solar energy generation facility that involves using photovoltaic panels to

generate electricity. Project-related infrastructure would not emit hazardous materials or involve handling hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school. Therefore, impacts would be less than significant and no further analysis is warranted.

d. Staff has reviewed the lists of projects relating to hazardous wastes pursuant to Section 65962.5 of the California Government Code and concluded the project site is not on the list. Therefore, there would be no impact and no further analysis is warranted.

e. The project area is not located within two miles of a public or public use airport or within an area covered by the Kern County Airport Land Use Compatibility Plan (ALUCP). Therefore, there are no anticipated safety hazards for people residing or working in the project area with respect to the project's proximity to a public or public use airport. The military aviation section of the ALUCP will be reviewed for the project's compliance with its policies. The project is designed to in conformance with Figure 19.08.160 (Military Review Requirements) of the Kern County Zoning Ordinance to avoid military flight test airspace for Edwards Air Force Base and China Lake Naval Weapons Center. Furthermore, the project site is located in the area where all structures over 100 feet in height are restricted. The solar panels would not exceed a height of 100 feet and therefore these structures would not interfere with the military flyover airspace. Impacts would be less than significant and no further analysis is warranted.

f. There are no private airports or airstrips located within two miles of the project site. The nearest landing field is the California City Municipal Airport, which is located approximately five miles southeast of the project site. None of the approach zones or noise contours related to this airport are in close proximity of the project site. Because the proposed project would not result in potential impacts related to safety hazards for people residing or working in the project area with respect to the project's proximity to a private airport or private airstrip, there would be no impact and no further analysis is warranted.

g. The proposed project development would not physically impede the existing emergency response plans, emergency vehicle access, or personnel access to the site. The site is located in a rural area with several alternative access roads allowing access to the site in the event of an emergency. As a part of the project, the applicant would pave existing dirt roadways to provide access to the site during project construction and operations. Also as part of the project, the applicant would provide access to and from SR 14 to parcels on both the east side and west side of the highway. This would involve obtaining approval from the CPUC for a vehicle crossing over the Union Pacific railroad tracks, and approval from Caltrans for on- and off-ramps to and from SR 14. Therefore, no impacts related to impairment of the implementation of or physical interference with an adopted emergency response plan or emergency evacuation plan are anticipated. Impacts would be less than significant and no further analysis is warranted.

h. The project site is desert, undeveloped and occupied by native vegetation. The site is located within a Local Responsibility Area (LRA) and designated as having moderate wildland fire potential. The proposed project would be required to comply with all existing regulations and requirements of the Kern County General Plan Safety Element and the Kern County Fire Code (Chapter 17.32), and would be reviewed for adherence to prevention measures for wildland fires. Furthermore, the project applicant would develop a fire management plan. The proposed project is not expected to result in significant impacts to the exposure of people or structures to a significant risk of loss, injury, or death involving wildland fires. Impacts would be less than significant and no further analysis is warranted.

i. The proposed project is a solar energy generation facility that would result in construction of photovoltaic arrays and other ancillary facilities. Project-related infrastructure is not expected to

result in features or conditions (such as standing water, agricultural products, agricultural waste, or human waste) that would provide habitat for vectors such as mosquitoes, flies, cockroaches or rodents. Construction workers would generate small quantities of solid waste (i.e., trash) that would be appropriately stored for permanent disposal. Therefore, impacts would be less than significant and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
IX. HYDROLOGY AND WATER QUALITY. Would the project:				
a. Violate any water quality standards or waste discharge requirements?	☐	☐	☒	☐
b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☒	☐
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on site or off site?	☒	☐	☐	☐
d. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on site or off site?	☒	☐	☐	☐
e. Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☒	☐
f. Otherwise substantially degrade water quality?	☐	☐	☒	☐
g. Place housing within a 100-year flood hazard area as mapped on a federal flood hazard boundary or flood insurance rate map or other flood hazard delineation map?	☐	☐	☐	☒
h. Place within a 100-year flood hazard area structures that would impede or redirect flood flows?	☒	☐	☐	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
i. Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☒	☐
j. Contribute to inundation by seiche, tsunami, or mudflow?	☐	☐	☒	☐

Discussion:

a. This project is located within the Regional Water Quality Control Board, Lahontan District. A Waste Discharge Permit will not be needed for this project from. The applicant will however prepare a SWPPP in compliance with the requirements of the NPDES General Construction Permit. The Lahontan District would administer the SWPPP. The SWPPP would prescribe temporary BMPs to control wind and water erosion during and shortly after construction of the project and permanent BMPs to control erosion and sedimentation once construction is complete. No further analysis is warranted.

b. During construction, water use would be limited to domestic water use (drinking water), ground conditioning and dust suppression. All sources of these waters will be delivered to the site. Water may also be used to ensure that no large accumulations of soil accumulate on rights-of-way. All water used during construction and operation would be brought to the site by truck and stored at the site in portable tanks or will come as bottled water for drinking purposes. Water use during operations is estimated to be a total of approximately 1.5 acre feet per year (or approximately 1,339 gallons per day). This water would be used primarily to periodically wash the PV modules. This water would not be supplied from local groundwater and therefore would not have the ability to substantially deplete groundwater supplies or interfere substantially with groundwater recharge. Impacts would be less than significant and no further analysis is warranted.

c. According to the U.S. Department of Agriculture's Natural Resources Conservation Service, soils at the project site consist mainly of Arizo gravelly loamy sand and Cajon loamy sand, with a small percentage of the site consisting of Whitewolf loamy sand. The project site's topography generally slopes from west to east, at a slope of approximately three percent, and is between 2,218 feet and 2,432 feet above mean sea level. The panels would require the construction of concrete pads for each array and fencing around the entire site. Evaluation of impacts to drainage patterns of the site, as well as the potential for increased erosion and/or siltation will be evaluated in the EIR.

d. Portions of Parcels 1, 2, 3 and 4 are located within a 100-year flood plain. The applicant has designed the project to avoid those areas, and as a result, only approximately 40 percent of the project site would be developed. However, generally flooding in the desert comes and goes quickly and is considered flashy in nature (hence the term flash flooding). High intensity rain occurs in a short period of time (a short duration storm event), typically a thunderstorm type of event, which results in rapid runoff. What then happens is the rainfall intensity exceeds the infiltration capacity of the soil and you have the potential for increased runoff. Development of the project site could decrease the pervious surface area of the project site, and could result in an increase in sheet flow across the site. As a part of the project, the applicant would prepare a SWPPP that would incorporate BMPs to limit erosion during construction and operation of the

project. However, the proposed project would alter drainage patterns at the site by developing a previously undeveloped site. Even though the applicant would avoid the areas of the site that are within the 100-year flood plain, added runoff from the panels could increase flooding. As a result, the impacts of flooding will be further evaluated in the EIR.

e. During construction and following installation of the solar arrays, the vast majority of the site will remain as open space. According to the U.S. Department of Agriculture's Natural Resources Conservation Service, on-site soils consist of Arizo gravelly loamy sand and Cajon loamy sand, with a small percentage of the site consisting of Whitewolf loamy sand. The design of the solar arrays is such that stormwater will receive full access to the pervious ground surface and infiltration would occur similar to existing conditions. No component of the project would concentrate runoff and exceed the capacity of existing or planned stormwater drainage systems. Similarly, no component of the project is considered a substantial source of polluted runoff. The construction period SWPPP and the operational period Water Quality Management Plan (WQMP) would ensure the proper control and treatment, if necessary, of any stormwater prior to discharge. With adherence to site-specific BMPs, potential pollutants will be minimized to the extent practicable and will not exceed numeric thresholds for water quality protection. Impacts would be less than significant and no additional analysis is warranted.

f. Project construction activities (such as grading) could potentially degrade water quality through erosion and subsequent sedimentation of streams. Additionally, accidental release of potentially harmful materials, such as engine oil, diesel fuel, and cement slurry could degrade the water quality of nearby streams. However, as discussed above, the proposed project would be required to develop a SWPPP and implement BMPs that would reduce the impact of project activities on surrounding water quality. With required adherence to all BMPs as identified in the project specific SWPPP, the proposed project would not have the ability to otherwise degrade water quality at the site or within the surrounding area. Impacts would be less than significant and no further analysis is warranted.

g. The proposed project does not include housing. Therefore no impact would occur and no further analysis is warranted.

h. The most recent Federal Emergency Management Act (FEMA) Flood Insurance Rate Maps (FIRMS) identify portions of Parcels 1, 2, 3 and 4 as being located within a 100-year flood plain or an area with a one-percent chance of flooding each year. The applicant has designed the project to avoid those areas. The proposed project would be reviewed by the Kern County Engineering and Survey Services Department, Floodplain Management Division for adherence to the floodplain management ordinance, and determination of whether the purchase of mandatory flood insurance would be required. This project could be affected by potential flooding and will be further evaluated in the EIR.

i. The project is not located within an area that is subject to flooding due to failure of a levee or dam. Please refer to response to Question IX(h) above regarding impacts from other flood hazards at the site. No further analysis is warranted.

j. The project is not located near an ocean or enclosed body of water, and would not be subject to inundation by seiche or tsunami. Mudflows are a type of mass wasting or landslide, where earth and surface materials are rapidly transported downhill under the force of gravity. Mudflow events are caused by a combination of factors, including soil type, precipitation, and slope. Mudflow may be triggered by heavy rainfall that the soil is not able to sufficiently drain or absorb. However, the project site is relatively flat, and is not located within an area of substantial slopes or slope instability. The potential for project structures to be inundated by mudflow would be less than significant and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
X. LAND USE AND PLANNING. Would the project:				
a. Physically divide an established community?	☐	☐	☒	☐
b. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐
c. Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

Discussion:

a. The project would be developed on vacant land and the surrounding area is predominantly undeveloped desert land. The nearest residences in the Fremont Valley area are located between 2.0 and 2.25 miles southeast of the project site. The next closest development of homes is located nearly five miles from the project site. The proposed project would not be located between these housing developments or communities and would not, therefore, physically divide an established community. No further analysis is warranted.

b. The project site parcels are have the base zone of A (Exclusive Agriculture). All of the parcels have additional zoning designations related to being in a flood plain or being affected by a geologic hazard. All of the adjacent parcels are also zoned A (Exclusive Agriculture). Land uses further to the north are zoned PL (Platted Lands). This zoning classification is for land that has been legally subdivided, but has been rendered nonconforming with regard to minimum lot size requirements of the various land use designations (map codes 8.1, 8.2, 8.3, 8.4 and 8.5) of the Kern County General Plan. Parcels located further east, west and south are also zoned A (Exclusive Agriculture). Further west begins an E (Estate) zoning district. However, because this area is limited in infrastructure (water, power, legal access), development opportunities would be limited. The proposed project would be consistent with the A (Exclusive Agriculture) zoning classification, which allows solar panels as a conditional use. Because the proposed project would be consistent with the zoning for the project site, as well as for zoning in the surrounding area, and because the proposed project is a conditionally permitted use and the applicant has requested a CUP, the project may be consistent with existing land use plans, policies and regulations. Although it is anticipated that the impacts will be less than significant, the impact will be analyzed further in the EIR.

c. The proposed project is not within the boundaries of any adopted habitat conservation plan or natural community conservation plan, therefore no impact would occur and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less–than-Significant Impact	No Impact
XI. MINERAL RESOURCES. Would the project:				
a. Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b. Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Discussion:

a. The project site is not located on land that contains mineral resources that would be of value to the region or the residents of the state, nor is it located in one of Kern County's many mining districts as identified by the California Division of Mines and Geology. The closest mine site is a surface mine, located over nine miles northeast of the project site. The project site is unimproved desert land and does not support any mining or related extraction operations. Nearby mining districts are primarily located in the mountains to the west and south. Although nearby Koehn Lake had a long history of supporting sodium borate for salt extraction, the salt mills were shut down in the 1970s. Kern County contains numerous other mining operations whose extractions include, but are not limited to, sand and gravel, stone, gold, dimensional stone, limestone, clay, shale, gypsum, pumice, decorative rock, silica, and specialty sand. Due to the fact that the project is not located near known mineral resources, it would have no impact on future mineral development; and no further analysis is warranted.

b. This site is not located in an area identified for an important mineral resource. No federal mining claims are located on this site. No nearby areas are designated on the General Plan for mineral resources (8.4 Petroleum and Mineral Resource). Developed of this site would not interfere with the recovery of any important minerals in this area. No further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XII. NOISE. Would the project:				
a. Expose persons to, or generate, noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies?	☐	☐	☒	☐
b. Expose persons to or generate excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c. Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
d. Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
e. Be located within the Kern County Airport Land Use Compatibility Plan, and expose people residing or working in the project area to excessive noise levels?	☐	☐	☒	☐
f. Be located in the vicinity of a private airstrip and expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Discussion:

a. Land uses determined to be "sensitive" to noise as defined by the Kern County General Plan include residential areas, schools, convalescent and acute care hospitals, parks and recreational areas, and churches. There are approximately 45 identified residential buildings located between approximately 2.0 and 2.25 miles southeast of the project site in the Fremont Valley area. These are the closest sensitive receptors, as defined by the Kern County General Plan Noise Element. The next development of homes is located over five miles from the project site.

The noise generated by the proposed use would be generated during construction, by the use of vehicles and equipment on the site. According to the Kern County General Plan Noise Element, noise levels should be 65 dB Ldn or less in outdoor activity areas, and 45 dB Ldn or less in interior living spaces or other noise sensitive interior spaces. In addition, the Kern County Zoning Ordinance states that it is unlawful for any person to create noise from construction between the hours of 9:00 PM and 6:00 AM on weekdays and 9:00 PM and 8:00 AM on weekends, which is audible to a person at a distance of 150 feet from the construction site. As previously mentioned, there are no sensitive land uses located within 150 feet of the project site. Other sensitive

receptors in the project area would be exposed to construction noise at incrementally lower levels. Because the noise source would be unobstructed by topography, the residences may hear faint repetitive noise when outdoors. Construction noise would have a less than significant impact on the nearest sensitive receptors. Therefore, the impact is considered to be less than significant and no further analysis is warranted.

b. Groundborne vibration and groundborne noise could originate from earth movement during the construction phase of the proposed project as well as from the operation and maintenance of the facilities. The project would be expected to comply with all applicable requirements for long-term operation, as well as with measures to reduce excessive groundborne vibration and noise to ensure that the project would not expose persons or structures to excessive groundborne vibration. Because the project site is at least two miles north of the nearest sensitive receptors and would not impact these sensitive receptors, no further analysis of ground-borne vibration and groundborne noise is warranted.

c. Because the proposed project would make use of fixed tilted arrays, the project site would generate little or no noise, with the exception of periodic maintenance or replacement of solar panels. The project would not introduce permanent sustained noise sources from moving (tracker) type panels and general maintenance. Construction activity would also increase ambient noise levels above existing levels for up to 7.5 months. However, since there are no sensitive receptors adjacent to the site (see discussion under response to Question XII(a), above), no further analysis of ambient noise levels and the project's potential impact on those levels is warranted.

d. Heavy equipment use during construction would cause a temporary or periodic increase in ambient noise levels. Temporary or periodic increases in ambient noise levels caused by construction activities could be reduced with the incorporation of mitigation measures. The Kern County Zoning Ordinance states that it is unlawful for any person to create noise from construction between the hours of 9:00 PM and 6:00 AM on weekdays and 9:00 PM and 8:00 AM on weekends, which is audible to a person at a distance of 150 feet from the construction site. As previously mentioned, there are no sensitive land uses located within 150 feet of the project site. As a result, impacts would be less than significant and no further analysis of project-related construction noise levels is warranted.

e. The proposed project is not located within the Kern County ALUCP. The nearest public airstrip is the California City Municipal Airport. Portions of the proposed project area may be located in or near the existing military flight corridors, which are a low-level, high-speed corridor where sonic booms and related damage are known to have occurred. Noise levels from military over flights often exceed County standards. The nearest public airport/public use airport is located approximately five miles southeast of the project site, the proposed project is not expected to exposure workers to significant impacts related to noise, and no further analysis related to public airports is warranted. The nearest military air field is Edwards Air Force Base, located approximately 16 miles south of the project site as well as China Lake Naval Weapons Center to the north about 25 miles. This site is under the military flight zone so periodic sonic booms currently occur and are considered the baseline for this area. As a result, potential noise impacts associated with airports would be considered less than significant and no further analysis is warranted.

f. There are no private airports or airstrips located within two miles of the project site. The nearest landing field is the California City Municipal Airport, which is located approximately five miles southeast of the project site. None of the approach zones or noise contours related to this airport are in close proximity of the project site. Because the proposed project would not result in potential impacts related to safety hazards for people residing or working in the project area with respect to the project's proximity to a private airport or private airstrip, there would be no impact,

and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less- than Significant Impact	No Impact
XIII. POPULATION AND HOUSING. Would the project:				
a. Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☒	☐
b. Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c. Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Discussion:

a. Although the proposed project would provide new employment consistent with adopted Kern County General Plan goals, plans, and policies, long-term employment opportunities would be minimal. The proposed project would require an average of 60 to 75 temporary construction workers, which would be a minimal increase in employment over the 7.5-month construction period given the project area's existing population. Construction workers are expected to travel to the site from various locations throughout Southern California, and the number of workers expected to relocate to the surrounding area is not expected to be substantial. If temporary housing should be necessary, it is expected that accommodations would be available in the nearby communities of Mojave and National City, as well as unincorporated communities throughout the project site vicinity. Therefore, the proposed project would not directly or indirectly induce the development of any new housing or businesses. Operation of the proposed project would also require approximately no permanent full-time and new part-time staff (project specific depending on size of project).

Typical established local thresholds of significance for housing and population growth pursuant to the *CEQA Guidelines*, Section 15064.7 include effects that would induce substantial growth or concentration of a population beyond County projections, alter the location, distribution, density, or growth rate of the population beyond that projected in the Housing Element, result in a substantial increase in demand for additional housing, or create a development that significantly reduces the ability of the County to meet housing objectives set forth in the General Plan Housing element. The effects of the proposed project in relation to these local thresholds are minimal.

Although the project would produce additional electricity, it is intended to meet the demand for energy that is already projected based on growth in communities around California. As such, the generation of electricity by the proposed project would be considered growth accommodating, rather than growth inducing. The project's "green" electricity would replace electricity generated

by fossil fuels as mandated by the State to the utility companies to produce a portion of their electricity with renewable energy, thereby contributing to California's renewable energy goals. The production of additional electricity by the proposed project would not contribute to induced growth. Impacts would be less than significant and further analysis is warranted.

b,c. The project is proposed to be sited on lands that are currently vacant. No residences will be condemned nor will people be displaced by this project. No impacts are expected by this project.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XIV. PUBLIC SERVICES. Would the project:				
a. Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or to other performance objectives for any of the public services:				
Fire protection?	☒	☐	☐	☐
Police protection?	☒	☐	☐	☐
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

Discussion:

a. **Fire Protection:** The Kern County Fire Department provides fire suppression and emergency medical services to the project area. The fire station located nearest to the project site is the California City Fire Station, located at 29789 Hacienda Boulevard in California City, approximately 13 miles from the southern perimeter of the project site. The primary fire station that would serve the project area is the Kern County Fire Department's Mojave Station, located at 1953 State Highway 58 in Mojave. The Mojave Station Response Area is approximately 431 square miles. The next closest County station would be Tehachapi Station, located at 800 South Curry Street, in Tehachapi, approximately 29 miles from the southern perimeter of the project site. The majority of the proposed project site has been identified by CAL FIRE (the California Department of Forestry and Fire Protection) as being within a LRA with a Moderate Fire Hazard Severity. Although as discussed in response to Question VIII(h) above, adherence to all applicable regulations would reduce wildfire ignitions and prevent the spread of wildfires, construction and operation activities may result in increased need for fire-fighting personnel and facilities in the area. The potential impact on fire services from construction in a LRA and operation of the solar panels is therefore potentially significant and will be evaluated in the EIR.

Police Protection: Police protection services in the proposed project area are provided by the Kern County Sheriff's Department. The Department's substation located closest to the project site is its Mojave Substation, located at 1771 Highway 58 in Mojave, approximately 15 miles south of the project site's southern perimeter. Although the potential is low, the project may attract vandals or other security risks, and construction activities could result in increases in traffic

volumes along SR 14 that could increase demand on law enforcement services. While on-site security would be provided and access would be limited to the areas surrounding the project site during construction and operation thereby minimizing the need for police surveillance and response the project's impacts on sheriff services is potentially significant and will be evaluated in the EIR.

Schools: During project construction, a relatively small number of construction workers would be required. It is expected that most of these workers would commute to the project site from surrounding communities. Therefore substantial temporary increases in population that would adversely affect local school populations are not expected. There would be no impact and no further analysis is warranted.

Parks/Libraries/Other Public Facilities: The project would result in increased demand for countywide public protection. The County will be evaluating the project to determine the appropriate fees required to pay for impacts to countywide public protection, sheriff patrol and investigation, emergency and fire services, and impacts to these issue areas will be evaluated in the EIR. However, the operation workforce would require no full-time staff and minimal part-time staff (for security, maintenance, etc.), as the project could be operated and monitored remotely. Therefore, substantial permanent increases in population that would adversely affect local parks, libraries and other public facilities (such as post offices) are not expected. The proposed project is expected to result in no impact on public services such as post offices, libraries, parks, and therefore no further analysis of these issue areas is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less–than-Significant Impact	No Impact
XV. RECREATION. Would the project:				
a. Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☒	☐
b. Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☒	☐

Discussion:

a,b. The project does not include new recreational facilities. The temporary increase of population during construction that might be caused by an influx of workers would be minimal. As a result, there would not be a detectable increase in the use of parks. Impacts would be less than significant, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XVI. TRANSPORTATION AND TRAFFIC. Would the project:				
a. Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)?	☒	☐	☐	☐
b. Exceed, either individually or cumulatively, a level of service (LOS) standard established by the county congestion management agency or adopted county threshold for designated roads or highways? Specifically, would implementation of the project cause the LOS for roadways and/or intersections to decline below the following thresholds or further degrade already degraded segment(s):				
i. Metropolitan Bakersfield General Plan LOS "C"?	☐	☐	☐	☒
ii. Kern County General Plan LOS "D"? (Transportation Impact Fee Areas LOS "C")	☐	☐	☒	☐
c. Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☒	☐
d. Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☒	☐
e. Result in inadequate emergency access?	☐	☐	☒	☐
f. Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☒	☐

Discussion:

a. Construction activities associated with the proposed project are anticipated to take approximately 7.5 months, and could potentially affect traffic volumes on nearby roadways including, but not limited to, SR 14. In addition to vehicle trips generated by construction workers traveling to the site, construction of the project would add vehicle trips to the area roadway system through delivery of construction equipment and materials. Delivery of construction material would require a number of oversize vehicle trips that may travel at slower speed than existing traffic on SR 14, the main access to all the sites and, due to their size, may intrude into adjacent travel lanes. These oversized trips may decrease the existing level of service (LOS) and may potentially increase impacts at the intersection of the access road off SR 14 and on area County roadways and intersections. Additionally, the total number of vehicle trips associated with all construction-related traffic (including construction workers) could temporarily increase daily traffic volumes traveling on the state highways, local roadways and intersections. Furthermore, stringing activities required for transmission line infrastructure may require temporary lane closures that may result in temporary traffic delays on affected roadways. These potential impacts on the local roadway system from construction related vehicle trips will be evaluated in the EIR.

b. Once constructed, solar operations typically employ a relatively small number of staff, including solar panel technicians, operations and administrative personnel, and managers. Most to all of these employees would be off-site. The potential impact of the project operational traffic on the area roadway system will be evaluated in the EIR.

   i. The proposed project site is located approximately 60 miles east of Bakersfield. Construction and operation of the project would result in increased vehicle trips on roadways in the project area; however, construction workers are expected to travel to the site from various locations throughout central and southern California and a relatively small number of workers is expected. Therefore, the project would not be expected to result in a substantial number of trips on roadways in the metropolitan Bakersfield area. No further analysis of this impact is warranted.

   ii. As detailed in the response to Question XVI(a) above, construction of the project would generate construction trips and may require roadway lane closures, which could temporarily increase the daily traffic volumes on local roadways and intersections. The small number of part-time employees required for maintenance of the proposed project are expected to originate from the local area and would not result in a substantial number of trips on local roadways. The LOS of area roadways would not experience a decline in the long term.

c. The project site is located approximately five miles from the California City Municipal Airport. The proposed project is subject to Section 19.08.160 (Height of Structures) of the Kern County Zoning Ordinance and the Military Aviation section of the ALUCP. The ALUCP requires findings that the project will not significantly impact the military mission in protected airspace. It is not anticipated that the project will interfere with airspace due to the relatively short height of the arrays and their non-reflective surface, which have about half the reflectance of standard residential and commercial glass. The impact is less than significant and no further analysis is warranted.

d. The project proposes access off of an existing dirt road that is considered private, although it can be accessed by the public. This dirt road would be improved to provide access to all portions of the project site and would require approval by the CPUC for a vehicle crossing at the Union Pacific Railroad tracks. Turnout intersections already exist at the project site. The applicant would also need to obtain an easement to cross the private property located between Parcel 3 and

Parcel 4. The ultimate design of these improvements would be reviewed by the CPUC, Caltrans, and Kern County Roads Department, which would ensure that these improvements would not result in any potential hazards to vehicular traffic. Use of the improved roadway to the project site would be limited to just access these sites and not allow trespassing beyond the project boundary because of the security fencing around the project site. Impacts would be less than significant and no further analysis is warranted.

e. As described in the response to Question VIII(g) above, the proposed project development would not physically impede existing emergency response plans, emergency vehicle access, or personnel access to the site. The site is located in a rural area with several alternative access roads allowing access to the site in the event of an emergency. As a part of the project, the applicant would pave existing dirt roadways to provide access to the site during project construction and operations. Also as part of the project, the applicant would provide access to and from SR 14 to parcels on both the east side and west side of the highway. This would involve obtaining approval from the CPUC for a vehicle crossing over the Union Pacific railroad tracks, and approval from Caltrans for on- and off-ramps to and from SR 14. Therefore, the proposed project would not result in inadequate emergency access to the site. Impacts would be less than significant and no further analysis is warranted.

f. As described in the response to Question XVI(a) above, construction of the project would generate construction trips and potential roadway lane closures which could temporarily increase the daily traffic volumes on local roadways and intersections. However, due to the rural nature of the project area, with a major portion of the surrounding lands belonging to the state or the federal government, no bus stops or designated bicycle lanes exist on the roadways and would not likely or possibly be permitted to be used on SR 14 during construction or operation. Therefore, the proposed project would not conflict with adopted policies, plans, or programs supporting alternative transportation. Impacts would be less than significant and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XVII. UTILITIES AND SERVICE SYSTEMS. Would the project:				
a. Exceed wastewater treatment requirements of the applicable regional water quality control board?	☐	☐	☒	☐
b. Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c. Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☒	☐
d. Have sufficient water supplies available to serve the project from existing entitlements and resources, or would new or expanded entitlements be needed?	☐	☐	☒	☐
e. Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☒	☐
f. Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☒	☐
g. Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☒	☐

Discussion:

a. The proposed project would generate a minimal volume of wastewater. During construction, temporary portable toilet facilities would be used and disposed of at an approved site.

During operation, the proposed project would not generate any wastewater as there would be no employees on-site. Employees would only be on-site twice a year to wash the panels. Portable toilet facilities would be available for on-site employees and wastewater would be disposed of at an approved site. Impacts will be less than significant.

b. The proposed project would not require the construction of a septic system and leach line. Wastewater generation during operation is expected to be insignificant as the proposed project

would require a relatively small number of employees who will use a portable toilet disposal system. During construction portable toilet facilities would be utilized and disposed of at an approved site. Therefore no impact will occur and no further analysis is warranted.

c. Although the project would create a small amount of additional impervious surface and may require a small amount of imported water for dust suppression during construction and the washing of panels twice a year, these changes would not substantially increase the amount increase the amount of storm water runoff. The project area is drained by natural stream channels and does not rely on constructed storm water drainage systems. As stated above, the pattern and concentration of runoff could be altered by project activities, such as grading of the site and roadways. However, the proposed project would be required to comply with the County's NPDES permit through a SWPPP or other means to contain water on-site from construction. As a condition of the CUP, a drainage plan will be required to be submitted and approved by the Kern County Engineering and Survey Services Department, Floodplain Division prior to issuance of a grading permit. With adherence to all applicable regulations, the proposed project would not require or result in the construction of new storm water drainage facilities or expansion of existing facility, the construction of which could cause significant environmental effects. Impacts would be less than significant and no further analysis is warranted.

d. During construction, water use would be limited to domestic water use (drinking water), ground conditioning and dust suppression. Water may also be used to ensure that no large accumulations of soil accumulate on rights-of-way. All water used during construction and operation would be brought to the site by truck and stored at the site in portable tanks. Water use during operations is estimated to be a total of approximately 1.5 acre feet per year (or approximately 1,339 gallons per day). This water would be used primarily to periodically wash the PV modules. Due to the minimal use of water proposed, impacts would be less than significant and no further analysis is warranted.

e. The project would not require the construction of a septic system. During both construction and operation wastewater would be contained within portable toilet facilities and disposed of at an approved site. Consequently, there is no wastewater treatment provider and impacts on existing wastewater treatment facilities would be less than significant.

f. The proposed project is not expected to generate a significant amount of waste that would exceed the capacity of local landfills. Materials brought to the proposed project site would be used to construct facilities and few residual materials are expected. Non-hazardous construction refuse and solid waste would be disposed of at a local landfill, while any hazardous waste generated during proposed project construction would be disposed of at an approved location. First Solar, Inc., the manufacture and supplier of the PV modules, as part of its commitment to improving the global environment, has established a Collection and Recycling Program to promote the collection and recycling of their modules. First Solar, Inc.'s program enables all module components to be recovered and recycled. For each module sold, First Solar, Inc. sets aside sufficient funds in a trust to meet the estimated costs of collecting and recycling modules at the end of their useful life. It is not anticipated that the amount of solid waste generated by the proposed project site would exceed the capacity of local landfills needed to accommodate the waste. It is anticipated that impacts would be less than significant, and no further analysis is warranted.

g. The proposed project would generate solid waste during construction and operation of the project, thus requiring the consideration of waste reduction and recycling measures. The 1989 California Integrated Waste Management Act (AB 939) requires Kern County to attain specific waste diversion goals. In addition, the California Solid Waste Reuse and Recycling Access Act of 1991, as amended, requires expanded or new development projects to incorporate storage areas for

recycling bins into the proposed project design. The project would be required to comply with the 1989 California Integrated Waste Management Act and the 1991 California Solid Waste Reuse and Recycling Access Act of 1991, as amended. Therefore impacts would be less than significant and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less than Significant Impact	No Impact
XVIII. MANDATORY FINDINGS OF SIGNIFICANCE.				
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b. Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒	☐	☐	☐
c. Does the project have environmental effects that would cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐

Discussion:

a. The EIR's biological resources section will discuss specific project impacts on plants and wildlife, including avian species. The document will also evaluate the project's contribution to cumulative biological resources impacts and propose mitigation that will reduce the impacts, particularly on avian species, to less-than-significant levels.

b. The project has the potential to contribute to cumulative impacts to aesthetics, agricultural resources, biological resources, land use and planning, and transportation and traffic. The EIR will evaluate the project's contribution to cumulative impacts in these and other areas as further impacts are identified.

c. Although there may be significant air quality impacts during construction, the long-term air quality impacts could be beneficial if fossil fuel use is reduced. The health impacts from the short-term cumulative contribution to air quality impacts will be evaluated in the EIR.

PLANNING DEPARTMENT

TED JAMES, AICP, Director
2700 "M" STREET, SUITE 100
BAKERSFIELD, CA 93301-2323
Phone: (661) 862-8600
FAX: (661) 862-8601 TTY Relay 1-800-735-2929
E-Mail: planning@co.kern.ca.us
Web Address: www.co.kern.ca.us/planning

RESOURCE MANAGEMENT AGENCY

Ted James Interim, RMA DIRECTOR
Community & Economic Development Department
Engineering & Survey Services Department
Environmental Health Services Department
Planning Department
Roads Department

NOTICE OF PREPARATION

DATE: March 8, 2010

To: See Attached Mailing List

FROM: Kern County Planning Department
Attn: Jaymie L. Brauer
2700 "M" Street, Suite 100
Bakersfield, CA 93301
(661) 862-8629

SUBJECT: NOTICE OF PREPARATION OF A DRAFT ENVIRONMENTAL IMPACT REPORT

The Kern County Planning Department as Lead Agency (per CEQA Guidelines Section 15052) has required that an Environmental Impact Report (per CEQA Guidelines Section 15161) be prepared for the project identified below. The Planning Department solicits the views of your agency as to the scope and content of the environmental information which is germane to your agency's statutory responsibilities in connection with the proposed project. Your agency will need to use the EIR prepared by our agency when considering your permit or other approval of projects.

Due to the limits mandated by State law, your response must be received by **April 7, 2010 at 5 pm.** In addition, comments can be submitted at a **scoping meeting** that will be held at the Kern County Planning Department on **March 26, 2010 at 1:30 pm** at the address shown above.

PROJECT TITLE Desert Solar Projects by enXco (PP10238): (1) Cal City Solar - Conditional Use Permit No. 8, Map 152; (2) Barren Ridge Solar - Conditional Use Permit No 9, Map 152

PROJECT LOCATION: (1) Neuralia Rd and Washburn; (2) SE corner Neuralia Rd and Harriet Ave

PROJECT DESCRIPTION: The proposed projects include conditional use permits to allow for the construction of two photovoltaic solar facilities with a combined energy output of approximately 196 megawatts. The project consists of a combined 1,273 acres. Water and sewer services are not required.

Signature:
Title: Planner II

Bureau of Land Management -
Caliente/Bakersfield Office
3801 Pegasus Drive
Bakersfield, CA 93308-6837

California Air Resources Board
Stationary Resource Division
Attn: Barbara Fry
PO Box 2815
Sacramento, CA 95812

California City Community Services District
21000 Hacienda Blvd
California City, CA 93505

California City Planning
21000 Hacienda Blvd
California City, CA 93515

California City SOI (Planning Department)
21000 Hacienda Blvd
California City, CA 93515

California Department of Conservation
Attn: Director's Office
801 K Street, MS24-01
Sacramento, CA 95814-3528

California Department of Conservation
Office of Land Conservation
801 K Street, MS 18-01
Sacramento, CA 95814

California Department of Food and Agriculture
1220 N Street
Sacramento, CA 95814

California Department of Health Services/Drinking Water
Attn: Jesse Dhaliwal
1200 Discovery drive, Suite 100
Bakersfield, CA 93309

California Department of Public Health
Drinking Water Field Operations Branch
265 W Bullard Avenue, Suite 101
Fresno, CA 93704-1755

California Department of Water Resources
San Joaquin District
3374 East Shields Avenue, Room A-7
Fresno, CA 93726

California Dept. of Conservation-DOGGER
4800 Stockdale Highway, Suite 417
Bakersfield, CA 93309

California Dept. of Fish & Game Attn
David Hacker
1234 East Shaw Avenue
Fresno, CA 93710

California Dept. of Fish & Game:
Central Region (Fresno)
1234 East Shaw Avenue
Fresno, CA 93710

California Energy Commission
1516 Ninth Street, Room 200
Sacramento, CA 95814

California Highway Patrol
Planning and Analysis Division
PO Box 942898
Sacramento, CA 94298-0001

California Historical Preservation
Attn: Susan Stratton
PO Box 942896
Sacramento, CA 94296-0001

California Integrated Waste Management
Attn: Sue O'Leary, MS #15
PO Box 4025
Sacramento, CA 95812-4025

California Public Utilities Commission,
Energy Division
505 Van Ness Avenue
San Francisco, CA 94102

California Regional Water Quality Control Board - Lahontan Region
14440 Civic Drive, Suite 200
Victorville, CA 92392-2306

California State Lands Commission
100 Howe Avenue, Suite 100 South
Sacramento, CA 95825-8202

Caltrans, District 9 Maintenance Area
Planning Department
500 South Main Street
Bishop, CA 93514

Center on Race, Poverty, and the Environment (Delano)
Attn: Caroline Farrell
1302 Jefferson Street, Suite 2
Delano, CA 93215

Center on Race, Poverty, and the Environment (SF)
Attn: Executive Director
47 Kearny Street, Suite 804
San Francisco, CA 94108-5528

China Lake Naval Air Weapons Station
Commanding Officer Code,
Environmental Management (O'Gara)
Mail Stop 4014
China Lake, CA 93555-6108

Chumash Council of Bakersfield
PO Box 902
Bakersfield, CA 93302

City of Arvin
PO Box 548
Arvin, CA 93203

City of Bakersfield
Planning Department
1715 Chester Avenue
Bakersfield, CA 93301

City of Delano
PO Box 3010
Delano, C A93216

City of Marciopa
PO Box 548
Maricopa, CA 93252

City of McFarland
401 West Kern Avenue
McFarland, CA 93250

City of Ridgecrest
100 West California Avenue
Ridgecrest, CA 93555

City of Shafter
336 Pacific Avenue
Shafter, CA 93263

City of Taft
Planning and Building
209 East Kern Street
Taft, CA 93268

City of Tehachapi
115 South Robinson Street
Tehachapi, CA 93561-1722

City of Wasco
764 E Street
Wasco, CA 93280-1930

Client Copies (15 copies of each site and 1 cd)

Cuddy Valley Statistical Consulting
Attn: Jan de Leeuq
11667 Steinhoff Road
Frazier Park, CA 93222

David Laughinghorse Robinson

Defenders of Wildlife
PO Box 953
Joshua Tree, CA 92252

Desert Tortoise Preserve Committee
4067 Mission Inn Avenue
Riverside, CA 92501

Edwards Air Force Base
AFFTC/XRX Bldg 0001, Room 110
#1 South Rosamond Blvd
Edwards AFB, CA 93524-1936

Environmental Protection Agency,
Region IX Office
75 Hawthorne Avenue
San Francisco, CA 94105

Farm Bureau Federation

Inyo County Planning Department
PO Drawer "L"
Independence, CA 93526

Kern COG

Kern County Administrative Officer

Kern County Air Pollution Control District

Kern County Community Development

Kern County Department of Agriculture

Kern County Library

Kern County Resource Management Agency
Special Projects/Fiscal Analysis

Kern County Roads

Kern County Sheriff

Kern County Superintendent of Schools
Attention: Mary Baker
1300 17th Street
Bakersfield, CA 93301

Kern County Waste Management Department

Kern County Water Agency
PO Box 58
Bakersfield, CA 93302-0058

Kern Valley Indian Council
PO Box 168
Kernvilla, CA 93238

Kings County Planning Agency
Kings County Government Building #6
1400 West Lacey Blvd
Hanford, CA 93230

Kitanemuk & Yowlumne Tejon Indians
Attn: Delia Dominguez
981 North Virginia
Covina, CA 91722

Local Agency Formation Commission
5300 Lennox Avenue, Suite 303
Bakersfield, CA 93309

Los Angeles County
Department of Regional Planning
320 West Temple Street, Room 1390
Los Angeles, CA 90012

Los Angeles Department of Water and Power
Attn: Jodean M Giese
111 North Hope Street, Room 1121
Los Angeles, CA 90012

Mojave School District (Mojave High School)
3500 Douglas
Mojave, CA 93501

Native American Hertiage Peservation Council of Kern County
PO Box 1507
Bakersfield, CA 93302

Northcutt & Associates
PO Box 2893
Lake Isabella, CA 93240

San Bernardino County
Office of Planning
385 North Arrowhead Avenue, 1st Floor
San Bernardino, CA 92415-0182

San Diego Gas & Electric Company
P.O. Box 129831
San Diego CA 92112-9831

San Joaquin Air Pollution Control District
1990 East Gettysburgh Avenue
Fresno, CA 93726

San Luis Obispo County
Planning and Building Department
County of Government Center
San Luis Obispo, CA 93408

Santa Barbara County
Planning and Development
123 East Anapamu Street
Santa Barbara, CA 93101

Santa Rosa Rancheria
Attn: Clarence Atwell, Chairperson
PO Box 8
Lemoore, CA 93245

Sierra Club/Kern Keaweah Chapter
Attn: Arthur Unger

Smart Growth Coalition - Bakersfield
302 S Mojave Street
Tehachapi, CA 93561-1826

Southern California Edison
42060 10th Street West
Lancaster, CA 93534

Southern California Edison Ridgecrest District
Attn: Planning Department
510 S. China Lake Blvd
Ridgecrest, CA 93555

Southern California Edison
Attn: Cathy Hart
42060 10th Street West
Lancaster, CA 93534

Southern San Joaquin Valley Archaeological Information Center
California State University
9001 Stockdale Hwy
Bakersfield, CA 93311

State Clearinghouse (15 copies of each site, 15 cds of each site)
Office of Planning and Research
PO Box 3044
Sacramento, CA 95812-3044

Tejon Indian Tribe
Attn: Kathy Morgan, Chairperson
2234 4th Street
Wasco, CA 93280

Tubatulabals of Kern County
PO Box 226
Lake Isabella, CA 93240

Tulare County
Planning & Development Department
Room 105-111
County Civic Center
Visalia, CA 93291-4503

Tule River Indian Tribe
Attn: Neal Peyron, Chairperson
PO Box 589
Porterville, CA 93258

U.S. Air Force
Western Regional Environmental Office
50 Fremont Street, Suite 2450
San Francisco, CA 94105 2230

U.S. Army
Dir of Public Works/Master Plan Div
P.O. Box 105097
Fort Irwin, CA 92310-5097

U.S. Army
Peter Rubin
5th Street, B790
Parks RFTA
Dublin, CA 94568

U.S. Department of Energy
Office of NEPA
Attn: Coral Borgstrom
1000 Independence Avenue, SW
Washington, DC 20585-0119

U.S. Fish & Wildlife Service- Ashleigh Blackford
2493 Portola Road, Suite B
Ventura, CA 93003

U.S. Marine Corps
Patrick Christman
Building 1164/Box 555246
Camp Pendleton, CA 92055

U.S. Navy
Sheila Donovan
1220 Pacific Highway
San Diego, CA 92132

US Army Corps of Engineers
Attn: Planning Division
1325 J Street
Sacramento, CA 95814

US Army Corps of Engineers
PO Box 997
Lake Isabella, CA 93240

US Fish & Wildlife Service-
Division of Ecological Services
2800 Cottage Eay #W-2605

Ventura County RMA Planning Division
Attn: Kim Rodriquez, Director
800 South Victoria Avenue, L1740
Ventura, CA 93009-1740

Notice of Completion & Environmental Document Transmittal

Mail to: State Clearinghouse, P. O. Box 3044, Sacramento, CA 95812-3044 (916) 445-0613
For Hand Delivery/Street Address: 1400 Tenth Street, Sacramento, CA 95814

SCH # _____

Project Title: EIR 02-10 JLB; Desert Solar Projects by enXco [1) Cal City Solar; 2) Barren Ridge Solar] (PP10238);
Lead Agency: Kern County Planning Department — Contact Person: Jaymie L. Brauer
Mailing Address: 2700 "M" Street Suite 100 — Phone: (661) 862-8629
City: Bakersfield — Zip: 93301-2323 — County: Kern

Project Location: County: Kern — City/Nearest Community: 1, 2) California City
Cross Streets: 1)Neurlia Rd & Washburn Rd; 2) Neuralia Rd and Harriet Ave — Zip Code: 93505; 93519
Lat. / Long: 1) 117° 58′ 39″ W/ 35° 11′ 28″ N; 2) 117° 58′ 39″ W/ 35° 13′ 17″ N — Total Acres: 1,273
Assessor's Parcel No.: 1) 330-010-01; 2)0469-030-01 — Section: 35 / 23 — Twp.: 31S — Range: 37E — Base: MDB&M
Within 2 Miles: State Hwy #: SR 14 — Waterways: N/A
Airports: Cal City Municpal — Railways: ARC Railroad — Schools: N/A

Document Type:

CEQA:
- ☒ NOP
- ☐ Early Cons
- ☐ Neg Dec
- ☐ Mit Neg Dec
- ☐ Draft EIR
- ☐ Supplement/Subsequent EIR (Prior SCH No.) _____
- Other _____

NEPA:
- ☐ NOI
- ☐ EA
- ☐ Draft EIS
- ☐ FONSI

Other:
- ☐ Joint Document
- ☐ Final Document
- ☐ Other _____

Local Action Type:

- ☐ General Plan Update
- ☐ General Plan Amendment
- ☐ General Plan Element
- ☐ Community Plan
- ☐ Specific Plan
- ☐ Master Plan
- ☐ Planned Unit Development
- ☐ Site Plan
- ☐ Rezone
- ☐ Prezone
- ☒ Use Permit
- ☐ Land Division (Subdivision, etc.)
- ☐ Annexation
- ☐ Redevelopment
- ☐ Coastal Permit
- ☐ Other _____

Development Type:

- ☐ Residential: Units _____ Acres _____
- ☐ Office: Sq.ft. _____ Acres _____ Employees _____
- ☐ Commercial: Sq.ft. _____ Acres _____ Employees _____
- ☐ Industrial: Sq.ft. _____ Acres _____ Employees _____
- ☐ Educational _____
- ☐ Recreational _____
- ☐ Water Facilities: Type _____ MGD _____
- ☐ Transportation: Type _____
- ☐ Mining: Mineral _____
- ☒ Power: Type Solar PV MW 196
- ☐ Waste Treatment: Type _____ MGD _____
- ☐ Hazardous Waste: Type _____
- ☐ Other: _____

Project Issues Discussed in Document:

- ☒ Aesthetic/Visual
- ☒ Agricultural Land
- ☒ Air Quality
- ☒ Archeological/Historical
- ☒ Biological Resources
- ☐ Coastal Zone
- ☒ Drainage/Absorption
- ☐ Economic/Jobs
- ☐ Other _____
- ☐ Fiscal
- ☒ Flood Plain/Flooding
- ☐ Forest Land/Fire Hazard
- ☒ Geologic/Seismic
- ☐ Minerals
- ☒ Noise
- ☐ Population/Housing Balance
- ☒ Public Services/Facilities
- ☐ Recreation/Parks
- ☐ Schools/Universities
- ☐ Septic Systems
- ☐ Sewer Capacity
- ☒ Soil Erosion/Compaction/Grading
- ☒ Solid Waste
- ☒ Toxic/Hazardous
- ☒ Traffic/Circulation
- ☒ Vegetation
- ☐ Water Quality
- ☒ Water Supply/Groundwater
- ☐ Wetland/Riparian
- ☒ Wildlife
- ☐ Growth Inducing
- ☐ Land Use
- ☒ Cumulative Effects

Present Land Use/Zoning/General Plan Designation:

A/FP (Exclus Ag, Floodplain), A (Exclus Ag) / General Plan: 8.5 (Resource Management); all vacant land

Project Description: *(please use a separate page if necessary)* The proposed projects include conditional use permits to allow for the construction of two photovoltaic solar facilities with a combined energy output of approximately 196 megawatts. The project consists of a combined 1,273 acres.

Reviewing Agencies Checklist

Lead Agencies may recommend State Clearinghouse distribution by marking agencies below with and "**X**".

If you have already sent your document to the agency please denote that with an "S".

S	Air Resources Board		Office of Emergency Services
	Boating & Waterways, Department of		Office of Historic Preservation
S	California Highway Patrol		Office of Public School Construction
	CalFire		Parks & Recreation
S	Caltrans District # 9		Pesticide Regulation, Department of
	Caltrans Division of Aeronautics	S	Public Utilities Commission
	Caltrans Planning (Headquarters)	S	Regional WQCB # Lohanta
	Central Valley Flood Protection Board		Resources Agency
	Coachella Valley Mountains Conservancy		S.F. Bay Conservation & Development Commission
	Coastal Commission		San Gabriel & Lower L.A. Rivers and Mtns Conservancy
	Colorado River Board		San Joaquin River Conservancy
S	Conservation, Department of		Santa Monica Mountains Conservancy
	Corrections, Department of	S	State Lands Commission
	Delta Protection Commission		SWRCB: Clean Water Grants
	Education, Department of		SWRCB: Water Quality
S	Energy Commission		SWRCB: Water Rights
S	Fish & Game Region # Fresno		Tahoe Regional Planning Agency
S	Food & Agriculture, Department of		Toxic Substances Control, Department of
	General Services, Department of		Water Resources, Department of
	Health Services, Department of		
	Housing & Community Development		Other _____
S	Integrated Waste Management Board		Other _____
	Native American Heritage Commission		

Local Public Review Period (to be filled in by lead agency)

Starting Date March 8, 2010 Ending Date April 7, 2010

Lead Agency (Complete if applicable):

Consulting Firm: _____
Address: _____
City/State/Zip: _____
Contact: _____
Phone: _____

Applicant: _____
Address: _____
City/State/Zip: _____
Phone: _____

Signature of Lead Agency Representative: _____ **Date:** 16 Feb 2010

Authority cited: Section 21083, Public Resources Code. Reference: Section 21161, Public Resources Code.

INITIAL STUDY/NOTICE OF PREPARATION

enXco Development Corporation Desert Solar Project (Barren Ridge Solar (Site 1) by enXco/ Cal City Solar (Site 2) by enXco)

CUP 8, Map 152 (Site 1); CUP 9, Map 152 (Site 2)

LEAD AGENCY:

Kern County Planning Department
2700 M Street, Suite 100
Bakersfield, CA 93301-2370

Contact: Jaymie Brauer, Planner
(661)852-8629

TECHNICAL ASSISTANCE BY:

ICF International
5558 California Avenue, Suite 310
Bakersfield, CA 93309

March 2010

1. Project Description

1.1 Location

The proposed project comprises two separate sites located in the eastern portion of Kern County, approximately 3 miles north of California City (Cal City). The sites are within the jurisdictional boundaries of the Kern County General Plan. The Barren Ridge site (Site 1) (APN 469-030-01) is located 1 mile north of the Cal City site (Site 2) (APN 330-010-01), separated by undeveloped land. Figure 1 shows the regional location of the project area for both sites, and Figure 2 shows a closer view of the project location. Both sites are located adjacent to and east of Neuralia Road. Site 1 is located 3.5 miles east of State Route 14 (SR-14); Site 2, slightly more south, is approximately 4.25 miles east of SR-14. Figure 2 shows the project sites boundaries and access locations. Site 1 is located in Township 31S, Range37E, and Sections 14, 24, 23, 25, and 26. Site 2 is located in Township 31S, Range 37E, and Sections 26, 36, and 35

Site 1 encompasses 647 acres, 611 of which are proposed for development. Site 2 encompasses 638 acres, 548 of which are proposed for two phases of development. Each site represents a standalone electric generation facility and can be developed and operated independently from the other sites.

1.2 Environmental Setting

The project sites are vacant with flat topography. Figure 3 shows an aerial view of the sites. Surrounding land uses consist largely of open desert with a limited number of single-family residences scattered throughout the immediate project area and a larger concentration of single-family residences located approximately 1.5 miles to the west. The residences nearest to the project site include one residence located approximately 1,200 feet north of Site 2 and one located approximately 2,500 feet west of Site 2. The Honda Proving Center of California (HPCC), a test track used primarily for testing Honda and Acura automobiles, is located 2.1 miles to the north of Site 2. The Desert Tortoise Research Natural Area (DTRNA), a 39.5-square-mile natural habitat set aside for the desert tortoise, is located 5 miles to the east of the sites, at the western edge of the Rand Mountains.

Figure 4 shows an Assessor Parcel Map of the sites and the surrounding area. The sites are currently designated 8.5 (Resource Management, minimum 20 acre parcels) under the Kern County General Plan and are zoned A (Exclusive Agriculture), with some portions zoned A FP (Exclusive Agriculture/Floodplain Combining) by the Kern County Zoning Ordinance. Figure 5 shows the existing zoning of the project sites and surrounding properties, and Figure 6 shows the existing General Plan map code designations for the sites and surrounding area. Table 1 illustrates this zoning and General Plan designation information. Neither parcel is under a Williamson Act Land Use Contract or within the boundaries of an Agricultural Preserve. The Federal Emergency Management Agency (FEMA) has mapped both sites entirely within Flood Zone A, which is characterized by a 1% chance of an annual flood. The sites are located within the Red Zone of the County Zoning Ordinance Military Review Requirements Map (19.08.160), which requires military review of structures greater than 200 feet in height.

Table 1. Surrounding Land Uses – Site 1

Direction from Project Site	Existing Land Use	Existing Land Use Designation	Existing Zoning
Project Site	Vacant	8.5 – Resource Management	A – Exclusive Agriculture A FP – Exclusive Agriculture & Floodplain Combining District
North	Vacant	8.5 – Resource Management	A – Exclusive Agriculture
East	Vacant	8.5 – Resource Management	PL RS FPS – Platted Lands District, Residential Suburban Combining District, and Floodplain Secondary Combining District PL RS – Platted Lands District and Residential Suburban Combining District RF – Recreation-Forestry District
West	Vacant	8.5 – Resource Management	A – Exclusive Agriculture PL RS MH – Platted Lands District, Residential Suburban Combining District, and Mobilehome Combining District
South	Vacant	1.2 – Incorporated Cities	A FPS – Exclusive Agriculture and Floodplain Combining Secondary District A FP – Exclusive Agriculture and Floodplain Combining District

Table 2. Surrounding Land Uses – Site 2

Direction from Project Site	Existing Land Use	Existing Land Use Designation	Existing Zoning
Project Site	Vacant	8.5 – Resource Management	A – Exclusive Agriculture A FP – Exclusive Agriculture and Floodplain Combining District
North	Residential	8.5 – Resource Management	A – Exclusive Agriculture A FP – Exclusive Agriculture and Floodplain Combining District A FPS – Exclusive Agriculture and Floodplain Combining Secondary District A GH – Exclusive Agriculture and Geologic Hazard Combining District
East	Vacant	8.5 – Resource Management 2.5 – Flood Hazard 1.1 – State and Federal Land	A FP – Exclusive Agriculture and Floodplain Combining District

Direction from Project Site	Existing Land Use	Existing Land Use Designation	Existing Zoning
West	Vacant	8.5 – Resource Management	A – Exclusive Agriculture A GH – Exclusive Agriculture and Geologic Hazard Combining District PL RS – Platted Lands District and Residential Suburban Combining District
South	Vacant	8.5 – Resource Management	UNK – Unknown

The closest fire station to the proposed project is the Mojave Fire Station #14, located at 1953 Highway 58, approximately 14 miles southwest of the sites. The closest sheriff station is the Mojave Substation located at 1771 Highway 58, approximately 13.8 miles southwest of the sites. The sites are located within the Mojave Unified School District. The closest schools to the site are the California City High School, located approximately 3.25 miles south of the sites; the Robert P. Ulrich Elementary School, located in California City approximately 4.25 miles south of the sites; and the California City Middle School, located approximately 5 miles south of the sites.

The sites are not located within the Sphere of Influence (SOI) of any existing airport, and no unique paleontological or historical resources are known to be located on the sites.

1.3 Proposed Project

The proposed project includes the approval of two conditional use permits (CUPs) to allow for the construction and operation of a separate solar photovoltaic (PV) power generation facility on each project site. Site 1 (CUP 8, Map 152) would generate 100 megawatts (MW), and Site 2 (CUP 9, Map 152) would generate a total of 96 MW, developed in two phases: Phase 1 would include a 20-MW solar facility developed on approximately 120 acres; Phase 2 would expand the project to produce an additional 76 MW of energy on 428 acres. The technology proposed would utilize a fixed-tilt, thin-film cadmium telluride (CdTe) PV module encapsulated in glass manufactured by First Solar, Inc. The PV modules would be coated with non-reflective material to eliminate reflection and glare. The PV modules convert sunlight into direct current (DC) electricity and do not consume fossil fuels or emit hazardous pollutants during operations. Power would be tied directly to Pacific Gas & Electric's (PG&E's) infrastructure. Additional project details are described in Section 1.4 below.

1.4 Project Characteristics

Facilities and Operations

Both proposed project facilities would install stationary, ground-mounted thin-film PV modules, support beams, module rail assemblies, inverters, transformers, buried electrical cables, circuit breakers, a new substation for each site, and distribution lines. Barren Ridge will interconnect with Los Angeles Department of Water and Power (LADWP), at Barren Ridge Substation. Cal City Phase 1 (19.9 MW) will interconnect with Southern California Edison (SCE) at Cal City, and Phase 2 (76 MW) will interconnect at Barren Ridge Sub with the LADWP SCE interconnection. Concrete supports would be used for the footings, foundations, and pads for the transformers and inverters.

At Site 1, the project would install 100 stationary ground-fix-mounted PV system blocks that would generate 100 MW. At Site 2, the project would install 96 stationary ground-fix-mounted PV system

blocks that would generate 96 MW. Each PV system block (1 MW) would consist of 174 subarrays (15,660 solar modules); 1,740 source circuits; and 1 inverter. The top of the subarray would be approximately 11.3 feet above grade at the tallest point and approximately 2.3 feet above grade at the lowest point.

The fixed-tilt modules would be constructed in east–west rows and would be mounted on fixed steel supports and positioned to receive optimal solar energy, but would not track the path of the sun. The subarrays (a collection of 90 PV modules and 10 source circuits) would typically be placed on an aluminum rail at a 25-degree angle. The proposed design involves no moving parts, no thermal cycle, and no water use for electricity generation.

The project would distribute the power generation to a substation that would be constructed within each site just east of Neuralia Road. The project substations would occupy an area approximately 200 feet by 150 feet each, and the tallest part of the substations would reach a height of approximately 60 feet.

The PV system would require the installation of an alternating current (AC) switchgear and erection of the PV modules and associated electrical equipment. The wiring from the solar modules delivers DC power along a proposed underground trench or aboveground conduit to the inverters located on the electrical equipment pads. The inverters convert the DC power to AC, which is then stepped up to medium voltage via the proposed subsurface medium-voltage transformers. The medium-voltage transformers deliver power along an overhead collection system to the proposed project substation, and the power is stepped up for interconnection to the electrical grid at the transmission corridor.

The proposed project would interconnect with the distribution and transmission system through existing or new power lines from the project sites. The appropriate energy purveyors are currently assessing their capacity to accommodate additional power on the existing infrastructure and would perform any upgrades deemed necessary. In the event such upgrades are needed, the potential environmental effects of the upgrade will be thoroughly analyzed pursuant to the California Environmental Quality Act (CEQA). The upgrades would be performed and owned by PG&E within their existing rights-of-way. The upgrades would be consistent with the existing overhead distribution lines.

The proposed project would provide motion-activated illumination for both normal and emergency conditions. Lighting would be designed to provide the minimum illumination needed to achieve safety and security objectives and would be downward facing and shielded to focus illumination on the desired areas only. The project perimeter would be secured with 8-foot chain link security fencing with privacy slats and three strands of barbed wire. If required, provision would be provided at the fence base for wildlife movement through the site.

Controlled access gates would be located at the site entrances located off Neuralia Road. The gated access point would be large enough to accommodate large delivery trucks. A small portion of the overall plant sites would be paved and limited to the site access roads. Improved (earthen or gravel) roads would be located throughout the sites to provide access to the solar equipment. Any large vegetation and brush that currently exists on the site would be removed, but existing low-lying vegetation would remain undisturbed, to the extent feasible, to provide ground cover and minimize dust generation.

Once the facility is fully operational, water would be required by the facility for module wash water and maintenance uses. Water would be sprayed on the PV modules periodically to remove dust and contaminants to maintain efficient conversion of sunlight to electrical power. The cleaning interval would be determined by the rate at which electrical output degrades between cleanings. It is expected that module cleaning would be required twice per year, and approximately 1 gallon would be required for washing each module during each cleaning. Combined, the two sites would have 3,085,020 modules; therefore, maintenance is estimated to require 3,085,020 gallons (9.5 acre feet) per cleaning, or 6,170,040

gallons (19 acre feet) per year. This water source would be trucked in quarterly or, in special cases, as needed.

No permanent operations and maintenance (O&M) office would be required to support the proposed project. Operational activities are limited to monitoring plant performance and responding to utility needs for plant adjustment. The project would operate during daylight hours only and would only require routine visits by personnel for operation, maintenance, and security. Module cleaning would require additional personnel for short periods of time.

No heavy equipment would be used during normal project operation. O&M vehicles would include trucks (pickup, flatbed), forklifts, and loaders for routine and unscheduled maintenance, and water trucks for solar module washing. Large heavy-haul transport equipment may be brought to the sites infrequently for equipment repair or replacement.

Construction

The project construction sequence is expected to begin with removal of vegetation for installation of the PV module structures ahead of structure installation. Parking areas for construction workers and staging and lay-down areas for construction materials would be prepared inside the solar field area. Construction access road beds would typically be 20 to 30 feet wide and would consist of compacted earth, surfaced with gravel or compacted soil. A stabilized entrance/exit would be provided to clean vehicle wheels prior to exiting the construction area. Minimal site grading is proposed for certain areas within the sites, and no export of soil is proposed. Initial grading work would include the use of excavators, graders, dump trucks, and end loaders, in addition to support pickups, water trucks, and cranes. Limited amounts of water would be required during construction to support concrete manufacturing, dust control, module washing, and sanitary use.

Temporary containers with equipment would be placed in the staging and lay-down areas. There may be a temporary project construction office onsite during construction.

A stormwater pollution prevention plan (SWPPP) incorporating best management practices (BMPs) for erosion control would be prepared and approved prior to the start of construction. A Notice of Intent for inclusion in the General Permit for Construction Activities would also be filed prior to construction. During site preparation, the SWPPP would be implemented and preliminary erosion control and sediment control would be installed.

Only non-hazardous wastes would be generated during the construction of the Project. The following wastes are anticipated to be generated: common household trash, cardboard, wood pallets, copper wire, scrap metal, and wood wire spools. The project would require recycling as much of the generated waste as feasible. Although construction is not expected to generate hazardous waste, field equipment used during construction would contain various hazardous materials such as diesel fuel, hydraulic oil, grease, solvents, adhesives, paints, and other petroleum-based products contained in construction vehicles.

Construction at both sites, from site preparation and grading to commercial operation, is planned to take 18 months and would begin in the fourth quarter of 2010 to the second quarter of 2012. Construction would be implemented over five phases: site preparation, subsurface work, system installation, testing, and clean-up/restoration.

The onsite construction workforce would consist of laborers, craftspeople, supervisory personnel, support personnel, and construction management personnel. The onsite assembly and construction workforce is expected to reach a peak of approximately 30 workers during the system installation phase for each project site. If the installation phase for both sites overlapped, there would be a total of 60 workers on site.

1.5 Project Objectives

The applicant's general objectives are to respond to recent national and regional forecasts that project an increase in consumption of electrical energy continuing into the foreseeable future. Renewable energy, including solar generation, is expected to provide a larger component of the electrical supply in the future. Continued increased consumption requires development of new generation facilities to satisfy demand.

- Achieve the Western Governors' Association's goal to develop 30,000 MW of clean energy by 2015 from traditional and renewable energy sources.
- Fulfill the development of renewable energy resources as part of an overall strategy to develop a diverse portfolio of domestic energy supplies for the future as envisioned in the federal Energy Policy Act of 2005 (Public Law 109-58) as a way to reduce greenhouse gas emissions.
- Attain the goal of producing 33% of the electricity sold in California that must come from renewable energy resources by 2020 as mandated by California Governor Arnold Schwarzenegger's Executive Order S-14-08.
- Accomplish the U.S. Department of Interior Secretarial Order No. 3285, establishing a new policy that "encouraging the production, development, and delivery of renewable energy is one of the Department's highest priorities."
- Generate commercially financeable renewable solar-generated electricity from proven technology, at a competitive cost, with low environmental impact, and deliver it to markets as soon as possible.

1.6 Proposed Discretionary Actions/Required Approvals

The County as Lead Agency for the project has discretionary authority over the primary project proposal. To implement this project, the applicant would need to obtain, at a minimum, the following discretionary permits/approvals:

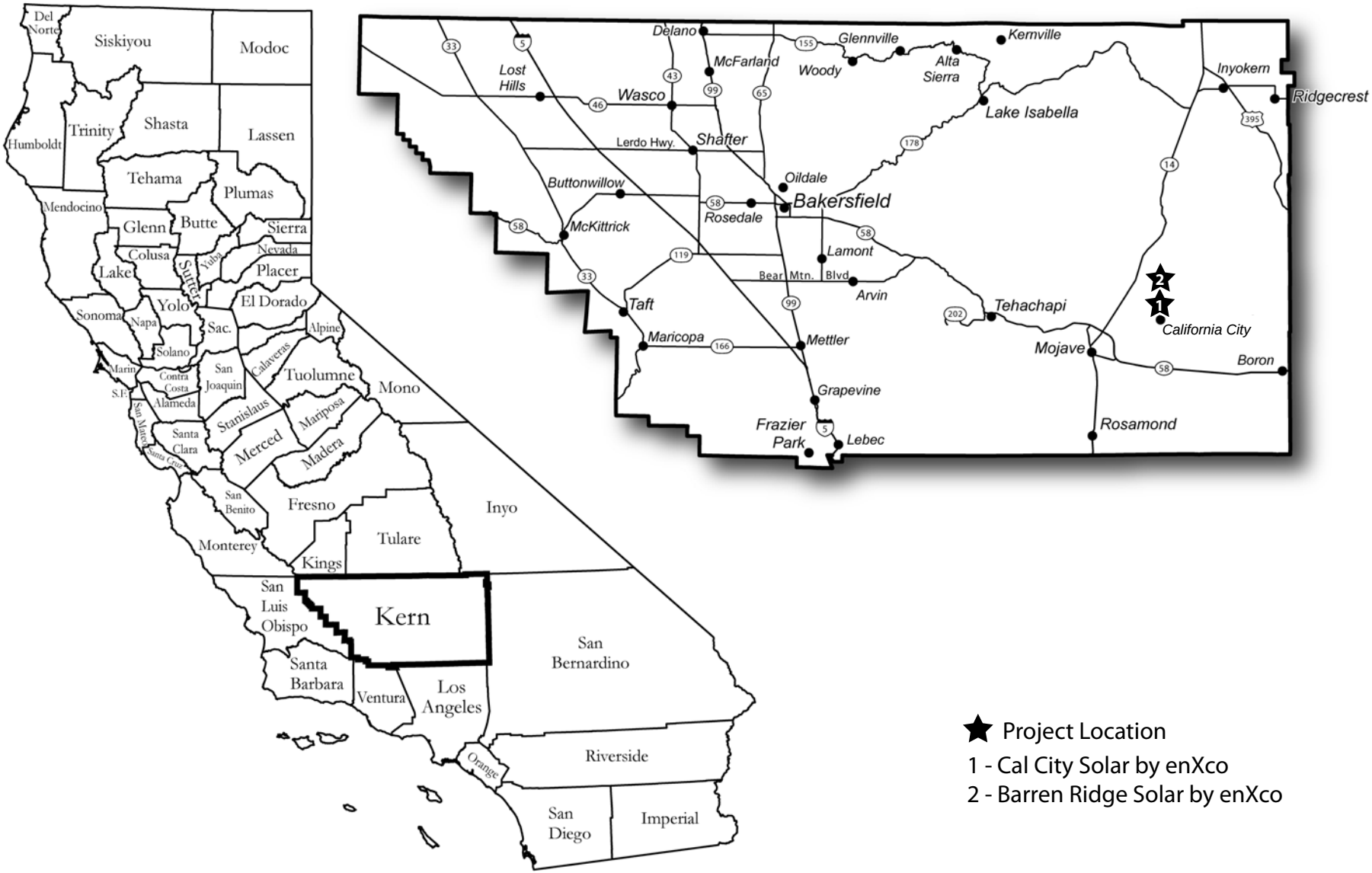
Kern County

- Consideration and certification of a Final Environmental Impact Report with appropriate findings and Mitigation Monitoring Program, by the Kern County Board of Supervisors
- Approval by Kern County of CUP No. 8, Map 152 and CUP No. 9, Map 152
- Grading and building permits
- Building permits

Other Responsible Agencies

- Stormwater Pollution Prevention Plan—Regional Water Quality Control Board (RWQCB)
- NPDES general construction permit—RWQCB
- California Department of Fish and Game (CDFG)/U.S. Fish & Wildlife Services (USFWS)
- Streambed alteration permits—CDFG
- San Joaquin Valley Air Pollution Control District Permits

The preceding is not necessarily a comprehensive list of all discretionary permits/approvals required; additional requirements may be identified during the environmental review process.



Source: Kern County (2010)

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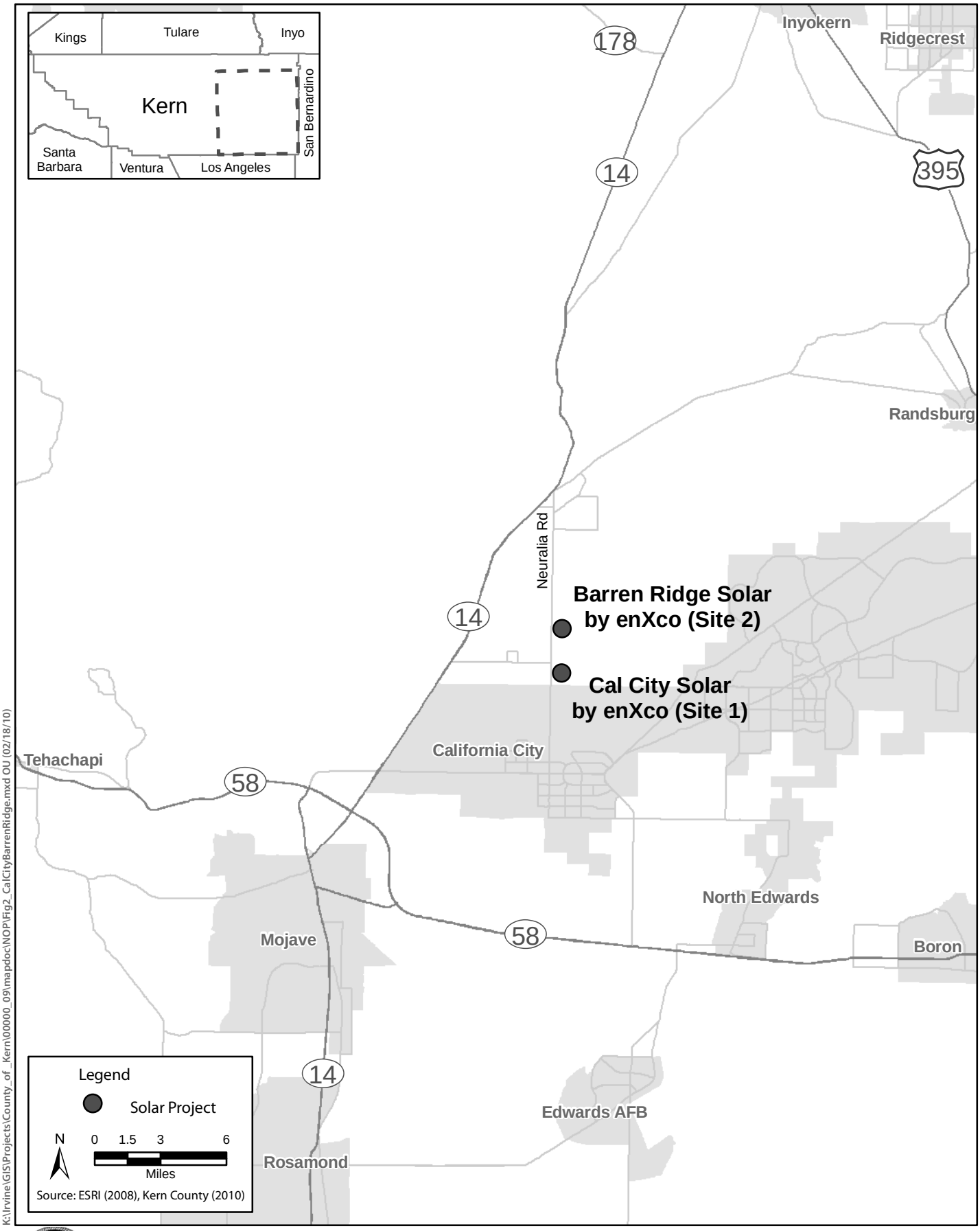
CUP 8, Map 152
CUP 9, Map 152

Figure 1
Regional Location



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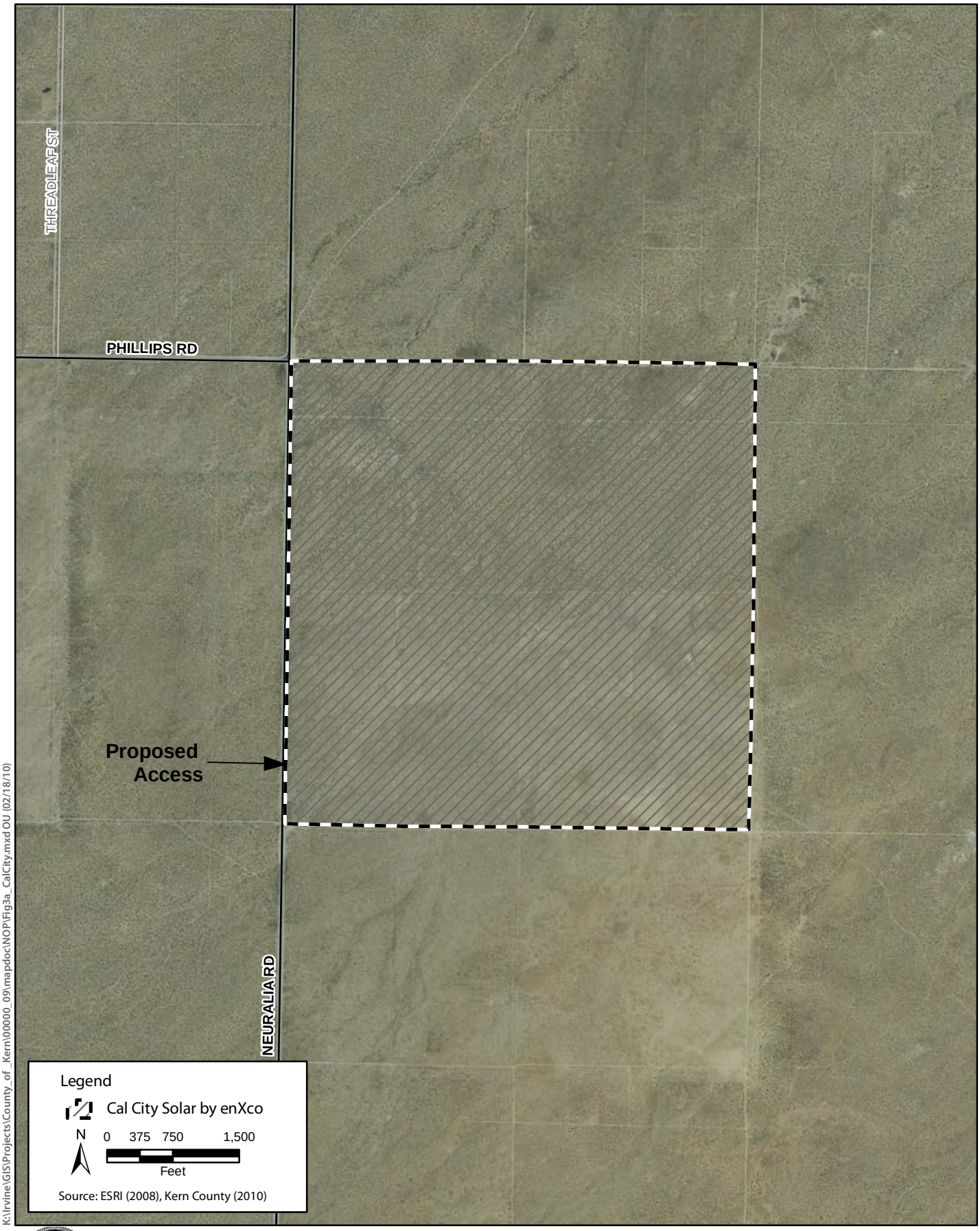
CUP 8, Map 152
CUP 9, Map 152

Figure 2
Vicinity Map



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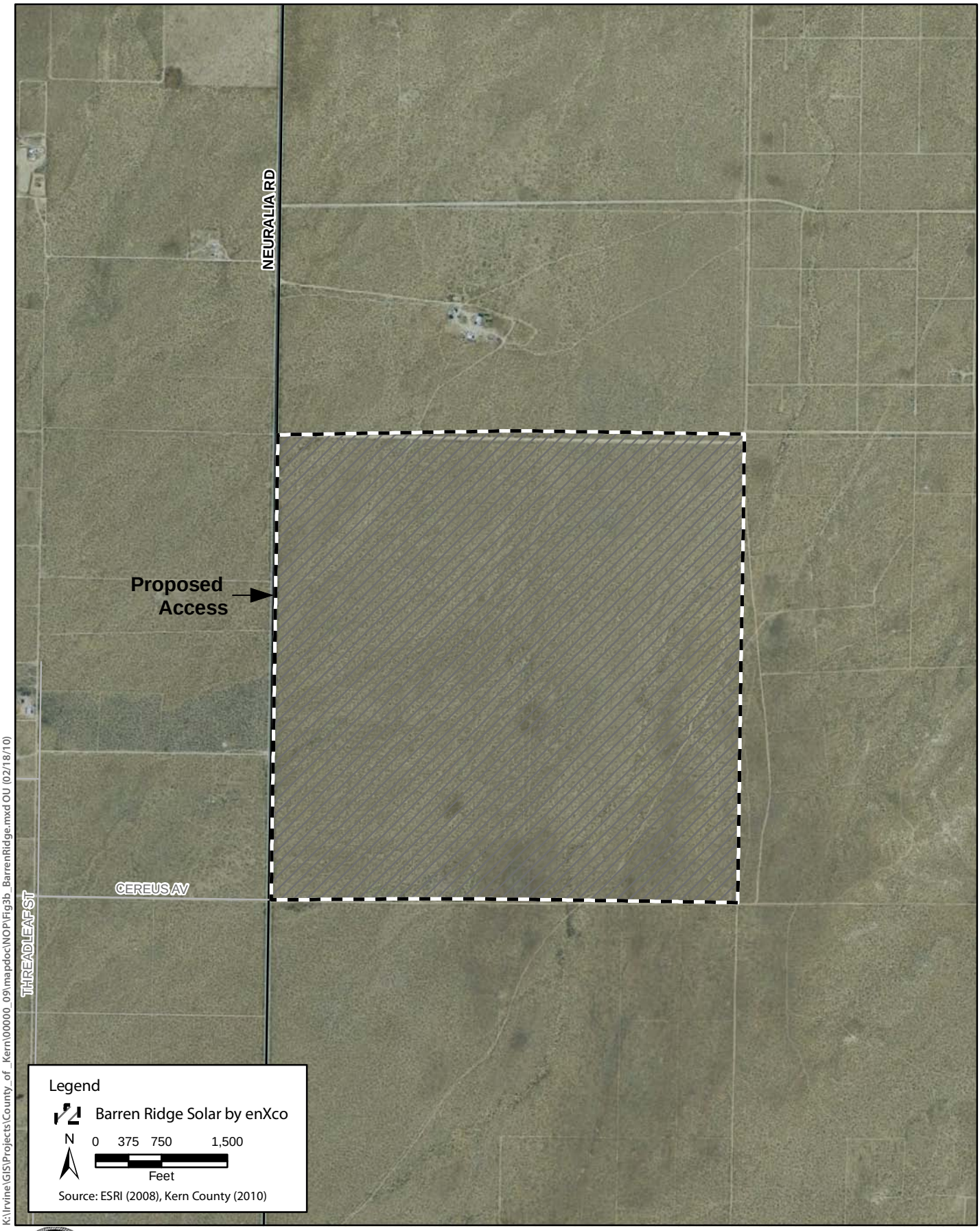
CUP 8, Map 152

Figure 3a
Site Boundaries and Access
Cal City Solar by enXco (Site 1)



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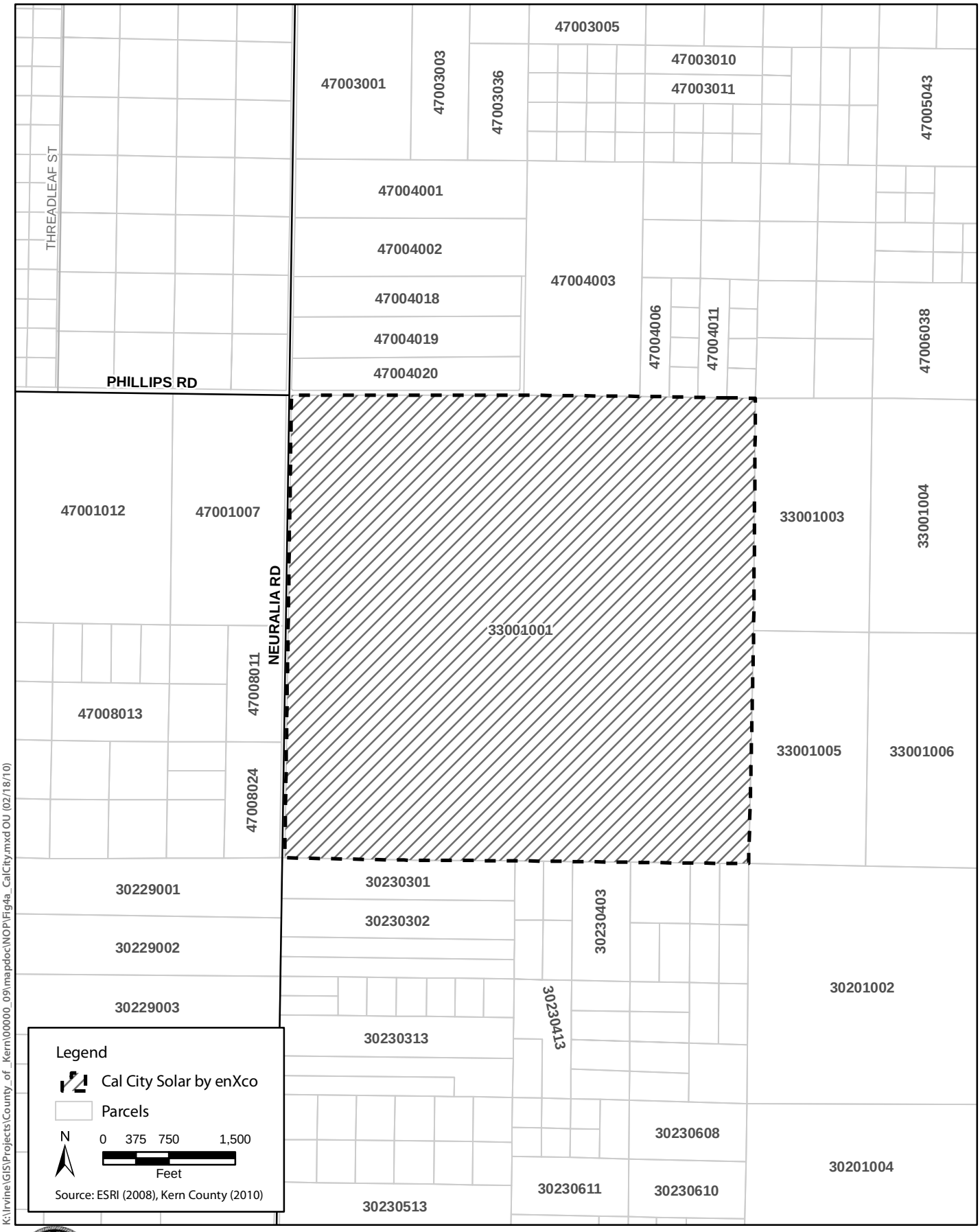
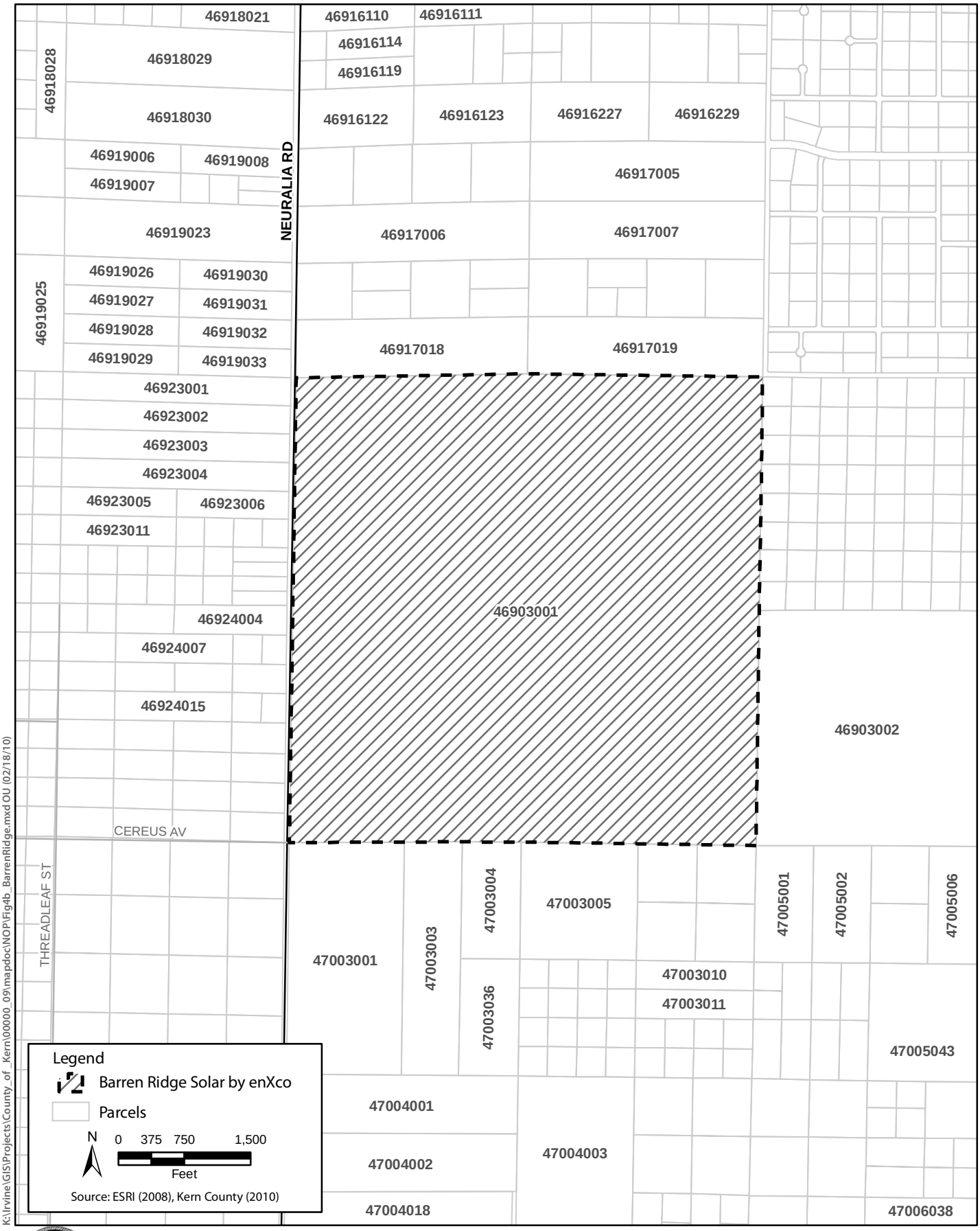
CUP 9, Map 152

Figure 3b
Site Boundaries and Access
Barren Ridge Solar by enXco (Site 2)



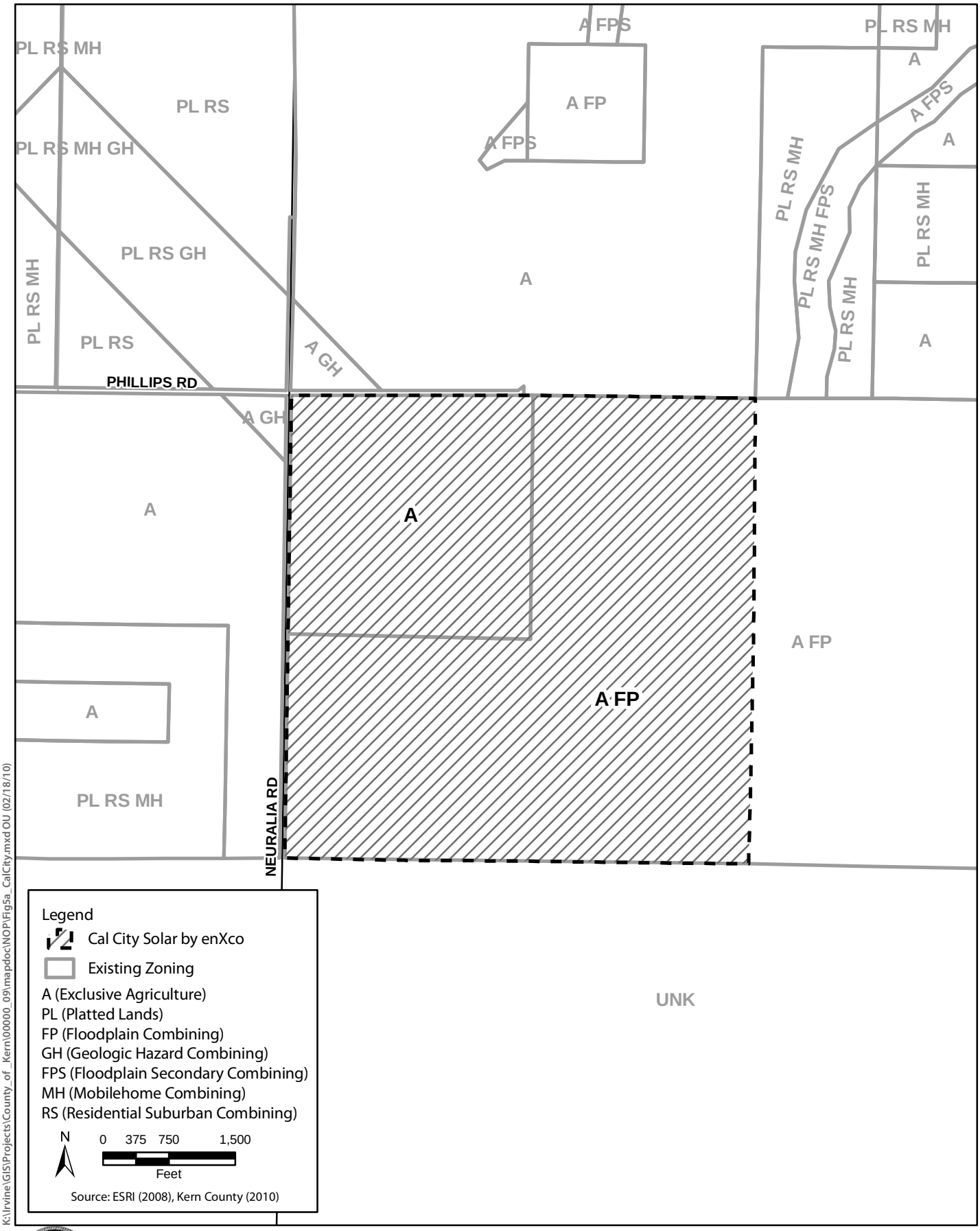
CUP 8 Map 152

Figure 4a
APN Map
Cal City Solar by enXco (Site 1)



CUP 9, Map 152

Figure 4b
APN Map
Barren Ridge Solar by enXco (Site 2)



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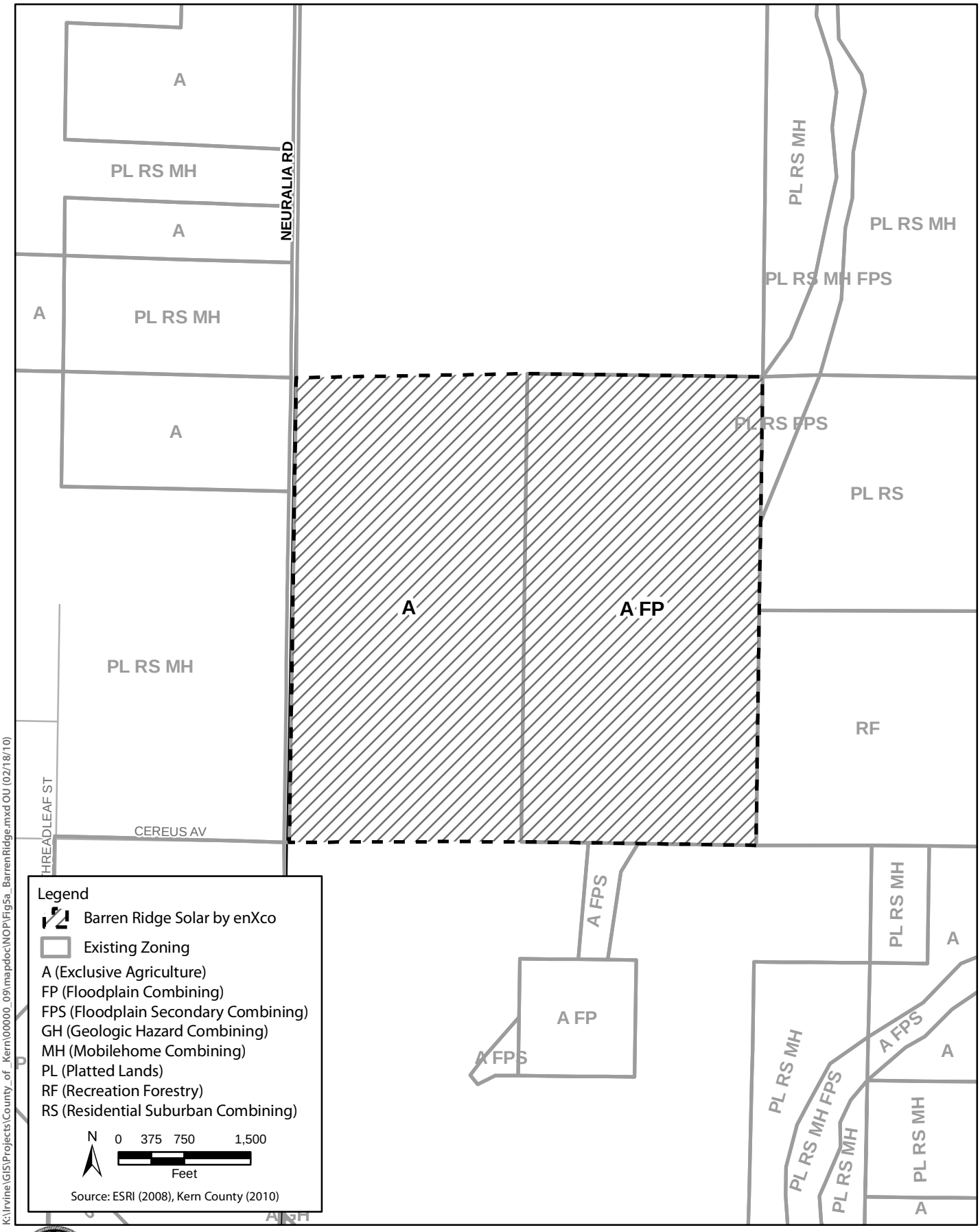
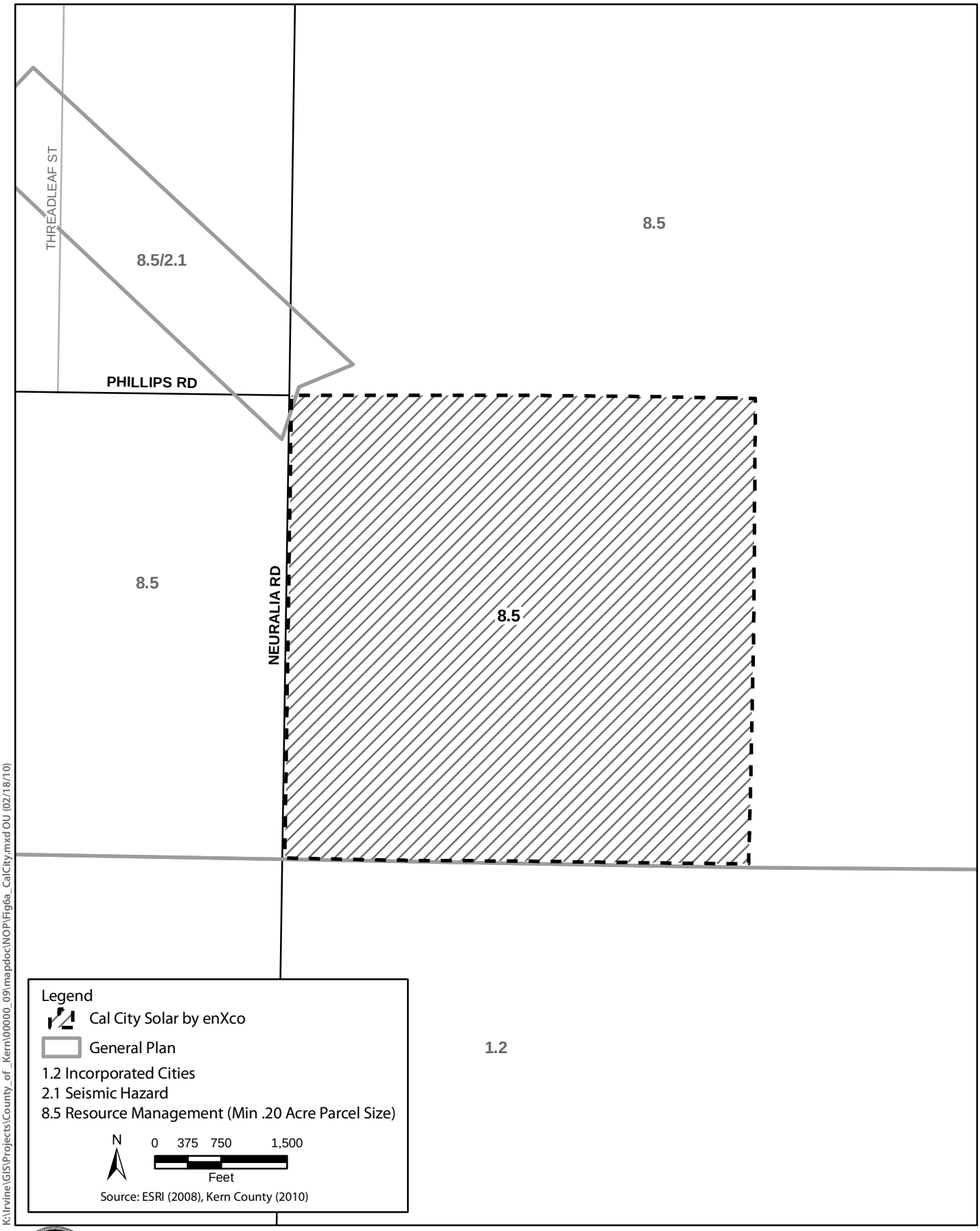
CUP 8 Map 152

Figure 5a
Existing Zoning
Cal City Solar by enXco (Site 1)



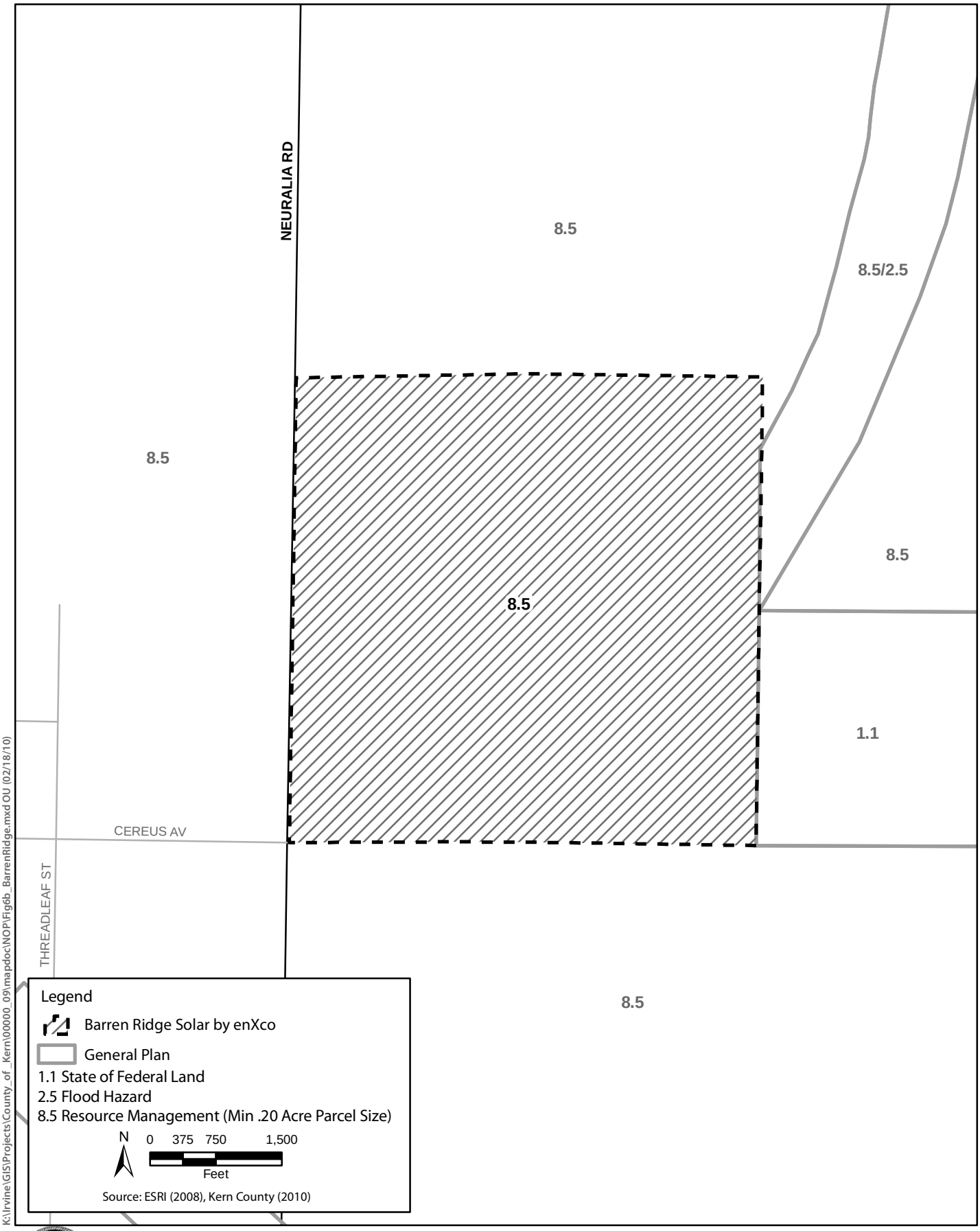
CUP 9, Map 152

Figure 5b
Existing Zoning
Barren Ridge Solar by enXco (Site 2)



CUP 8 Map 152

Figure 6a
Existing General Plan
Cal City Solar by enXco (Site 1)



CUP 9, Map 152

Figure 6b
Existing General Plan
Barren Ridge Solar by enXco (Site 2)

GENERAL NOTES:

LOCATION: 637.7± ACRES ON NEURALIA ROAD WASHBURN BLVD AND PHILLIPS ROAD, APPROXIMATELY 2.8 MILES NORTH OF THE CAL CITY SUBSTATION NEAR CALIFORNIA CITY IN UNINCORPORATED KERN COUNTY, CALIFORNIA. APN: 330-010-01.

SITE INFORMATION BASED ON SURVEY BY SMITHCO SURVEYING ENGINEERING DATED 09/29/09.

PROJECT NOTES:

PROPOSED SYSTEM TO CONSIST OF 20 STATIONARY FIXED-TILT GROUND-MOUNTED THIN FILM PHOTOVOLTAIC SYSTEM BLOCKS USING FS-275 MODULES.

9 MODULES ARE CONNECTED IN SERIES TO FORM A SOURCE CIRCUIT.

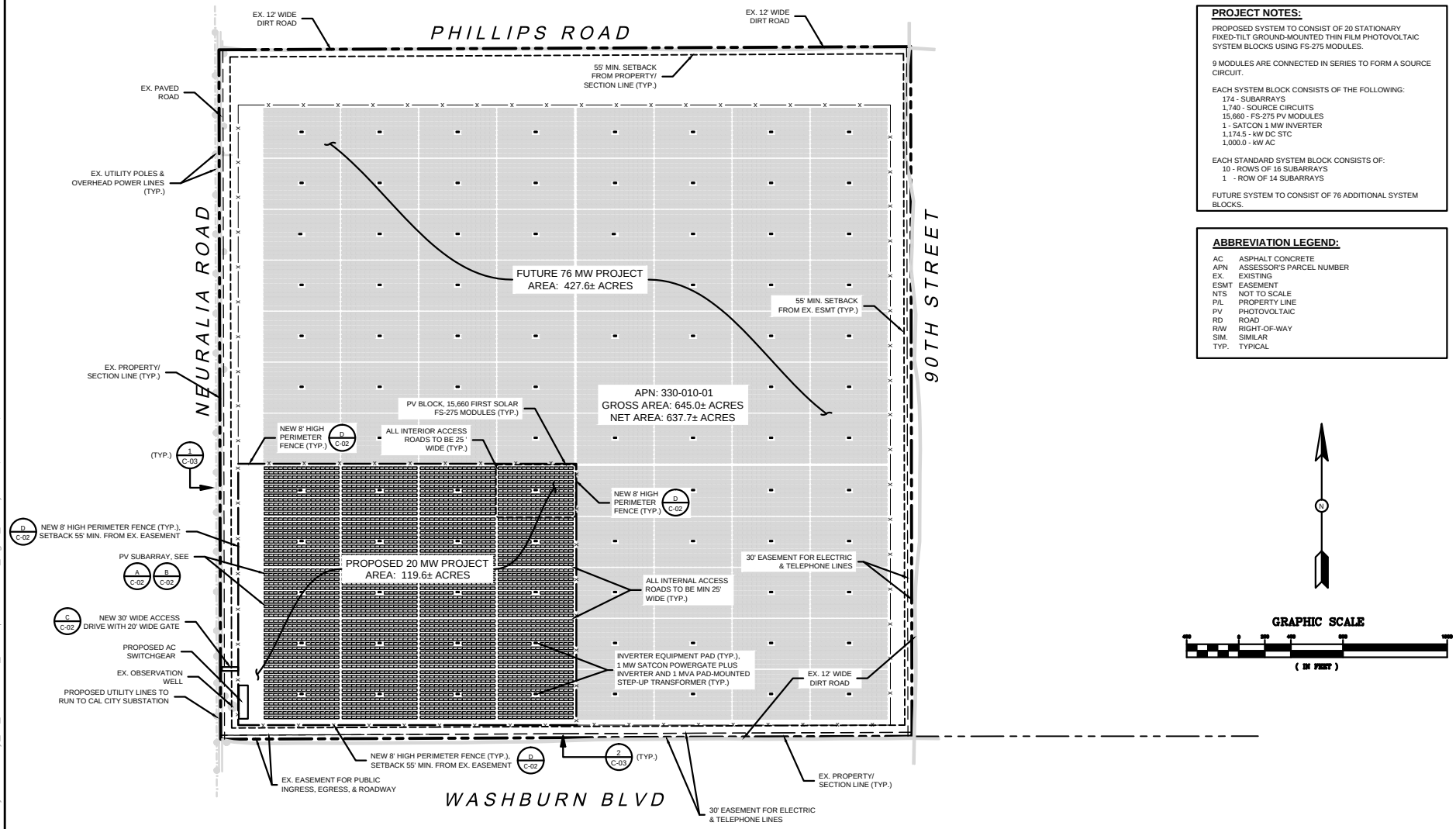
EACH SYSTEM BLOCK CONSISTS OF THE FOLLOWING:
- 174 - SUBARRAYS
- 1,740 - SOURCE CIRCUITS
- 15,660 - FS-275 PV MODULES
- 1 - SATCON 1 MW INVERTER
- 1,174.5 - kW DC STC
- 1,000.0 - kW AC

EACH STANDARD SYSTEM BLOCK CONSISTS OF:
- 10 - ROWS OF 16 SUBARRAYS
- 1 - ROW OF 14 SUBARRAYS

FUTURE SYSTEM TO CONSIST OF 76 ADDITIONAL SYSTEM BLOCKS.

ABBREVIATION LEGEND:

AC	ASPHALT CONCRETE
APN	ASSESSOR'S PARCEL NUMBER
EX.	EXISTING
ESMT	EASEMENT
NTS	NOT TO SCALE
P/L	PROPERTY LINE
PV	PHOTOVOLTAIC
RD	ROAD
R/W	RIGHT-OF-WAY
SIM.	SIMILAR
TYP.	TYPICAL



Source: enXco (2009)

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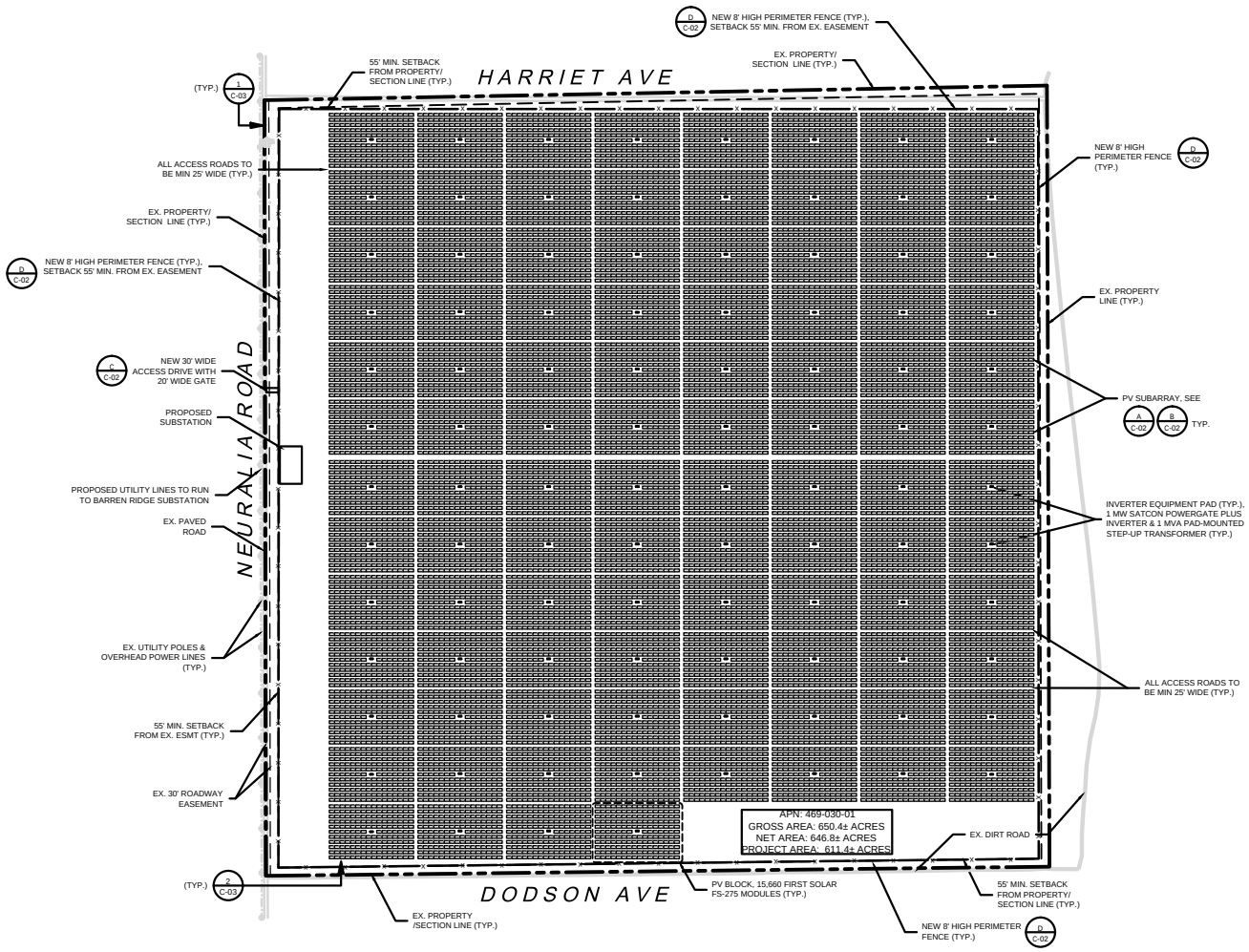
CUP 8, Map 152

Figure 7a
Proposed Site Plan
Cal City Solar by enXco (Site 1)



GENERAL NOTES:

LOCATION: 646.8 ACRES ON NEURALIA ROAD BETWEEN HARRIET AVENUE AND DODSON AVENUE, APPROXIMATELY 4.1 MILES SOUTHEAST OF THE BARREN RIDGE SUBSTATION NEAR CALIFORNIA CITY IN UNINCORPORATED KERN COUNTY, CALIFORNIA. APN: 469-030-01.

SITE INFORMATION BASED ON SURVEY BY SMITHCO SURVEYING ENGINEERING DATED 10/01/09.

PROJECT NOTES:

SYSTEM TO CONSIST OF 100 STATIONARY FIXED-TILT GROUND-MOUNTED THIN FILM PHOTOVOLTAIC SYSTEM BLOCKS USING FS-275 MODULES.

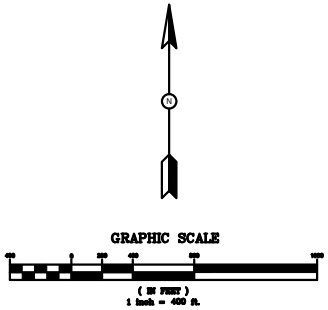
9 MODULES ARE CONNECTED IN SERIES TO FORM A SOURCE CIRCUIT.

EACH SYSTEM BLOCK CONSISTS OF THE FOLLOWING:
- 174 - SUBARRAYS
- 1,740 - SOURCE CIRCUITS
- 15,660 - FS-275 PV MODULES
- 1 - SATCON 1 MW INVERTER
- 1,174.5 - kW DC STC
- 1,000.0 - kW AC

EACH STANDARD SYSTEM BLOCK CONSISTS OF:
- 10 - ROWS OF 16 SUBARRAYS
- 1 - ROW OF 14 SUBARRAYS

ABBREVIATION LEGEND:

AC	ASPHALT CONCRETE
APN	ASSESSOR'S PARCEL NUMBER
EX.	EXISTING
ESMT	EASEMENT
NTS	NOT TO SCALE
P/L	PROPERTY LINE
PV	PHOTOVOLTAIC
RD	ROAD
R/W	RIGHT-OF-WAY
SIM.	SIMILAR
TYP.	TYPICAL



Source: enXco (2009)

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CUP 9, Map 152

Figure 7b
Proposed Site Plan
Barren Ridge Solar by enXco (Site 2)

KERN COUNTY ENVIRONMENTAL CHECKLIST FORM

Environmental Factors Potentially Affected

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "potentially significant impact" as indicated by the Kern County Environmental Checklist on the following pages.

☒ Aesthetics	☐ Agriculture and Forest Resources	☒ Air Quality
☒ Biological Resources	☒ Cultural Resources	☒ Geology and Soils
☒ Greenhouse Gas Emissions	☐ Hazards and Hazardous Materials	☒ Hydrology and Water Quality
☐ Land Use and Planning	☐ Mineral Resources	☐ Noise
☐ Population and Housing	☒ Public Services	☐ Recreation
☒ Transportation and Traffic	☒ Utilities and Service Systems	☒ Mandatory Findings of Significance

Determination

On the basis of this initial evaluation:

☐ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☒ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect (a) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (b) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENT IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier ENVIRONMENT IMPACT REPORT or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier ENVIRONMENT IMPACT REPORT or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature — Date: 4 March 10

Printed Name: Jaymie Brauer — For: Ted Jones

Evaluation of Environmental Impacts

1. A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in the parentheses following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e.g., the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e.g., the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).
2. All answers must take account of the whole action involved, including offsite as well as onsite, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.
3. Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation, or less than significant. "Potentially Significant Impact" is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an environmental impact report (EIR) is required.
4. Negative Declaration: "Less than Significant with Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less-than-Significant Impact." The lead agency must describe the mitigation measure and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section XVII, "Earlier Analyses," may be cross-referenced).
5. Earlier analyses may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration, Section 15063(c)(3)(D). In this case, a brief discussion should identify the following:
   a. Earlier Analysis Used. Identify and state where they are available for review.
   b. Impacts Adequately Addressed. Identify which effects from the above checklist where within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.
   c. Mitigation Measures. For effects that are "Less than Significant with Mitigation Incorporated," describe the mitigation measures that were incorporated or refined from the earlier document and the extent to which they address site-specific conditions for the project.
6. Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g., general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.
7. Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.
8. This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.
9. The explanation of each issue should identify:
   d. the significance criteria or threshold, if any, used to evaluate each question; and
   e. the mitigation measure identified, if any, to reduce the impact to a less-than–significant level.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
I. AESTHETICS. Would the project:				
a. Have a substantial adverse effect on a scenic vista?	☒	☐	☐	☐
b. Substantially damage scenic resources, including, but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☒	☐	☐	☐
c. Substantially degrade the existing visual character or quality of the site and its surroundings?	☒	☐	☐	☐
d. Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	☒	☐	☐	☐

Discussion:

a. Placement of PV solar panels in the Site 1 and Site 2 project site areas would alter the views of the area. Windshield views from motorists in passing vehicles on a few nearby roads (Neuralia Road) and SR-14 (3.5 miles to the west) would observe solar subarrays and general construction alterations to the natural site. The area is sparsely populated, and very few residents are located within a 2-mile radius of the project sites. However, the few residents that are present would have some views of the project solar subarrays. According to the Kern County General Plan, the project sites are potentially located within an area designated for or identified as having a scenic vista or scenic views. This will be discussed in the EIR.

b. The area surrounding the project sites consists almost entirely of undeveloped land in its natural state. The construction of PV solar panels would change the viewshed from public roads, including SR-14 located 3.5 miles to the west. While SR-14 is not an officially designated state scenic highway by the California Department of Transportation, it is eligible for official designation. Consequently, the project would have the potential to substantially damage scenic resources within a state scenic highway. This will be discussed in the EIR.

c. The project sites are vacant with flat topography. Surrounding land uses consist largely of open desert with a limited number of residential uses scattered west and north of the sites, with a larger concentration approximately 1.5 miles to the west of Site 2. The HPCC, a test track used primarily for testing Honda and Acura automobiles, is located 2.1 miles to the north. The DTRNA, a 39.5-square-mile natural habitat set aside for the desert tortoise, is located to the east at the western edge of the Rand Mountains. Because the area is still in its natural state and the surrounding area is lightly developed, a potential aesthetic impact could occur by developing the project sites. This impact will be further evaluated in the EIR.

d. The area is largely undeveloped and remains in its natural state. Existing light sources include sparsely populated residential land uses approximately 1.5 miles to the west and the HPCC

2.1 miles to the north. The PV modules are designed to absorb sunlight to maximize electrical output. In addition, the modules are encased in anti-reflective glass. The result is that modules reflect approximately half the light of standard residential and commercial glass.

The lighting proposed for the project sites is security lighting only and would not be turned on unless triggered by motion. This proposed lighting is regulated by the Kern County Zoning Ordinance. However, further analysis of the specific lighting required and the effects of nighttime light on the area as well as impacts from glare from the project are warranted and will be further evaluated in the EIR.

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Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
II. AGRICULTURE AND FOREST RESOURCES. In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. In determining whether impacts to forest resources, including timberland, are significant environmental effects, lead agencies may refer to information compiled by the California Department of Forestry and Fire Protection regarding the state's inventory of forest land, including the Forest and Range Assessment Project and the Forest Legacy Assessment project, and the forest carbon measurement methodology provided in the Forest Protocols adopted by the California Air Resources Board. Would the project:				
a. Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to nonagricultural use?	☐	☐	☐	☒
b. Conflict with existing zoning for agricultural use or a Williamson Act Contract?	☐	☐	☐	☒
c. Conflict with existing zoning for, or cause rezoning of, forest land (as defined in Public Resources Code section 12220(g)), timberland (as defined by Public Resources Code section 4526), or timberland zoned Timberland Production (as defined by Government Code section 51104(g))?	☐	☐	☐	☒
d. Result in the loss of forestland or conversion of forestland to non-forest use?	☐	☐	☐	☒
e. Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland to nonagricultural use or conversion of forestland to non-forest use?	☐	☐	☐	☒

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
f. Result in the cancellation of an open space contract made pursuant to the California Land Conservation Act of 1965 or Farmland Security Zone Contract for any parcel of 100 or more acres (Section 15206(b)(3) Public Resources Code)?	☐	☐	☐	☒

Discussion:

a. The project sites and surrounding areas are designated Nonagricultural and Natural Vegetation in the Farmland Mapping and Monitoring Program (FMMP) of the California Resources Agency. There is no designated Prime Farmland, Unique Farmland, or Farmland of Statewide Importance within the proposed project area. The project sites are not within the boundaries of an Agricultural Preserve; therefore, impacts would not occur.

b. The Kern County zone classification for both subject properties is A (Exclusive Agriculture) and A FP (Exclusive Agriculture, Floodplain Combining), which allows for resource extraction and energy development uses with the approval of a conditional use permit (CUP). The proposed project includes applications to approve a CUP, consistent with the Kern County Zoning Ordinance. The Barren Ridge Solar and the Cal City Solar sites are not under an active Williamson Act Contract, nor are parcels in the surrounding areas. The proposed project would not conflict with existing zoning ordinances for agricultural use or a Williamson Act Contract, and impacts would not occur.

c. There is no forest land or timberland, or associated zoning, on site or within the surrounding vicinity. As such, there would be no impacts related to the conversion of forestland or timberland.

d. See (c), above.

e. The nearest designated Important Farmland site is located approximately 50 miles west of both Site 1 and Site 2, near the unincorporated community of Wheeler Ridge. As such, the project would not convert Important Farmland to a non-agricultural use, and no impacts would occur. There are no forestlands at the project sites. Therefore, the project would not result in the loss of forestland or conversion of forestland to non-forest use.

f. The project would not result in the cancellation of an open space contract, such as a Farmland Security Zone Contract or Williamson Act Land Use contract, for any parcel of 100 or more acres. Neither of the sites is under any such contract. There would be no impact.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
III. AIR QUALITY. Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a. Conflict with or obstruct implementation of the applicable air quality plan?	☒	☐	☐	☐
b. Violate any air quality standard as adopted in (c)i or ii, or as established by EPA or air district, or contribute substantially to an existing or projected air quality violation?	☒	☐	☐	☐
c. Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is in nonattainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)? Specifically, would implementation of the project exceed any of the following adopted thresholds:				
i. San Joaquin Valley Unified Air Pollution Control District:				
Operational and Area Sources				
Reactive organic gases (ROG) 10 tons per year.	☐	☐	☒	☐
Oxides of nitrogen (NO_X) 10 tons per year.	☐	☐	☒	☐
Particulate matter (PM10) 15 tons per year.	☐	☐	☒	☐
Stationary Sources - as Determined by District Rules				
Severe nonattainment 25 tons per year.	☐	☐	☒	☐
Extreme nonattainment 10 tons per year.	☐	☐	☒	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
ii. Kern County Air Pollution Control District				
Operational and Area Sources				
Reactive organic gases (ROG) 25 tons per year.	☒	☐	☐	☐
Oxides of nitrogen (NO_X) 25 tons per year.	☒	☐	☐	☐
Particulate matter (PM10) 15 tons per year.	☒	☐	☐	☐
Stationary Sources – as Determined by District Rules				
25 tons per year.	☒	☐	☐	☐
d. Expose sensitive receptors to substantial pollutant concentrations?	☒	☐	☐	☐
e. Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒

Discussion:

a. The project would be located entirely within the jurisdiction of the Kern County Air Pollution Control District (KCAPCD), in the Mojave Desert Air Basin (MDAB). The KCAPCD is designated as moderate nonattainment for state 1-hour ozone standards and nonattainment (former subpart 1) for the federal 8-hour ozone standard. The Kern County portion of the MDAB is designated as nonattainment for the state PM10 standard and serious nonattainment for the federal PM10 standard. Project construction would generate emissions of NO_X and PM10 that could result in significant impacts to air quality in the area. Equipment usage and activities during construction of the proposed project would result in emissions of PM10 and ozone precursors, including NO_X and volatile organic compounds (VOCs), which could result in significant impacts to air quality in the area. The sources of emissions would include heavy equipment used to excavate and grade the array pads and access areas, cranes, and on-road motor vehicles for equipment and material deliveries and workers commuting to and from the sites. Grading and activity on unpaved roads and lay-down areas would contribute to PM10 emissions. This impact is potentially significant. Further analysis of air quality impacts is warranted to determine whether the project would conflict with or obstruct implementation of the applicable plans for attainment and, if so, to determine the reasonable and feasible mitigation measures that could be imposed. These issues will be evaluated in the EIR.

b. Short-term construction emissions could significantly contribute to an existing or projected air quality violation of PM10 or ozone standards, requiring the consideration of mitigation measures. This impact is potentially significant and will be evaluated further in the EIR.

c. The KCAPCD is a nonattainment area for the state and federal standards for ozone and PM10. The KCAPCD rules and regulations would apply to all project activities. Cumulative contributions to this basin could be potentially significant. Construction and operational emissions will be analyzed

in the EIR. Project activities during the construction phase may occur within the KCAPCD or other air district jurisdictions. The air quality analysis will include a quantitative discussion of emissions created by this project regardless of the air basin, including such activities as truck trips to deliver panels or employees to the site.

d. No residential buildings have been identified within the boundaries of the project sites. However, several residences have been identified within 2 miles of the project area. The nearest schools and hospital are located in California City, approximately 4 miles to the south of Site 2. Construction-related activity would result in diesel exhaust emissions and dust that could adversely affect air quality for the nearest sensitive receptors. Mitigation measures for diesel equipment and dust control that are recommended by the KCAPCD will be evaluated as part of the EIR to avoid or reduce the impacts to construction workers and occupants of nearby residences.

e. Aside from odors associated with vehicle exhaust and fueling, no odors would result from the proposed project. Because there are only a few potential residences in the vicinity, fueling odors during project construction would not result in impacts on a substantial number of people. Therefore, the proposed project is not expected to result in significant air quality impacts related to objectionable odors, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
IV. BIOLOGICAL RESOURCES. Would the project:				
a. Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special-status species in local or regional plans, policies, or regulations or by the California Department of Fish and Game (CDFG) or U.S. Fish and Wildlife Service (USFWS)?	☒	☐	☐	☐
b. Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations, or by the CDFG or USFWS?	☒	☐	☐	☐
c. Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☒	☐	☐	☐
d. Interfere substantially with the movement of any native resident or migratory fish or wildlife species, or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☒	☐	☐	☐
e. Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f. Conflict with the provisions of an adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Discussion:

a. The project sites are undeveloped, sandy desert land covered by native vegetation and dirt roads. Several special-status plant and animal species have the potential to occur on or near the proposed project sites. Field surveys and detailed reports for special-status plant and animal species and species listed as either threatened or endangered by either the state or federal government will be prepared to support a full discussion of potential impacts in the EIR. Impacts to biological resources are potentially significant and will be analyzed in the EIR.

b. Project-related access roads and transmission lines may cross streams and washes that would require evaluation for riparian habitat and may also require a streambed alteration agreement with

CDFG. The project's impact to sensitive plant communities is potentially significant and will be further evaluated in the EIR.

c. Wetlands, as defined by Section 404 of the Clean Water Act, may be present on the project sites. The project's impacts on potential wetlands will therefore be evaluated in the EIR.

d. The project sites and surrounding areas may be used for migration or dispersal by some avian species (e.g., burrowing owl). Project construction and operation could potentially remove foraging habitat. This impact is potentially significant and will be evaluated in the EIR.

e. As stated above, the project sites are undeveloped sandy desert land covered by native vegetation and dirt roads. There is no local policy or ordinance protecting biological resources applicable to the sites, and the sites are not located within a habitat conservation plan boundary. Impacts would not occur.

f. There is no adopted habitat conservation plan, natural community conservation plan, or other approved local, regional, or state habitat conservation plan applicable to the sites. Impacts would not occur.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
V. CULTURAL RESOURCES. Would the project:				
a. Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?	☒	☐	☐	☐
b. Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?	☒	☐	☐	☐
c. Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☒	☐
d. Disturb any human remains, including those interred outside of formal cemeteries?	☒	☐	☐	☐

Discussion:

a. Development of the project would require some ground disturbance. A cultural resources survey is currently being conducted for the project sites. Further evaluation is warranted to identify potential impacts and formulate avoidance or mitigation measures, if applicable. The results of the cultural resources survey will be discussed in the EIR.

b. An archaeological resources survey of the sites is being completed. Further evaluation is necessary to identify potential impacts and to formulate avoidance or mitigation measures, if applicable. The results of the archaeological resources survey will be discussed in the EIR.

c. Kern County is rich in paleontological resources. Of particular note are the Maricopa and Citric Brea Tar Pits, the Bean Hills Petrified Forest, and Shark Tooth Hill at Round Mountain. Because the proposed project is not located near any of these known paleontological resources or geological features, and construction activities involve relatively shallow excavations and trenching, impacts on paleontological resources are considered to be less than significant. Standard conditions of approval require halting of all ground-disturbing activities if paleontological resources are uncovered during the construction phase. Implementation of these conditions of approval would ensure that impacts on paleontological resources would be less than significant; however, further discussion in the EIR is warranted.

d. Development of the project would require some ground disturbance. There is no evidence that the proposed Project site is located within an area likely to contain human remains. However, there is potential for the inadvertent discovery of human remains during earthmoving activities. If human remains are discovered, further excavation or disturbance would be prohibited pursuant to Section 7050.5 of the California Health and Safety Code. Section 7050.5 of the California Health and Safety Code and Section 5097.98 of the Public Resources Code provide specific measures for addressing the discovery of Native American remains. The potential for human remains to be encountered is a potentially significant impact. This impact will be further analyzed in the EIR. .

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
VI. GEOLOGY AND SOILS. Would the project:				
a. Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i. Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☒	☐
ii. Strong seismic ground shaking?	☒	☐	☐	☐
iii. Seismic-related ground failure, including liquefaction?	☐	☐	☒	☐
iv. Landslides?	☐	☐	☒	☐
b. Result in substantial soil erosion or the loss of topsoil?	☐	☐	☒	☐
c. Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or offsite landslide, lateral spreading, subsidence, liquefaction, or collapse?	☐	☐	☒	☐
d. Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☒	☐	☐	☐
e. Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems in areas where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

Discussion:

a. i. The proposed projects would be located approximately 2 miles from the nearest fault in the vicinity of the Garlock Fault Zone. There are two left-lateral strike slip faults approximately 2 miles north of Site 1. Additionally, there are left-lateral strike slip faults approximately 3.25 miles northwest and approximately 4.5 miles northeast of Site 1, respectively. Construction of the proposed project would be subject to all applicable ordinances of the Kern County Building Code (Chapter 17.08). Kern County has adopted the California Building Standards

Code, 2007 Edition (CCR Title 24), which imposes substantially the same requirements as the International Building Code (IBC), 2006 Edition, with some modifications and amendments. The entire County is located in seismic Zone 4, a designation previously used in the Uniform Building Code (UBC) to denote the areas of the highest risk to earthquake ground motion. Adherence to all applicable regulations would mitigate any potential impacts associated with the proposed project. The proposed project would not have the ability to expose people to adverse impacts resulting from surface rupture of a known earthquake fault. A preliminary geotechnical report is being prepared for this project, and the issue will be evaluated in more detail in the EIR. The proposed project would not have a full-time staff, and no habitable buildings would be constructed. The potential to expose people or structures to potential substantial adverse effects, including risk of loss, injury, or death from rupture of a known fault, would be less than significant.

ii. As in most of Southern California, strong seismic ground shaking could occur at the project site, resulting in damage to structures that are not properly designed to withstand strong ground shaking. The project area is located within a fault zone related to the Garlock Fault, which runs nearby. The operation of the proposed project depends on fixed tilted PV arrays that could be affected by strong ground shaking. As noted above, the proposed project would not require full-time staff for operational activities and activities would be monitored remotely most of the time. In addition, the project would not involve structures that would be occupied for any significant amount of time during either construction or operational activities. Should strong seismic ground shaking occur at the project site, damage to the PV modules and other ancillary facilities would likely result. However, because the proposed project would not establish a permanent onsite population, damage to these onsite structures would not expose substantial numbers of people to potential adverse effects. In addition, construction of the proposed project would be subject to all applicable ordinances of the Kern County Building Code. Furthermore, the structures constructed as part of the project would be required by state law to be constructed in accordance with all applicable IBC and CBC earthquake construction standards, including those relating to soil characteristics. Adherence to all applicable regulations would mitigate any potential impacts associated with seismic ground shaking at the project site. The project would potentially be subject to moderate to strong ground shaking from local and regional earthquakes, particularly if the event occurs on the Garlock Fault. This potential impact will be evaluated in the EIR.

iii. The soil foundations throughout much of Kern County, especially in the desert area of eastern Kern County, are composed of thick, unconsolidated, coarse-textured alluvial sediments of gravel, sand, and silt of granitic composition. Based on information available in the Kern County General Plan Environmental Impact Report, given the great depth to groundwater in the desert area, liquefaction does not present a major potential hazard within eastern Kern County. No habitable buildings would be constructed as part of the project. New construction, including the solar subarrays, would be built to withstand strong ground shaking and would be compliant with the current California Building Code. Consequently, the potential to expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death from strong seismic ground shaking, would be less than significant. The potential for substantial adverse effects due to seismic-related ground failure, including liquefaction, is considered less than significant and further discussion is not warranted in the EIR.

iv. The site topography and that of the surrounding area is flat and is not considered to be a high risk for landslides. Developing the project sites with solar subarrays would not expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death

involving landslides. Impacts would be less than significant and do not warrant further analysis in the EIR.

b. Grading would be required for foundations for each subarray. Construction activities could result in substantial soil erosion if the sites do not employ BMPs. However, a SWPPP would be prepared and would describe BMPs that would be employed to ensure erosion from construction activities such as grading does not occur. During operation, the project would not substantially alter the soils or contribute to soil erosion. Consequently, the project would not result in substantial soil erosion or the loss of topsoil. Impacts from soil erosion would be less than significant.

c. A preliminary soils characterization will be included as part of the project analysis to examine the current baseline stability of the soils that underlie the project area, and the findings of that report will be evaluated in the EIR. While potential impacts are expected to be less than significant, they will be evaluated in the EIR, and mitigation measures will be presented if necessary, to protect both structures and people from adverse effects due to landslide, lateral spreading, subsidence, liquefaction, or collapse.

d. Expansive soils generally result from specific clay minerals that expand when saturated and shrink in volume when dry. The geotechnical report and soils characterization, to be prepared prior to the issuance of the grading or other construction permit, would provide recommendations on treating the soil to ensure the foundations of the solar subarrays and ancillary structures would be sound and would not create substantial risks to life or property. The preliminary soils characterization will confirm the presence or absence of expansive soils within the project area, and those results will be evaluated in the EIR.

e. Neither Site 1 nor Site 2 would include any septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater. Therefore, there would be no impact.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
VII. GREENHOUSE GAS EMISSIONS. Would the project:				
a. Generate greenhouse gas emissions, either directly or indirectly, that may have a significant impact on the environment?	☒	☐	☐	☐
b. Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of greenhouse gases?	☐	☐	☒	☐

Discussion:

a. Greenhouse gases (GHGs) emitted by human activity are implicated in global climate change or global warming. The principal GHGs are carbon dioxide (CO_2), methane (CH_4), NO_X, ozone, water vapor, and fluorinated gases. Fossil fuel consumption in the transportation sector (on-road motor vehicles, off-highway mobile sources, and aircraft) is the single largest source of GHG emissions, accounting for approximately 50% of GHG emissions globally. Construction activities associated with heavy equipment operation, truck deliveries, and construction worker commute trips would temporarily generate GHGs; however, operation of the project is intended to offset GHGs generated by traditional sources of electricity. Potential impacts will be further evaluated in the EIR.

b. California has passed several bills and the governor has signed at least three executive orders regarding GHGs. Assembly Bill (AB) 32 (the Global Warming Solutions Act) was passed by the California legislature on August 31, 2006. It requires the state's global warming emissions to be reduced to 1990 levels by 2020. The reduction will be accomplished through an enforceable statewide cap on GHG emissions that will be phased in starting in 2012.

In 2002, California established its Renewable Portfolio Standard (RPS) Program, with the goal of increasing the percentage of renewable energy in the state's electricity mix to 20% renewable energy by 2017. In 2006, under Senate Bill (SB) 107, the RPS program codified the 20% goal. The RPS program requires electric utilities and providers to increase procurement from eligible renewable energy resources by at least 1% of their retail sales annually until they reach 20% by 2010. On November 17, 2008, the governor signed Executive Order S-14-08, requiring California utilities to reach the 33% renewable goal by 2020. The proposed project is intended to 1) reduce production of power from fossil fuel power plants and 2) contribute to a reduction in GHGs. This issue will be further evaluated in the EIR.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
VIII. HAZARDS AND HAZARDOUS MATERIALS.				
Would the project:				
a. Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☒	☐
b. Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☒	☐
c. Emit hazardous emissions or involve handling hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school?	☐	☐	☐	☒
d. Be located on a site that is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e. Be located within an airport land use plan or, where such a plan has not been adopted, be within 2 miles of a public airport or public use airport, and result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f. Be located within the vicinity of a private airstrip and result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g. Impair implementation of, or physically interfere with, an adopted emergency response plan or emergency evacuation plan?	☐	☐	☒	☐
h. Expose people or structures to a significant risk of loss, injury, or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?	☐	☐	☒	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
i. Generate vectors (flies, mosquitoes, rodents, etc.) or have a component that includes agricultural waste? Specifically, would the project exceed the following qualitative threshold: The presence of domestic flies, mosquitoes, cockroaches, rodents, and/or any other vectors associated with the project is significant when the applicable enforcement agency determines that any of the vectors:				
i. Occur as immature stages and adults in numbers considerably in excess of those found in the surrounding environment; and	☐	☐	☒	☐
ii. Are associated with design, layout, and management of project operations; and	☐	☐	☒	☐
iii. Disseminate widely from the property; and	☐	☐	☒	☐
iv. Cause detrimental effects on the public health or well being of the majority of the surrounding population.	☐	☐	☒	☐

Discussion:

a. The proposed project is not expected to create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials as defined by the Hazardous Materials Transportation Uniform Safety Act. Non-hazardous wastes would be transported from the sites during construction activities, including common household trash, cardboard, wood pallets, copper wire, scrap metal, and wood wire spools. While construction vehicles would contain some hazardous materials, such as diesel fuel, hydraulic oil, grease, solvents, adhesives, paints, and other petroleum based products, these materials are commonly used during construction activities and would not be disposed of on the project sites. All applicable safety standards would be adhered to for the safe handling and use of these materials.

The solar modules themselves contain cadmium telluride, which acts as a semiconductor in solar panels. It has been used successfully in solar panels because it resists corrosion and chemicals, and has a high tolerance for high temperatures. It also has a low melting point and is an excellent conduit of electricity. Cadmium is a byproduct of zinc, lead, and copper mining. Tellurium is a semi-metallic element, which when combined with cadmium produces the compound cadmium telluride (CdTe). A broken panel could result in exposure to CdTe; and improper handling of CdTe can result in respiratory-related health risks. According to the applicant, all workers would be trained to handle any hazardous wastes at the site. As described above, all broken panels would be recycled through a qualified recycling company.

Once operational, the proposed project would not require the routine transport of hazardous material to or from the project sites. On occasion, maintenance activities may produce small

amounts of waste associated with maintenance activities, including broken and rusted metal, defective or malfunctioning modules, electrical materials, empty containers, and other miscellaneous solid wastes, including the typical refuse generated by workers. According to the applicant, most of these materials would be collected and returned to the manufacturer (First Solar, Inc.) for recycling, as part of their established Collection and Recycling Program. Any occasionally defective or broken solar modules would also be returned to the manufacturer for proper recycling as requested by the manufacturer. Operational activities could generate biodegradable dielectric fluid and mineral oil from the transformers and miscellaneous electrical equipment. Spent oil would be collected and delivered to a recycling company at the time it is removed from the equipment, and would not be stored on site. Each transformer would be provided with full secondary containment. However, the mineral oil would not normally require replacement. If required by the Kern County Environmental Health Services Department, Material Safety Data Sheets for all applicable materials present on site would be made readily available to onsite personnel during construction and operations.

There are no designated routes for the transport of hazardous materials located on or immediately adjacent to the proposed project, and the closest route is about 3.5 miles west of the project sites (SR-14). Due to the minimal use of hazardous materials and the low level of risk associated with their use during construction activities, impacts are expected to be less than significant; however, further analysis is warranted in the EIR.

b. According to the California Department of Conservation, the project sites are not located within an oil field and there are no known oil wells on site. As discussed above under issue (a), the use of hazardous materials would be limited to common substances associated with construction vehicles (i.e., gasoline, hydraulic oil, and grease) and does not pose a potentially significant impact due to the release of hazardous materials into the environment. The proposed project would be subject to all local, state, and federal laws pertaining to the use of hazardous materials on site, and would be subject to review by the Kern County Environmental Health Services Department. Through the review process, the proposed project would be required to submit a complete list of all materials used on site, how the materials will be transported, and in what form they will be used; these would be recorded to maintain safety and prevent possible environmental contamination or worker exposure. All onsite workers would be trained to properly identify and handle hazardous waste resulting from the proposed project. Therefore, with adherence to all applicable local, state, and federal laws pertaining to the use and storage of hazardous materials, potential impacts would be less than significant, and no further analysis is warranted.

c. The proposed project sites are located in a predominantly undeveloped and rural area in the central-eastern portion of Kern County, and there are no existing or proposed schools within 0.25 mile of either project site. The nearest schools are approximately 4 miles south of the project sites in California City: California City Middle School and Robert P. Ulrich Elementary School. Additionally, the proposed project is a solar energy generation facility that involves using photovoltaic panels to generate electricity. Project-related infrastructure would not emit hazardous materials or involve handling hazardous or acutely hazardous materials, substances, or waste within 0.25 mile of an existing or proposed school. Therefore, no impacts would occur and further analysis is not warranted.

d. Review of the lists of projects relating to hazardous wastes pursuant to Section 65962.5 of the California Government Code indicates that the project sites are not on the list. There are no known leaking underground storage tanks (LUST) cleanup sites, land disposal sites, military sites, permitted underground storage tank (UST) facilities, or any other cleanup sites within the project boundaries. Therefore, no impacts would occur, and further analysis is not warranted.

e. According the Kern County General Plan, the project is not located within 2 miles of a public or public use airport or within an area covered by the Kern County Airport Land Use Compatibility Plan (ALUCP). The closest military airfield is Edwards Air Force Base, approximately 20 miles to the south. The project is designed to be in conformance with Section 19.08.160 (Height of Structures) of the Kern County Zoning Ordinance to avoid military flight test airspace for Edwards Air Force Base. Therefore, there are no anticipated safety hazards for people residing or working in the project area with respect to the project's proximity to a public or public use airport. Because the project is not located within 2 miles of a public airport or an area covered by the Kern County ALUCP, impacts would not occur.

f. There are no private airports or airstrips located within 2 miles of the project sites. The nearest landing field is the California City Municipal Airport, which is located approximately 2.5 miles northeast of the project sites. None of the approach zones or noise contours related to this airport are in proximity of the project sites. Because the proposed project would not result in potential impacts related to safety hazards for people residing or working in the project area with respect to the project's proximity to a private airport or private airstrip, there would be no impact, and no further analysis is warranted.

g. The proposed project development would not physically impede the existing emergency response plans, emergency vehicle access, or personnel access to the sites. The sites are located in a rural area with several alternative access roads, allowing easy access to the sites in the event of an emergency. Therefore, no impacts related to impairment of the implementation of or physical interference with an adopted emergency response plan or emergency evacuation plan is anticipated. Impacts would be less than significant, and no further analysis is warranted.

h. The project area is in a dry desert climate containing mostly low-lying vegetation; any larger occurrences of vegetation within the project area would be removed during site preparation. The potential for construction and operation of the proposed project to result in increased risk of wildfires in the project area is considered to be "Moderate." Project operations would not include permanent employees or personnel, and the project sites are not located adjacent to urbanized areas or areas where residences are intermixed with wildlands. Project approval would be subject to any ordinances, codes, or regulations regarding wildfire protection by the Kern County General Plan Safety Element and the Kern County Fire Code (Chapter 17.32), and would be reviewed for adherence to prevention measures for wildland fires. Consequently, the proposed project is not expected to result in exposure of people or structures to a significant risk of loss, injury, or death involving wildland fires. Impacts related to wildland fires are less than significant and do not warrant further evaluation in the EIR.

i. The proposed project is a solar energy generation facility that would result in construction of PV panels and operations and maintenance facilities. Project-related infrastructure is not expected to result in features or conditions (such as standing water, agricultural products, agricultural waste, or human waste) that would provide habitat for vectors such as mosquitoes, flies, cockroaches, or rodents. Workers would generate small quantities of solid waste (i.e. trash) that would be appropriately stored for permanent disposal. Therefore, impacts would be less than significant, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
IX. HYDROLOGY AND WATER QUALITY. Would the project:				
a. Violate any water quality standards or waste discharge requirements?	☐	☐	☒	☐
b. Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level that would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☒	☐
c. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner that would result in substantial erosion or siltation on site or off site?	☒	☐	☐	☐
d. Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner that would result in flooding on site or off site?	☒	☐	☐	☐
e. Create or contribute runoff water that would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☒	☐	☐	☐
f. Otherwise substantially degrade water quality?	☒	☐	☐	☐
g. Place housing within a 100-year flood hazard area as mapped on a federal flood hazard boundary or flood insurance rate map or other flood hazard delineation map?	☐	☐	☐	☒
h. Place within a 100-year flood hazard area structures that would impede or redirect flood flows?	☒	☐	☐	☐

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
i. Expose people or structures to a significant risk of loss, injury, or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒
j. Contribute to inundation by seiche, tsunami, or mudflow?	☐	☐	☒	☐

Discussion:

a. The sites are within the RWQCB Lohatan Region. Prior to project construction, a SWPPP would be prepared and would describe the BMPs that would be required during the construction phase. BMPs would eliminate substantial soil erosion and significantly reduce water runoff from the sites. A Notice of Intent for the inclusion in the General Permit for Construction activities would also be filed prior to construction. During operation, only the limited foundations associated with the subarrays and ancillary structures would be impervious. Internal access roads would be kept to a minimum and would use pervious surfaces such as crushed granite to allow for ground absorption. Implementation of the SWPPP and adherence to the applicable regulations would reduce potential water quality impacts to a less-than-significant level.

b. During construction, water use would be limited to ground conditioning and dust suppression. The applicant proposes to provide bottled water during construction for onsite employees. Water may also be used to ensure that large amounts of soil do not accumulate on rights-of-way. All water used during construction would be brought to Site 2 by truck from a local water delivery provider and stored at the site in portable tanks. Water would be required during operations to periodically wash the PV modules. It is anticipated that 1 gallon would be required for each solar module twice annually. With 3,085,020 modules on the site, water usage is estimated to be 3,085,020 gallons (9.5 acre feet) per washing, or 6,170,040 gallons (19 acre feet) per year, assuming two washings per year. Water would be trucked in to the sites, and would not be supplied from local groundwater. Therefore, the project would not substantially deplete groundwater supplies. Because the project would not add a considerable amount of impervious surfaces, the project would not interfere substantially with groundwater recharge. This impact would be less than significant, and no further analysis is warranted.

c. The project sites are topographically flat. Review of the FEMA Flood Insurance Rate Maps indicates that the sites are within Flood Zone A, which means the sites have an estimated 1% chance of annual flooding. The project would require the construction of concrete pads for each array and fencing around the entire sites. The construction of the concrete pads for installation of the arrays would have the potential to slightly alter the existing drainage pattern of the sites or area. However, incorporation of design measures would reduce impacts to a less-than-significant level by employing design techniques and best management practices. Nevertheless, these impacts are potentially significant. Evaluation of impacts to drainage patterns of the sites will be evaluated in the EIR.

d. As noted above, the sites are within Flood Zone A, and flood impacts are potentially significant. This issue will be evaluated in the EIR.

e. See response to (a) above. During construction and following installation of the solar arrays, the vast majority of the site will remain as pervious soils. The design of the solar arrays is such that stormwater will receive full access to the pervious ground surface and infiltration would occur similar to existing conditions. No component of the project would concentrate runoff and exceed the capacity of existing or planned stormwater drainage systems. Similarly, no component of the project is considered a substantial source of polluted runoff. A SWPPP would be implemented during construction that would reduce water runoff pollutants and runoff volumes. Operations would not substantially increase impervious surface area because there would still be natural surfaces throughout much of the sites that would allow for ground absorption. Further analysis is required to identify appropriate mitigation/design measures and evaluate their effectiveness. As a result, the impacts from potentially increasing surface runoff will be further evaluated in the EIR

f. Project construction activities (such as grading) could potentially degrade water quality through erosion and subsequent sedimentation of streams. Additionally, accidental release of potentially harmful materials—such as engine oil, diesel fuel, and cement slurry—could degrade the water quality of nearby streams. Implementation of BMPs (through the SWPPP) would likely reduce the impact of project activities on surrounding water quality. However, this potential impact will be further evaluated in the EIR.

g. The proposed project does not include housing. Therefore, the project would not place housing in a flood zone, and no further analysis is warranted.

h. As noted above, the sites are within Flood Zone A, and flood impacts are potentially significant. This issue will be evaluated in the EIR.

i. The project is not located near water bodies contained by dams or levees. Therefore, the project would not be affected by dam or levee failure, and no further analysis is warranted.

j. The project is not located near an ocean or enclosed body of water and would not be subject to inundation by seiche or tsunami. A mudflow is a type of mass wasting or landslide where earth and surface materials are rapidly transported downhill under the force of gravity. Mudflow events are caused by a combination of factors, including soil type, precipitation, and slope. Mudflows may be triggered by heavy rainfall that the soil is not able to sufficiently drain or absorb. As a result of this super-saturation, soil and rock materials become unstable and eventually slide away from their existing location. However, the project is several miles from the Rand Mountains to the east. The potential for project structures to be inundated by mudflow is less than significant, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
X. LAND USE AND PLANNING. Would the project:				
a. Physically divide an established community?	☐	☐	☒	☐
b. Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to, the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☒	☐
c. Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

Discussion:

a. The project sites are both on vacant land, which is similar to the immediately surrounding areas. The nearest established communities include California City, located approximately 4 miles south of the proposed sites, and a small residential community in unincorporated County land approximately 1.5 miles west of the sites. Constructing the project would not block access to and from these communities or otherwise divide a community. Therefore, impacts would be considered to be less than significant, and no further analysis is warranted.

b. The proposed project sites are zoned A (Exclusive Agriculture), A FP (Exclusive Agriculture, Floodplain Combining), and a map code designation of 8.5 (Natural Resources) by the Kern County General Plan. The proposed project involves the development of Site 1, a 100-MW solar PV power generating facility on 646.7 acres of vacant land and Site 2, a 96-MW solar PV power generating facility on 638 acres. Surrounding parcels are variously zoned A, A FP, PL RS (Platted Lands, Residential Suburban Combining), RF (Recreation Forestry), and PL RS MH (Platted Lands, Residential Suburban Combining, Mobilehome Combining). Development of this type is considered an Energy Development Use, which is conditionally permitted in the sites' zoning designation, subject to the requirements and procedure of a CUP, per the Kern County Zoning Ordinance (Chapter 19.12). Discretionary review of the proposed project and the approval of a CUP would confirm the project's consistency with the Kern County General Plan and Zoning Ordinance adopted for the purpose of avoiding or mitigating an environmental effect. No other additional land use plan, policy, or regulation of an agency with jurisdiction over the project applies to either site, and, as such, project impacts would remain less than significant. However, land use policies and regulations will be further discussed in the EIR.

c. The proposed project is not within the boundaries of any adopted habitat conservation plan or natural community conservation plan; therefore, no impact would occur.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XI. MINERAL RESOURCES. Would the project:				
a. Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b. Result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan?	☐	☐	☐	☒

Discussion:

a. Kern County contains numerous mining operations including, but are not limited to, sand and gravel, stone, gold, dimensional stone, limestone, clay, shale, gypsum, pumice, decorative rock, silica, and specialty sand. Neither Site 1 nor Site 2 is located in an area designated as a Mineral Resources Zone (MRZ) by the Department of Geology, Mines, and Reclamation. Site 1 is located in an area with a clay deposit approximately 3.75 miles to the northwest, a Halsey deposit approximately 5.25 miles to the northeast, and a Daly deposit approximately 5.75 miles to the north east. Site 2 is located approximately 7.25 miles from three uranium mineral resource zones in the southeast. However, no mineral resources have been identified on site. Consequently, the project would not result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state. Therefore the project would have no impact on future mineral development, and no further analysis is warranted.

b. Based on a review of California Geological Survey publications, parts of Kern County are rich in mineral deposits. However, no mineral resources have been identified on Site 2y the local general plan, a specific plan, or other land use plan. Therefore, implementation of the project would not result in the loss of availability of a locally important mineral resource recovery site delineated on a local general plan, specific plan, or other land use plan. The proposed project has an approximate lifespan of 25 years, after which the arrays could be removed should it be necessary; therefore, installation of the arrays would not preclude future onsite mineral resource development, nor would the project result in the permanent loss of a locally important mineral resource recovery site. There would be no impact, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XII. NOISE. Would the project:				
a. Expose persons to, or generate, noise levels in excess of standards established in a local general plan or noise ordinance or applicable standards of other agencies?	☐	☐	☒	☐
b. Expose persons to or generate excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c. Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
d. Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
e. Be located within the Kern County Airport Land Use Compatibility Plan, and expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f. Be located in the vicinity of a private airstrip and expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒

Discussion:

a. Land uses determined to be sensitive to noise as defined by the Kern County General Plan include residential areas, schools, convalescent and acute care hospitals, parks and recreational areas, and churches. The majority of the area surrounding the proposed project is rural with some residential development occurring about 1.5 miles west of the project. There are a few scattered residences within 1 mile of the proposed project sites. The closest concentrated residential community is approximately 1.5 miles to the west. No schools, convalescent and acute care hospitals, parks and recreational areas, or churches were identified within the vicinity of the project.

There would be little noise associated with operation of the project, limited to infrequent maintenance activities. The temporary noise generated would be during construction activities through the use of vehicles and equipment on the sites. Construction activities would only occur during daylight hours between Monday and Friday. Moreover, the project would fully comply with the noise ordinance of the Kern County Zoning Ordinance.

As previously mentioned, there are no sensitive land uses located within 150 feet of the project site. Other sensitive receptors in the project area would be exposed to construction noise at

incrementally lower levels. Because the noise source would be unobstructed by topography, the residences may hear faint repetitive noise when outdoors. Construction noise would have a less-than-significant impact on the nearest sensitive receptors. Therefore, the impact is considered to be less than significant, and no further analysis is warranted.

b. The proposed project is not located within proximity of sensitive receptors, and construction activities are not expected to involve pile drivers, jackhammers, or other machinery and equipment that would typically contribute to excessive groundborne vibrations and noise levels. Project-related impacts are considered to be less than significant. Because of the limited potential for project construction to result in groundborne vibration or noise at any residences or other sensitive receptors, no further analysis of ground-borne vibration and groundborne noise is warranted.

c. The project would not introduce permanent noise sources from general maintenance. Once the project is constructed, personnel would visit the sites periodically for inspection, security, maintenance, and system monitoring purposes, which are not expected to substantially increase ambient noise levels. Impacts are expected to be less than significant, and no further analysis is warranted.

d. Heavy equipment use during construction would cause a temporary or periodic increase in ambient noise levels. As discussed above under issues a and b, sensitive noise receptors are not located within the immediate project vicinity, and temporary or periodic increases in ambient noise levels caused by construction activities would be subject to Kern County Zoning Ordinance for construction noise. As such, impacts are expected to be less than significant, and no further analysis of project-related construction noise levels is warranted.

e. The proposed project is not located within the Kern County Airport Land Use Compatibility Plan. The nearest public airstrip is the California City Airport, located 2.5 miles southwest of the project sites. The nearest military air field is Edwards Air Force Base, approximately 20 miles south of the project. Noise from this facility would have little or no effect on workers at the project site. Therefore, the proposed project is not expected to result in significant impacts to noise, and no further analysis related to public airports is warranted.

f. The proposed project is not located within the vicinity of any known private airstrips. The nearest landing field is the California City Municipal Airport, which is located approximately 2.5 miles southwest of the project site. None of the approach zones or noise contours related to this airport are near the project site. There would be no impacts, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XIII. POPULATION AND HOUSING. Would the project:				
a. Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☒	☐
b. Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c. Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Discussion:

a. Although the proposed project would provide new employment consistent with adopted Kern County goals, plans, and policies, long-term employment opportunities would be minimal. The project would require up to 60 temporary workers at any one time (if the installation of both sites occurs simultaneously), which would be a minimal increase in employment over the 18 month construction period given the project area's existing population. Construction workers are expected to travel to the sites from various locations throughout southern California, and the number of workers expected to relocate to the surrounding area is not expected to be substantial. If temporary housing should be necessary, it is expected that accommodations would be available in the nearby communities of Tehachapi, California City, Fremont Valley, Mojave, Sand Canyon, and Twin Oaks. Therefore, the proposed project would not directly or indirectly induce the development of any new housing or businesses. Operation of the proposed project would not require permanent full-time or part-time resident staff but personnel would periodically visit the sites for inspection, security, maintenance, and system monitoring purposes. However, given the scope of the existing population and available housing in the area, this increase is not considered significant.

Typical established local thresholds of significance for housing and population growth pursuant to the State CEQA Guidelines, Section 15064.7, include effects that would induce substantial growth or concentration of a population beyond County projections, alter the location, distribution, density, or growth rate of the population beyond that projected in the Housing Element, result in a substantial increase in demand for additional housing, or create a development that significantly reduces the ability of the County to meet housing objectives set forth in the General Plan Housing element. The effects of the proposed project in relation to these local thresholds are minimal.

Although the project would produce additional electricity, it is intended to meet the demand for energy that is already projected based on growth in communities around California. As such, the generation of electricity by the proposed project would be considered growth accommodating, rather than growth inducing. The project's electricity would offset and fully replace electricity

generated by fossil fuels, thereby contributing to California's renewable energy goals. This will be discussed in the growth-inducing effects chapter of the EIR.

b, c. The project is proposed to be sited on lands that are currently vacant. No residences would be displaced, nor would people be displaced by this project. No impacts are expected by this project.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XIV. PUBLIC SERVICES. Would the project:				
a. Result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times, or to other performance objectives for any of the public services:				
Fire protection?	☒	☐	☐	☐
Police protection?	☒	☐	☐	☐
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☒	☐
Other public facilities?	☐	☐	☒	☐

Discussion:

a. **Fire Protection:** The Kern County Fire Department provides fire suppression and emergency medical services to the project area. The primary fire station that would serve the project area is the Mojave Fire Station #14, located approximately 14 miles southwest of the project sites. The proposed project sites are within the unzoned Local Responsibility Area (LRA) designation of the Department of Forestry and Fire Protection's Fire Hazard Severity Zone. No habitable structures would be built on site. The structures would be limited to the solar subarrays and ancillary structures. No permanent staff would be on site. However, construction and operation activities may result in increased risk of wildfire, which could impact fire fighting capacity in the area. The potential impact on fire services from construction in an LRA area and operation of the solar panels is therefore potentially significant and will be evaluated in the EIR.

Police Protection: Police protection services in the proposed project area are provided by the Kern County Sheriff's Department. The nearest station is the Mojave Substation, located approximately 13.8 miles southwest of the project sites. Although the potential is low, the project may attract vandals or other security risks, and construction activities could temporarily result in increases in traffic volumes along Neuralia Road, 90th Street, Harriet Avenue, Dodson Avenue, Phillips Road, Washburn Boulevard, and SR-14 that could increase demand on law enforcement services. Onsite security would be provided, including 8-foot slatted fencing with barbed wired at the top. Access to the sites would be limited to the areas surrounding the project sites during construction and operation, thereby minimizing the need for police surveillance and response. However, the project may require new or expanded facilities to maintain acceptable service ratios, response times, or to

keep other performance objectives for police services. The impact would is potentially significant and will be further evaluated in the EIR.

Schools: During project construction, a relatively small number of construction workers (up to an average of 30 workers per site) would be required. However, it is expected that most of these workers would commute to the project sites from surrounding communities. Therefore, substantial temporary increases in population that would adversely affect local school populations are not expected. Likewise, the operation workforce is not expected to generate a permanent increase in population that would impact school populations. There would be no impact, and no further analysis is warranted.

Parks: The population increase that would be experienced during the construction phase of the proposed project would be small, if at all, and would be temporary. The project would not require new or expanded park facilities to maintain acceptable service ratios or to keep other performance objectives. Impacts on parks would be less than significant, and no further analysis is warranted.

Other Public Services: The population increase that would be experienced during the construction phase of the proposed project would be small, if at all, and would be temporary. The project would not require new or expanded post office and library facilities to maintain acceptable service ratios or to keep other performance objectives. Impacts on post office and library facilities would be less than significant, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XV. RECREATION. Would the project:				
a. Increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☒	☐
b. Include recreational facilities or require the construction or expansion of recreational facilities that might have an adverse physical effect on the environment?	☐	☐	☒	☐

Discussion:

a, b. The project does not include new recreational facilities. The temporary increase of population during construction that might be caused by an influx of workers would be minimal. As a result, there would not be a detectable increase in the use of parks. Impacts would be less than significant, and no further analysis is warranted.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XVI. TRANSPORTATION AND TRAFFIC. Would the project:				
a. Cause an increase in traffic that is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in the number of vehicle trips, the volume-to-capacity ratio on roads, or congestion at intersections)?	☒	☐	☐	☐
b. Exceed, either individually or cumulatively, a level of service (LOS) standard established by the county congestion management agency or adopted county threshold for designated roads or highways? Specifically, would implementation of the project cause the LOS for roadways and/or intersections to decline below the following thresholds or further degrade already degraded segment(s):				
i. Metropolitan Bakersfield General Plan LOS "C"?	☐	☐	☒	☐
ii. Kern County General Plan LOS "D"?	☒	☐	☐	☐
iii. Tehachapi Specific Plan LOS "C"?	☐	☐	☐	☒
c. Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☒	☐	☐	☐
d. Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☒	☐
e. Result in inadequate emergency access?	☐	☐	☒	☐
f. Result in inadequate parking capacity?	☐	☐	☐	☒
g. Conflict with adopted policies, plans, or programs supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☒	☐

Discussion:

a. Access to Site 1 is provided by Neuralia Road, which travels in a north-south direction, connecting to SR-14 to the north and California City to the south. The site is bound by dirt roads Harriet Avenue and Dodson Avenue to the north and south, respectively. Access to Site 2 is also provided by Neuralia Road and is bound by dirt roads Phillips Road and Washburn Boulevard to the north and south, respectively. The proposed project would not include permanent employees or staff; however, operations would be conducted on an unstaffed basis and monitored remotely. Personnel would visit the sites periodically for inspection, security, maintenance, and system monitoring purposes.

Construction of the proposed project is expected to take approximately 18 months for both sites. Construction activities would include a total of five phases including site preparation, underground work, system installation, testing, and clean up/restore. The average number of construction workers would range from 10 to 15 during any given phase of the project with a largest average of 30 workers at the system installation phase.

In addition to vehicle trips generated by construction workers traveling to the sites, construction of the project would add vehicle trips to the area roadway system through delivery of construction equipment and materials. Delivery of construction material would require a number of oversized vehicle trips that may travel at slower speeds than existing traffic and, due to their size, may intrude into adjacent travel lanes. These oversized trips may decrease the existing level of service (LOS) on area freeways, roadways, and intersections. Additionally, the total number of vehicle trips associated with all construction-related traffic (including construction workers) could temporarily increase daily traffic volumes traveling on local roadways and intersections. Furthermore, stringing activities required for transmission line infrastructure may require temporary lane closures that may result in temporary traffic delays on affected roadways. A traffic generation count is being prepared for the project. These potential impacts on the local roadway system from construction-related vehicle trips will be evaluated in the EIR.

b. i, ii. Construction of the project would result in increased vehicle trips on roadways in the project area; however, construction workers are expected to travel to the sites from various locations throughout the region. Due to the relatively small number of workers expected (between an average of 15 and 30), increased trips would not be expected to result in a substantial number of trips on roadways in the metropolitan Bakersfield area. Construction of the project would generate construction trips related to materials delivery and larger construction-related vehicles that may require roadway lane closures. This potential to temporarily increase the daily traffic volumes on local roadways and intersections could be significant. As such, daily traffic volumes will be included in the traffic generation count being prepared and will be evaluated in the EIR.

Once constructed, operations would employ a relatively small number of staff, including solar panel technicians, operations and administrative personnel, and managers. All of these employees would be off site. Site operations would be conducted on an unstaffed basis and monitored remotely. Personnel would visit the sites periodically for inspection, security, maintenance, and system monitoring purposes. Given the foregoing information, the project's operational impacts on the regional Kern County traffic/circulation system are expected to be less than significant, but further analysis of this issue is warranted in the EIR.

iii. The project site is not located within the boundaries of the Tehachapi Specific Plan; therefore, no impacts would occur and further analysis of this issue is not warranted in the EIR.

c. The proposed project is located approximately 2.5 miles northeast of the California City Airport. The Edwards Air Force Base airfield is located 20 miles to the southeast. The project sites are not within the Airport Land Use Compatibility Plan area. As noted in Section 1.2, "Environmental Setting," the proposed project is subject to the Military Aviation section of the ALUCP, and is located in a "red" zone, which requires military review of all structures exceeding a height of 200 feet. While it is not anticipated that the project would interfere with airspace due to the relatively short height of the arrays and their non-reflective surface, a complete review and discussion will be included in the EIR and reviewed by the appropriate airport and military contacts.

d. Project-related traffic is expected during project construction and occasionally during periodic site visits. No unsafe design features are proposed as a part of the project. Project traffic would enter and exit Site 1 and Site 2 from a proposed gated access point off of Neuralia Road designed to accommodate large delivery trucks. The proposed gated access point and the compacted road-base parking and staging area would be constructed in accordance with Kern County roadway and parking construction standards. County traffic engineering would review the site access and circulation plans to ensure no design features would result in a substantial hazard increase.

   The project includes a CUP to allow for energy development projects and would be consistent with the Kern County General Plan and Zoning Ordinance. As such, impacts related to hazards or incompatible uses would be less than significant.

e. As described in the response to (a) above, construction of the project would generate construction trips and potential roadway lane closures, which could temporarily increase the daily traffic volumes on local roadways and intersections, thereby impeding emergency access. However, the project construction sites would be in remote areas with minimal traffic. Traffic that is present could be easily diverted. Thus, the potential for project-related traffic to result in inadequate emergency access is less than significant, and no further analysis is warranted.

f. As described in the response to (a) above, construction of the project would generate construction trips and potential roadway lane closures, which could temporarily reduce roadway parking. However, designated parking spaces do not exist along the roadways in the project area; therefore, construction-related traffic and roadway lane closures would not result in a reduction of available public parking supply. Additionally, construction vehicles would park at the construction staging areas located on the project sites and would not result in a reduction of available public parking. No impact would occur, and this issue will not be further evaluated in the EIR.

g. As described in the response to (a) above, construction of the project would generate construction trips and potential roadway lane closures, which could temporarily disrupt any bicycle traffic on local roadways. However, due to the rural nature of the project area, no bus stops or designated bicycle lanes exist on the roadways likely to be used during construction and operation. Furthermore, it is estimated that only an average of 15–30 workers would be on each site at one time; commuting trips would be minimal. The EIR will consider how traffic impacts, if any, can be mitigated through ride-sharing and by limiting mid-day trips off site for lunch by providing food on site. The EIR will also discuss how the project conforms to General Plan policies supporting alternative transportation.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XVII. UTILITIES AND SERVICE SYSTEMS. Would the project:				
a. Exceed wastewater treatment requirements of the applicable regional water quality control board?	☐	☐	☒	☐
b. Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c. Require or result in the construction of new stormwater drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☒	☐
d. Have sufficient water supplies available to serve the project from existing entitlements and resources, or would new or expanded entitlements be needed?	☐	☐	☐	☒
e. Result in a determination by the wastewater treatment provider that serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f. Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☒	☐
g. Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

Discussion:

a. The proposed project would generate a minimal volume of wastewater. During construction, the proposed project would require up to 60 temporary workers during construction, if installation of the two sites occurs simultaneously. Wastewater would be contained within portable toilet facilities and disposed of at an approved site. The Kern County Environmental Health Services Department is responsible for monitoring the use of portable toilet facilities, and a condition of approval would require the applicant to provide documentation of a portable toilet pumping contract. During operation, the proposed project would not generate any wastewater because there would be no employees on site. Employees would only be on site two to four times a year to wash the solar modules. At those times, wastewater would be contained within portable toilet facilities and

disposed of at an approved site. Impacts would be less than significant, and no further analysis is warranted.

b. The proposed project would not require the construction of new water or wastewater treatment facilities or expansion of existing facilities because there would be no permanent employees on site. Bottled water would be used for drinking when employees are on site for construction and during routine solar module cleaning. Water for washing the panels would be purchased from the local purveyor and brought in by water trucks. Construction would employ portable toilet facilities that would be properly emptied off site by the provider. Because the proposed project would provide its own water source, it would not affect existing water supply systems. Because the project is not proposing the construction of any new facilities, no impact would occur and no further analysis is warranted.

c. Although the project would create a minor amount of impervious surface area and may require water to be imported for dust suppression during construction and the washing of panels two to four times a year, these changes would not substantially increase the amount of stormwater runoff. The project area is drained by natural stream channels and does not rely on constructed stormwater drainage systems. As stated in Section IX(c), the pattern and concentration of runoff could be altered by project activities, such as grading of the sites and roads, and would comply with the National Discharge Pollution Prevention System (NPDES) through implementation of the SWPPP to contain water on site from construction. Impacts would be less than significant, and any further analysis will be discussed in the Hydrology and Water Quality Section of the EIR.

d. The proposed project would bring non-potable water to the sites by truck. This water would only be used during construction and in the maintenance activities that would take place two to four times a year. During operation, water would be used at approximately 1 gallon per solar module per cleaning, which would amount to a relatively small quantity of water considering the zoning designation of Exclusive Agriculture. There would be no impact on the existing entitlements, and this would not require new or expanded entitlements. The proposed project would have sufficient water supplies. Therefore, there would be no impact, and no further analysis is warranted.

e. The project would not entail construction of any permanent onsite restroom facilities. Construction would employ portable toilet facilities that would be properly emptied off site by the provider. Therefore, the project would not require use of a wastewater treatment plant and would not construct a septic system. Consequently, there would be no impacts to existing wastewater treatment facilities, and no further analysis is warranted.

f. The project would require recycling to the maximum extent feasible, in support of AB 939. The project is not expected to generate a significant amount of waste that would exceed the capacity of local landfills. Most of the materials would be prefabricated in the factory (e.g. solar modules, structural assembly, inverters, etc). Few residual materials are expected. Non-hazardous construction refuse and solid waste would be disposed of at a local landfill, while any hazardous waste generated during proposed project construction would be disposed of at an approved location. As noted in Section VIII, the applicant states that most of the broken or unused solar panel materials would be collected and returned to the manufacturer (First Solar, Inc.) for recycling, as part of their established Collection and Recycling Program. The amount of solid waste generated by the proposed project sites would not exceed the capacity of local landfills ability to accommodate the waste. Impacts would be less than significant, and no further analysis is warranted.

g. The proposed project would generate some solid waste during construction and very little during operation of the project. However, most of the materials would be prefabricated in the factory (e.g., solar modules, structural assembly, inverters, etc) and few residual materials are expected. As noted

in (f), above, the project proponent would recycle via the manufacturer's solar panel materials recycling program. Additionally, the project would be subject to recycling to the maximum extent feasible in support of AB 939, which requires Kern County to attain specific waste diversion goals. Because it is expected that little waste would be created and that which is created would be recycled to the maximum extent feasible, the project would fully comply with federal, state, and local statutes and regulations related to solid waste and there would be no impact.

Issues (and Supporting Information Sources):	Potentially Significant Impact	Less than Significant with Mitigation Incorporated	Less-than-Significant Impact	No Impact
XVIII. MANDATORY FINDINGS OF SIGNIFICANCE.				
a. Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, substantially reduce the number or restrict the range of a rare or endangered plant or animal, or eliminate important examples of the major periods of California history or prehistory?	☒	☐	☐	☐
b. Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are significant when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects.)	☒	☐	☐	☐
c. Does the project have environmental effects that would cause substantial adverse effects on human beings, either directly or indirectly?	☒	☐	☐	☐

Discussion:

a. The EIR's biological resources section will discuss specific project impacts on plants and wildlife, including avian species. The document will also evaluate the project's contribution to cumulative biological resources impacts and, where deemed necessary, will propose mitigation that will reduce any cumulative impact. In addition, the cultural resources section will discuss the potential for the project to eliminate important examples of the major periods of California history or prehistory.

b. The project has the potential to contribute to cumulatively considerable impacts on aesthetics, air quality (construction only), biological resources, cultural resources, geology, greenhouse gas emissions, hydrology and water quality, public services, and traffic and transportation. The EIR will evaluate the project's contribution to cumulative impacts in these and other areas as further impacts are identified.

c. Although there may be significant air quality impacts during construction, the long-term air quality impacts could be beneficial if fossil fuel use is reduced. The health impacts from the short-term cumulative contribution to air quality impacts will be evaluated in the EIR.

Declaration

I, Matt Hagemann, declare as follows:

1. I am presently employed as a Geologist at Soil Water Air Protection Enterprise. I make this declaration from my personal knowledge. If called as a witness, I could testify competently to facts stated in this declaration.

2. I prepared the attached map outlining the approximate boundaries of the following:

a. The proposed Beacon Solar Energy Project using the proposed site location in the Beacon Solar Energy Project Application for Certification found at http://www.energy.ca.gov/sitingcases/beacon/documents/index.html;

b. The proposed Cal City Solar Project and Barren Ridge Solar Project using the proposed site locations in Kern County's Notice of Preparation found at http://www.co.kern.ca.us/planning/pdfs/notices/enxco_desert_solar_nop.pdf; and

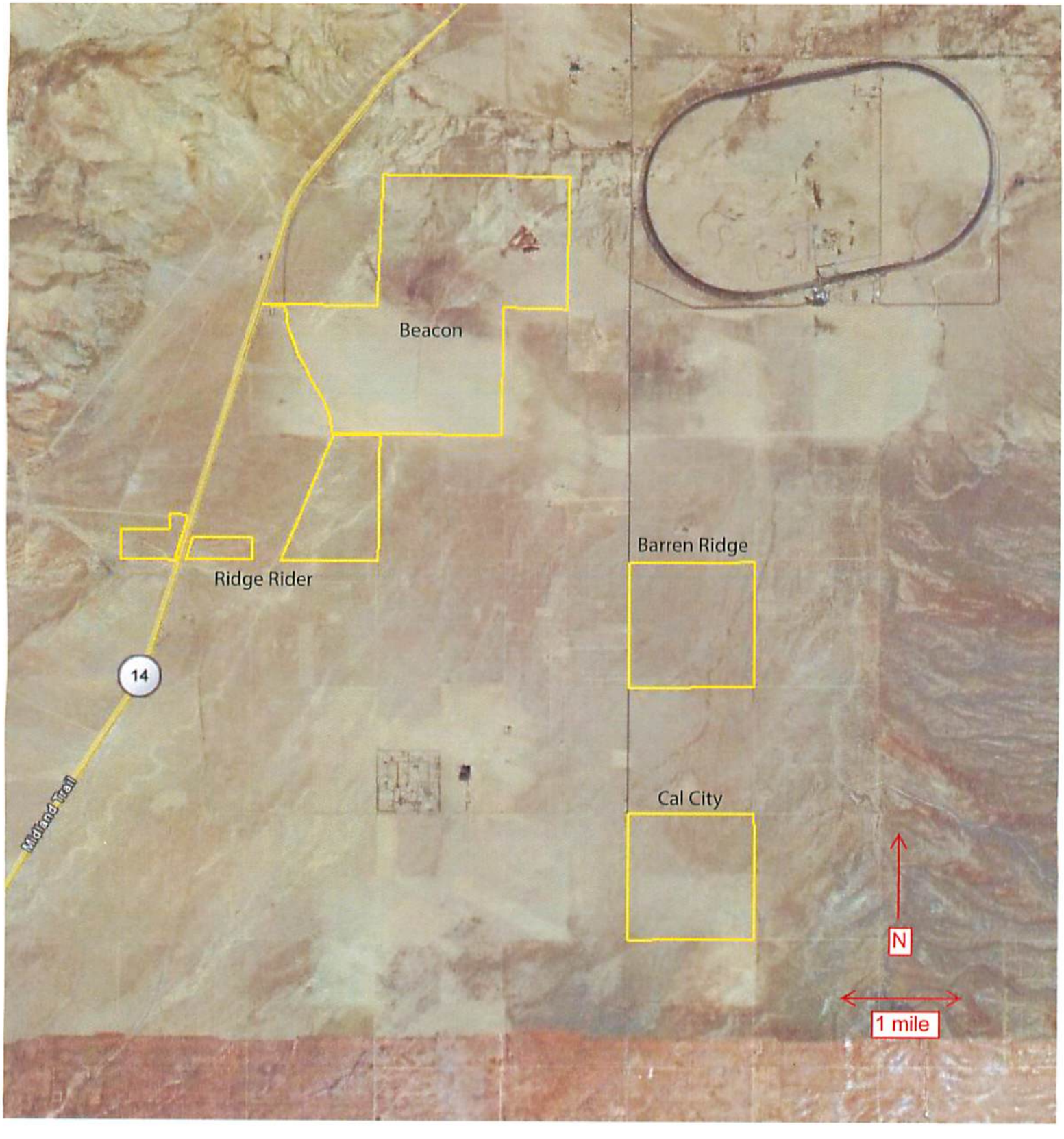
c. The proposed Ridge Rider Solar Park Project using the proposed site location in Kern County's Notice of Preparation found at http://www.co.kern.ca.us/planning/pdfs/notices/ridge_rider_solar_nop.pdf.

3. I declare under penalty of perjury under the laws of the State of California that the foregoing is true and correct.

Executed this 28 day of May, 2010, at Newport Beach California.

Matt Hagemann

M Hagemann


Beacon
Ridge Rider
Barren Ridge
Cal City
14
Midland Trail
N
1 mile

199910103'7

BOYLE

2601 F Street (93301)
P.O. Box 670, Bakersfield, CA 93302
TEL: (661)325-7253
FAX: (661)395-0359
www.boyleengineering.com

STATE CLEARINGHOUSE
1400 Tenth Street, Room 121
Sacramento, CA 95814

October 6, 1999

Consultation Process on Proposed Negative Declaration for
Rosamond Community Services District
Wastewater Treatment Plant Expansion

The Rosamond Community Services District (RCSD) has determined that preparation of a negative declaration is appropriate for the referenced project. As required by Section 15073 of the State CEQA Guidelines, we are submitting the proposed Negative Declaration to all responsible agencies for consultation. This consultation is requested by RCSD to reflect the environmental concerns of the responsible agencies involved with the project

If a response is not received from your agency within 30 days, we will assume that your agency has no comment.

Should you have any questions, please feel free to contact me.

Boyle Engineering Corporation

Ben P. Horn, P.E.
Project Manager

MAR 2006
Received
Fish & Game
Region 4

Enclosure: As Noted

Copies to:
RCSD

R0413000\Ltr(StateClearinghouse)1099.doc

Appendix C

NOTICE OF COMPLETION

State of California
Office of Planning and Research
1400 Tenth Street
Sacramento, California 95814

MAR 2006
Received

Project Title:
RCSD Wastewater Treatment Plant Expansion

Project Location — Specific:
Sections 27 and 34, T9N, R12W, SBBM.

Project Location — City:
Rosamond

Project Location — County:
Kern

Description of Nature, Purpose, and Beneficiaries of Project:
The purpose of the proposed project is to increase the treatment capacity of the existing wastewater treatment plant in order to meet the disposal needs of the Rosamond Community Services District, which provides service to the community of Rosamond. As the community of Rosamond continues to grow, the wastewater treatment plant must be able to keep up with the treatment demands. The proposed project would include both expansions to the existing treatment facilities and also the addition of new effluent disposal facilities. The community of Rosamond as a whole stands to benefit from the proposed facilities improvements.

Lead Agency:
Rosamond Community Services District

Division:

Address Where Copy of Negative Declaration / Initial Study is Available:
Rosamond Community Services District
2700 20th Street West
Rosamond, CA 93560

Review Period:
30 days

Contact Person:
Sherry DeLano

Area Code / Phone / Extension:
(661) 256-3411

Mail to: State Clearinghouse, 1400 Tenth Street, Room 121, Sacramento, CA 95814 — 916/445-0613

Notice of Completion and Environmental Document Transmittal Form

See NOTE below
SCH # _____

1. Project Title: Rosamond Community Services District, Wastewater Treatment Plant Expansion
2. Lead Agency: Rosamond Community Services District
3. Contact Person: Sherry DeLano
3a. Street Address: 2700 - 20th Street West
3b. City: Rosamond
3c. County: Kern
3d. Zip: 93560
3e. Phone: (661) 256-3411

Project Location

4. County: Kern
4a. City/Community: Rosamond
4b. Assessor's Parcel No. 471-190-(09,27,28,32,33)
4c. Section: 27,34 Twp. 9N Range: 12W Base: SBBM
5a. Cross Streets: Patterson Rd. & Sierra Hwy
5b. For Rural, Nearest Community: Rosamond
6. Within 2 Miles: a. State Hwy #: 14
b. Airports: _____
c. Railways: Southern Pacific (SPRR)
d. Waterways: _____

7. Document Type

CEQA:
- ☐ 01. NOP
- ☐ 02. Early Cons
- ☒ 03. Neg Dec
- ☐ 04. Draft EIR
- ☐ 05. Supplement/Subsequent EIR (Prior SCH No.)_____
- ☐ 06. NOE
- ☐ 07. NOC
- ☐ 08. NOD

NEPA:
- ☐ 09. NOI
- ☐ 10. PONSI
- ☐ 11. Draft EIS
- ☐ 12. EA

Other:
- ☐ 13. Joint Document
- ☐ 14. Final Document
- ☐ 15. Other_____

8. Local Action Type

- ☐ 01. General Plan Update
- ☐ 02. New Element
- ☐ 03. General Plan Amendment
- ☐ 04. Master Plan
- ☐ 05. Annexation
- ☐ 06. Specific Plan
- ☐ 07. Community Plan
- ☐ 08. Redevelopment
- ☐ 09. Rezone
- ☐ 10. Land Division (Subdivision, Parcel Map, Tract Map, etc.)
- ☐ 11. Use Permit
- ☐ 12. Waste Mgmt Plan
- ☐ 13. Cancel Ag Preserve
- ☐ 14. Other_____

9. Development Type

- ☐ 01. Residential: *Units*_____ *Acres*_____
- ☐ 02. Office: *Sq.ft.*_____ *Acres*_____ *Employees*_____
- ☐ 03. Shopping/Commercial: *Sq.ft.*_____ *Acres*_____ *Employees*_____
- ☐ 04. Industrial: *Sq.ft.*_____ *Acres*_____ *Employees*_____
- ☐ 05. Water Facilities: *Type*_____ *MGD*_____
- ☐ 06. Transportation: *Type*_____
- ☐ 07. Mining: *Mineral*_____
- ☐ 08. Power: *Type*_____ *Watts*_____
- ☒ 09. Waste Treatment: *Type* Wastewater Treatment Plant
- ☐ 10. OCS Related _____
- ☐ 11. Other:_____

10. Total Acres: 16
11. Total Jobs Created: N/A

12. Project Issues Discussed in Document

- ☐ 01. Aesthetic/Visual
- ☐ 02. Agricultural Land
- ☐ 03. Air Quality
- ☐ 04. Archeological/Historical
- ☐ 05. Coastal Zone
- ☐ 06. Economic
- ☐ 07. Fire Hazard
- ☐ 08. Flooding/Drainage
- ☐ 09. Geologic/Seismic
- ☐ 10. Jobs/Housing Balance
- ☐ 11. Minerals
- ☒ 12. Noise
- ☐ 13. Public Services
- ☐ 14. Schools
- ☐ 15. Septic Systems
- ☐ 16. Sewer Capacity
- ☐ 17. Social
- ☐ 18. Soil Erosion
- ☐ 19. Solid Waste
- ☐ 20. Toxic/Hazardous
- ☒ 21. Traffic/Circulation
- ☐ 22. Vegetation
- ☐ 23. Water Quality
- ☐ 24. Water Supply
- ☐ 25. Wetland/Riparian
- ☐ 26. Wildlife
- ☐ 27. Growth Inducing
- ☐ 28. Incompatible Landuse
- ☐ 29. Cumulative Effects
- ☐ 30. Other _____

13. Funding (approx.): Federal $_____ State $_____ Total $_____

14. Present Land Use and Zoning: The property is part of the existing Rosamond Community Services District Wastewater Treatment Plant. The surrounding property consists of vacant land.

15. Project Description: The proposed project would entail the expansion of the Rosamond Community Services District Wastewater Treatment Plant. Improvements would include adding treatment capacity and effluent disposal facilities. The initial expansion will provide an additional 0.5 million gallons per day (MGD) of capacity; however, the facilities will be expandable to an ultimate capacity of 1.0 MGD.

16. Signature of Lead Agency Representative: Ben P. [illegible] Date: 9-28-99

NOTE: Clearinghouse will assign identification numbers for all new projects. If a SCH number already exists for a project (e.g. from a Notice of Preparation or previous draft document) please fill it in.

Form Revised April 1986 — Replaces CA189 *Mark distribution on reverse*

Reviewing Agencies

- ☐ Resources Agency
- ☐ Boating/Waterways
- ☐ Conservation
- ☐ Fish and Game
- ☐ Forestry
- ☐ Colorado River Board
- ☐ Dept. Water Resources
- ☐ Reclamation
- ☐ Parks and Recreation
- ☐ Office of Historic Preservation
- ☐ Native American Heritage Commission
- ☐ S. F. Bay Cons. & Dev't Commission
- ☐ Coastal Commission
- ☐ Energy Commission
- ☐ State Lands Commission
- ☐ Air Resource Board
- ☐ Solid Waste Management Board
- ☐ SWRCB: Sacramento
- ☐ RWQCB: Region #_____
- ☐ Water Rights
- ☐ Water Quality
- ☐ Caltrans District _____
- ☐ Dept. of Transportation Planning
- ☐ Aeronautics
- ☐ California Highway Patrol
- ☐ Housing and Community Development
- ☐ Statewide Health Planning
- ☐ Health
- ☐ Food and Agriculture
- ☐ Public Utilities Commission
- ☐ Public Works
- ☐ Corrections
- ☐ General Services
- ☐ OLA
- ☐ Santa Monica Mountains
- ☐ TRPA
- ☐ OPR - OLGA
- ☐ OPR - Coastal
- ☐ Bureau of Land Management
- ☐ Forest Service
- ☐ Other _____
- ☐ Other _____

For SCH Use Only

Date Received at SCH _____

Date Review Starts _____

Date to Agencies _____

Date to SCH _____

Clearance Date _____

Catalog Number _____

Applicant _____

Consultant _____

Contact _____ Phone _____

Address _____

Notes:

Environmental Checklist Form

1. **Project title:** Wastewater Treatment Plant Expansion

2. **Lead agency name and address:** Rosamond Community Services District
   2700 20th Street West
   Rosamond, CA 93560

3. **Contact person and phone number:** Mrs. Sherry DeLano, Manager, (661) 256-3411

4. **Project location:** Kern County, California, Sections 27 and 34, T9N, R12W, SBBM.

5. **Project sponsor's name and address:** Rosamond Community Services District
   2700 20th Street West
   Rosamond, CA 93560

6. **General plan designation:** N/A

7. **Description of project:** The proposed project would entail the expansion of the Rosamond Community Services District (RCSD) Wastewater Treatment Plant. The treatment facilities would include grit removal, flow splitting, tie-in to the existing system, an extended aeration reactor basin, one secondary clarifier, return and waste activated sludge pumping station, chemical feed facility, filters, ultraviolet disinfection, sludge drying beds, and a control building. Effluent disposal facilities would include new effluent storage facilities and a reclaimed water pump station to feed the existing reclaimed water pipelines. The expanded wastewater treatment facilities will have an initial 12-year flow treatment capacity of 0.5 million gallons per day (MGD) but will be expandable to meet the 20-year flow of 1.0 MGD. Space has been provided in the proposed layout to allow for the phased expansion of the facility to an ultimate plant capacity of 2.34 MGD. At the present time, the facilities have a capacity of 1.3 MGD. Facilities to be constructed will be located on RCSD owned property.

8. **Surrounding land uses and settings:** The property surrounding the project site consists of an existing District wastewater treatment plant and vacant land.

9. **Other public agencies whose comments are requested:**

Agency	Permit/Approval
1. STATE CLEARINGHOUSE	Environmental Review
2. Kern County Planning Department	Environmental Review
3. Kern County Engineering & Survey Services	Environmental Review
4. Kern County Health Department	Environmental Review
5. Kern Council of Governments	Environmental Review
6. Edwards Air Force Base	Environmental Review

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:

The environmental factors checked below would be potentially affected by this project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

- ☐ Aesthetics
- ☐ Biological Resources
- ☐ Hazards & Hazardous Materials
- ☐ Mineral Resources
- ☐ Public Services
- ☐ Utilities/Service Systems
- ☐ Agriculture Resources
- ☐ Cultural Resources
- ☐ Hydrology/Water Quality
- ☐ Noise
- ☐ Recreation
- ☐ Mandatory Findings of Significance
- ☐ Air Quality
- ☐ Geology/Soils
- ☐ Land Use/Planning
- ☐ Population/Housing
- ☐ Transportation/Traffic

DETERMINATION: (To be completed by the Lead Agency)

On basis of this initial evaluation:

☒ I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.

☐ I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION will be prepared.

☐ I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.

☐ I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect 1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and 2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.

☐ I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards, and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.

Signature Ben P. Hoen Date 9-28-99

Printed name BEN P. HOEN For Rosamond Community Services District

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact

ENVIRONMENTAL IMPACTS:

I. Aesthetics. *Would the project:*

a) Have a substantial adverse effect on a scenic vista?	☐	☐	☐	☒
b) Substantially damage scenic resources, including but not limited to, trees, rock outcroppings, and historic buildings within a state scenic highway?	☐	☐	☐	☒
c) Substantially degrade the existing visual character or quality of the site and its surroundings?	☐	☐	☐	☒
d) Create a new source of substantial light or glare that would adversely affect day or nighttime views in the area?	☐	☐	☐	☒

Clarification for Responses:

a,b,c,d. The project will not result in a negative visual / aesthetic impact.

II. Agricultural Resources: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment model (1997) prepared by the California Dept. of Conservation as an optional model to use in assessing impacts on agriculture and farmland. *Would the project:*

a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland), as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?	☐	☐	☐	☒
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?	☐	☐	☐	☒
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?	☐	☐	☐	☒

Clarification for Responses:

a,b,c. The project will not convert any land designated or zoned for agricultural usage.

III. Air Quality. Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. *Would the project:*

a) Conflict with or obstruct implementation of the applicable air quality plan?	☐	☐	☐	☒
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?	☐	☐	☐	☒

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions that exceed quantitative thresholds for ozone precursors)?	☐	☐	☐	☒
d) Expose sensitive receptors to substantial pollutant concentrations?	☐	☐	☐	☒
e) Create objectionable odors affecting a substantial number of people?	☐	☐	☐	☒

Clarification for Responses:

a,b,c. The proposed project will not violate any applicable air quality plans or standards.

d. Increased pollutant concentrations will not occur as a result of the proposed project.

e. The properties surrounding the proposed project site are sparsely populated. Therefore, the improved facilities will not expose substantial numbers of people to objectionable odors.

IV. Biological Resources. *Would the project:*

a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U.S. fish and Wildlife Service?	☐	☐	☐	☒
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of fish and Game or U.S. Fish and Wildlife Service?	☐	☐	☐	☒
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?	☐	☐	☐	☒
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident or migratory wildlife corridors, or impede the use of native wildlife nursery sites?	☐	☐	☐	☒
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?	☐	☐	☐	☒
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Community conservation Plan, or other approved local, regional, or state habitat conservation plan?	☐	☐	☐	☒

Clarification for Responses:

a,b,c,d,e,f. The majority of the proposed project will be located on RCSD owned property that is currently part of the existing wastewater treatment plant facilities. The property is presently used for plant operations and material storage and therefore the proposed improvements should not adversely affect the above listed items.

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact
V. Cultural Resources. *Would the project:*				
a) Cause a substantial adverse change in the significance of a historical resource as defined in §15064.5?	☐	☐	☐	☒
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to §15064.5?	☐	☐	☐	☒
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?	☐	☐	☐	☒
d) Disturb any human remains, including those interred outside of formal cemeteries?	☐	☐	☐	☒

Clarification for Responses:

a. There are no known cultural resources within the vicinity of the project.

b. It is always possible that articles of archaeological significance could be discovered during the construction process. If this should occur, all construction would immediately cease until a qualified archaeologist could be brought to the site to determine the significance of the discovery.

c. There are no known unique paleontological resources or geologic features within the project vicinity.

d. There are no known human remains interred within the project area. However, upon the discovery of human remains, construction would immediately cease and the proper authorities would be contacted.

VI. Geology and Soils. *Would the project:*				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:	☐	☐	☐	☒
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of a known fault? Refer to Division of Mines and Geology Special Publication 42.	☐	☐	☐	☒
ii) Strong seismic ground shaking?	☐	☐	☐	☒
iii) Seismic-related ground failure, including liquefaction?	☐	☐	☐	☒
iv) Landslides?	☐	☐	☐	☒
b) Result in substantial soil erosion or the loss of topsoil?	☐	☐	☐	☒
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?	☐	☐	☐	☒
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?	☐	☐	☐	☒
e) Have soils incapable of adequately supporting the use of septic tanks or alternative wastewater disposal systems where sewers are not available for the disposal of wastewater?	☐	☐	☐	☒

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact

Clarification for Responses:

a. The proposed project site is not located on a known fault and therefore should not expose people to the listed impacts.

b,c,d,e. The project should not result in substantial erosion because it will not substantially alter the existing topography of the region. No unstable soil conditions are known to exist within the project vicinity.

VII. Hazards and Hazardous Materials. *Would the project:*

a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?	☐	☐	☐	☒
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?	☐	☐	☐	☒
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?	☐	☐	☐	☒
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?	☐	☐	☐	☒
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?	☐	☐	☐	☒
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?	☐	☐	☐	☒
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas of where residences are intermixed with wildlands?	☐	☐	☐	☒

Clarification for Responses:

a. Hazardous materials will not be routinely transported, used, or disposed of at the project site.

b. The wastewater treatment facilities are designed to contain the untreated sewage influent locally in the event of an accident.

c. There are no existing or proposed schools within one-quarter mile of the proposed facilities.

d. The proposed facilities are not located on a hazardous materials site.

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact

e,f. There are no public airports within the vicinity of the project site; however, Edwards Air Force Base does lie just to the east of the site. The proposed improvements would not create a safety hazard for people working at the Air Force Base.

g. Local emergency plans will not be affected by the proposed project.

h. Wildland fires should not occur as a result of the proposed improvements.

VIII. Hydrology and Water Quality. *Would the project:*

a) Violate any water quality standards or waste discharge requirements?	☐	☐	☐	☒
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?	☐	☐	☐	☒
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?	☐	☐	☐	☒
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?	☐	☐	☐	☒
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?	☐	☐	☐	☒
f) Otherwise substantially degrade water quality?	☐	☐	☐	☒
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?	☐	☐	☐	☒
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?	☐	☐	☐	☒
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?	☐	☐	☐	☒
j) Inundation by seiche, tsunami, or mudflow?	☐	☐	☐	☒

Clarification for Responses:

a. The facility would be designed to meet or exceed all water quality and waste discharge standards.

b. The proposed project will not interfere with the availability or quantity of the local groundwater.

c,d,e. No local streams or rivers will be altered by the proposed improvements. Drainage should continue to flow in an easterly direction to Edwards Air Force Base lakebed.

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact

f. The proposed facility improvements would not affect the quality of the groundwater within the region.

g,h,i,j. The proposed improvements are not located within the 100-year flood plain (see attached FIRM map) and therefore will not expose people or structures to the above hazards.

IX. Land Use and Planning. *Would the project:*

a) Physically divide an established community?	☐	☐	☐	☒
b) Conflict with any applicable land use plan, policy, or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?	☐	☐	☐	☒
c) Conflict with any applicable habitat conservation plan or natural community conservation plan?	☐	☐	☐	☒

Clarification for Responses:

a. The proposed improvements are to be constructed on the southeasterly boundary of the community of Rosamond.

b,c. A majority of the proposed project will be constructed on the District's existing wastewater treatment property. Any improvements to the property should be compatible with the existing land use in the area.

X. Mineral Resources. *Would the project:*

a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?	☐	☐	☐	☒
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?	☐	☐	☐	☒

Clarification for Responses:

a,b. No impacts to mineral resources of local, regional, or statewide importance are anticipated.

XI. Noise. *Would the project result in:*

a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?	☐	☐	☒	☐
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?	☐	☐	☒	☐
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?	☐	☐	☒	☐
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☐	☒
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?	☐	☐	☒	☐

Clarification for Responses:

a,b,d. The potential for increased noise levels and vibrations will exist for the duration of the construction period. However, the increase will only be temporary and will end once the construction is complete.

c. Ambient noise levels will increase within the project area as a result of the proposed improvements. However, the lack of housing within the vicinity of the project will keep noise impacts to a minimum. Furthermore, noise emittance requirements will be incorporated into the design of the facilities.

e,f. The proposed facilities will not be located near a public airport. Edwards Air Force Base lies just to the east of the proposed project site; however, the noise from the construction of the facilities should not have any significant effect upon the residents or employees at the base.

XII. Population and Housing. *Would the project:*

a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) ore indirectly (for example, through extension of roads or other infrastructure)?	☐	☐	☐	☒
b) Displace substantial numbers of existing housing, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?	☐	☐	☐	☒

Clarification for Responses:

a,b,c. The project is not expected to induce population growth. Furthermore, the proposed facilities will not displace housing or people within the project area. The expansion is proposed in order to provide the required treatment capacity that the growing community of Rosamond will require in the future.

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact
XIII. Public Services				
a) Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered governmental facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response time or other performance objectives for any of the public services:				
Fire protection?	☐	☐	☐	☒
Police protection?	☐	☐	☐	☒
Schools?	☐	☐	☐	☒
Parks?	☐	☐	☐	☒
Other public facilities?	☐	☐	☐	☒

Clarification for Responses:

a. The proposed project should in no way interfere with fire protection, police protection, schools, parks, or other public facilities.

XIV. Recreation				
a) Would the project increase the use of existing neighborhood and regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?	☐	☐	☐	☒
b) Does the project include recreational facilities or require the construction of expansion of recreational facilities which might have an adverse physical effect on the environment?	☐	☐	☐	☒

Clarification for Responses:

a,b. The proposed project will not affect existing or proposed recreational facilities.

XV. Transportation/Traffic. *Would the project:*				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?	☐	☐	☒	☐
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?	☐	☐	☐	☒
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?	☐	☐	☐	☒
d) Substantially increase hazards due to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e.g., farm equipment)?	☐	☐	☐	☒
e) Result in inadequate emergency access?	☐	☐	☐	☒

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact
f) Result in inadequate parking capacity?	☐	☐	☐	☒
g) Conflict with adopted policies, plans, or programs, supporting alternative transportation (e.g., bus turnouts, bicycle racks)?	☐	☐	☐	☒

Clarification for Responses:

a. The possibility exists to disrupt local traffic patterns both during and after the construction phase of the project. However, the majority of the traffic interruptions will be temporary and should only occur in the immediate vicinity of the ongoing work. It is also possible that after construction, the daily operation of the expanded treatment facilities will cause an increase in the local traffic flows.

b,c,d,e,f,g. The other traffic conditions listed above should not be affected by the proposed construction.

XVI. Utilities and Service Systems. *Would the project?*

a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?	☐	☐	☐	☒
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?	☐	☐	☐	☒
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?	☐	☐	☐	☒
e) Result in a determination by the wastewater treatment provider that services or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?	☐	☐	☐	☒
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?	☐	☐	☐	☒
g) Comply with federal, state, and local statutes and regulations related to solid waste?	☐	☐	☐	☒

Clarification for Responses:

a,b,e. Not Applicable.

c,d. The proposed project will not require new water supply or storm water drainage facilities.

f,g. The project will not require landfill service nor will it interfere with solid waste statutes and regulations.

	Potentially Significant Impact	Potentially Significant Unless Mitigation Incorporated	Less than Significant Impact	No Impact
XVII. Mandatory Finding of Significance.				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?	☐	☐	☐	☒
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?	☐	☐	☐	☒
c) Does the project have environmental effects that will cause substantial adverse effects on human beings, either directly or indirectly?	☐	☐	☐	☒

Clarification for Responses:

a,b,c. The proposed project will not degrade, either individually or cumulatively, the quality of the surrounding environment.

NOTES TO USER

This map is for use in administering the National Flood Insurance Program; it does not necessarily identify all areas subject to flooding, particularly from local drainage sources of small size, or all planimetric features outside Special Flood Hazard Areas.

Areas of special flood hazard (100-year flood) include Zones A, A1-30, AE, AH, AO, A99, V, V1-30 AND VE.

Certain areas not in the Special Flood Hazard Areas (zones A and V) may be protected by flood control structures.

Coastal base flood elevations apply only landward of the shoreline shown on this map.

For adjoining map panels, see separately printed Index to Map Panels.

INITIAL IDENTIFICATION:
JUNE 20, 1978

FLOOD HAZARD BOUNDARY MAP REVISIONS:

FLOOD INSURANCE RATE MAP EFFECTIVE:
SEPTEMBER 29, 1986

FLOOD INSURANCE RATE MAP REVISIONS:
SEPTEMBER 29, 1989

Map revised SEPTEMBER 6, 1995 to incorporate previously issued letter of map revision.

To determine if flood insurance is available in this community, contact your insurance agent, or call the National Flood Insurance Program, at (800) 638-6620.

APPROXIMATE SCALE IN FEET

2000 0 2000

KEY TO MAP

500-Year Flood Boundary

100-Year Flood Boundary

Zone Designations

100-Year Flood Boundary

500-Year Flood Boundary

Base Flood Elevation Line With Elevation In Feet** — 513

Base Flood Elevation In Feet Where Uniform Within Zone** — (EL 987)

Elevation Reference Mark — RM7x

Zone D Boundary

River Mile — •M1.5

**Referenced to the National Geodetic Vertical Datum of 1929

EXPLANATION OF ZONE DESIGNATIONS

ZONE	EXPLANATION
A	Areas of 100-year flood; base flood elevations and flood hazard factors not determined.
AO	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; average depths of inundation are shown, but no flood hazard factors are determined.
AH	Areas of 100-year shallow flooding where depths are between one (1) and three (3) feet; base flood elevations are shown, but no flood hazard factors are determined.
A1-A30	Areas of 100-year flood; base flood elevations and flood hazard factors determined.
A99	Areas of 100-year flood to be protected by flood protection system under construction; base flood elevations and flood hazard factors not determined.
B	Areas between limits of the 100-year flood and 500-year flood; or certain areas subject to 100-year flooding with average depths less than one (1) foot or where the contributing drainage area is less than one square mile; or areas protected by levees from the base flood. (Medium shading)
C	Areas of minimal flooding. (No shading)
D	Areas of undetermined, but possible, flood hazards.
V	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors not determined.
V1-V30	Areas of 100-year coastal flood with velocity (wave action); base flood elevations and flood hazard factors determined.

NATIONAL FLOOD INSURANCE PROGRAM

FIRM
FLOOD INSURANCE RATE MAP

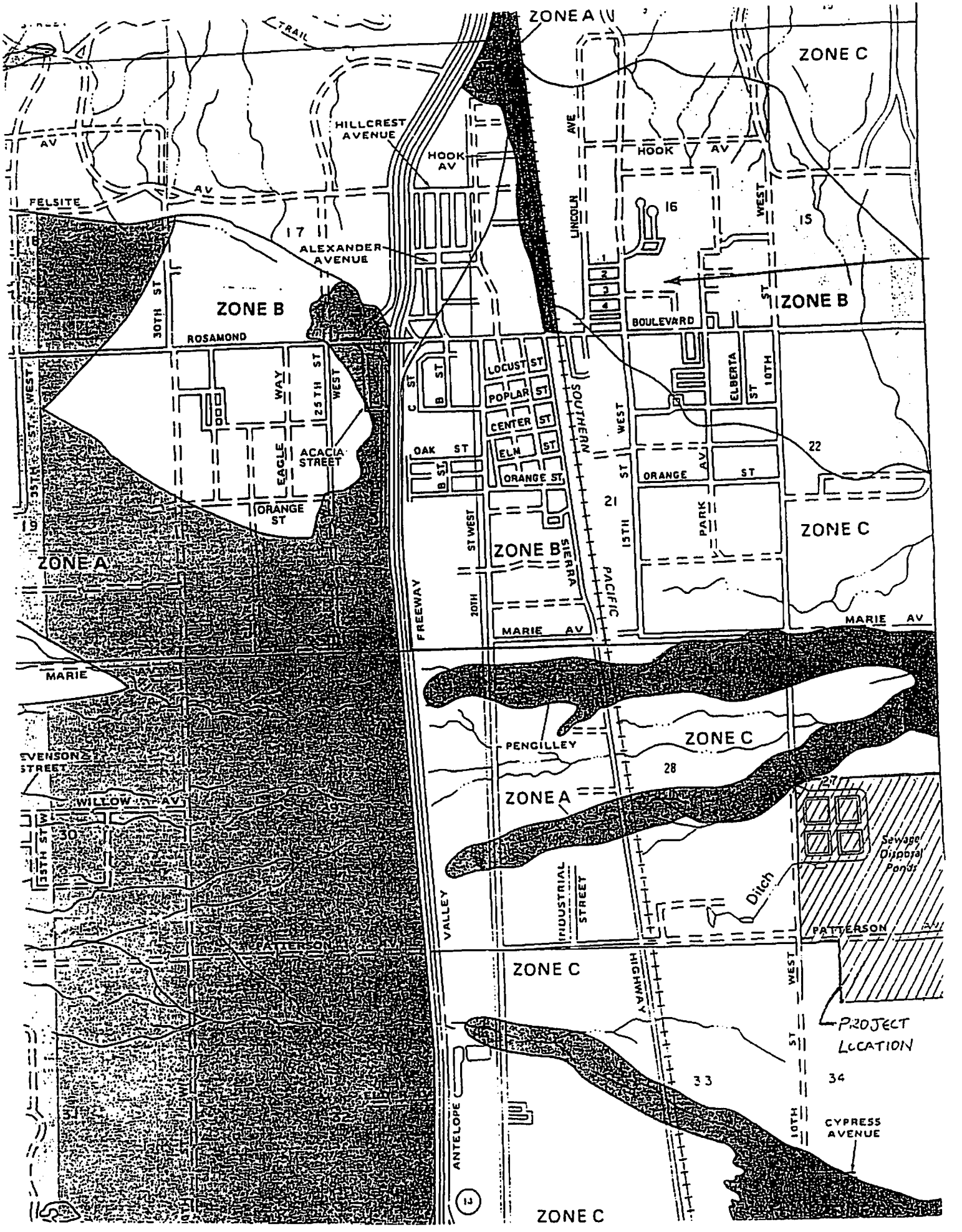
KERN COUNTY
CALIFORNIA
(UNINCORPORATED AREAS)

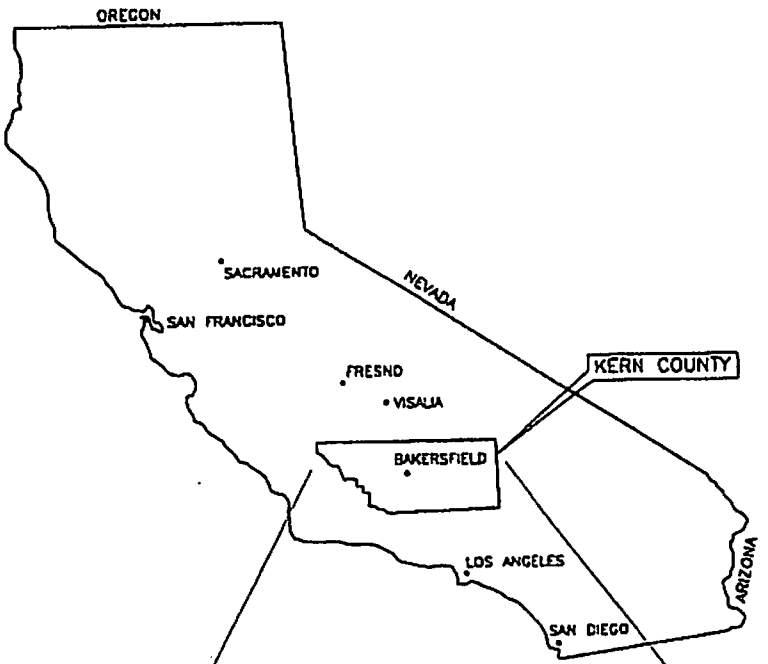
PANEL 2025 OF 2075
(SEE MAP INDEX FOR PANELS NOT PRINTED)

COMMUNITY-PANEL NUMBER
060075 2025 D

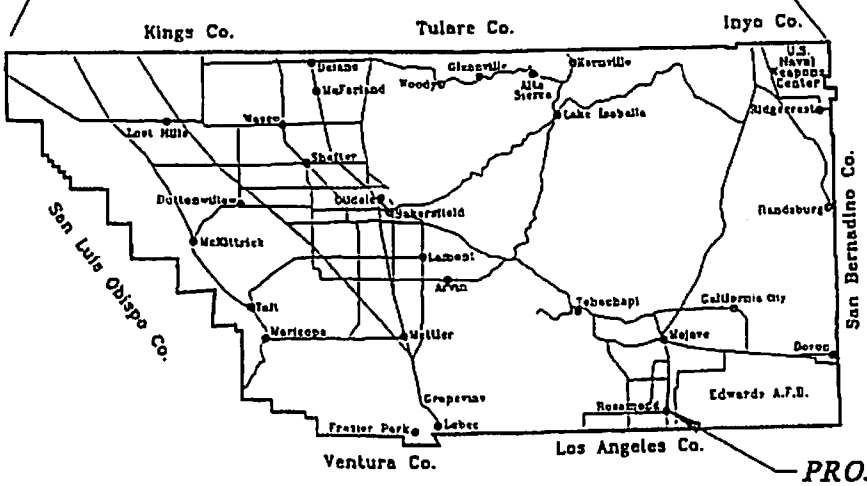
MAP REVISED:
SEPTEMBER 6, 1995

Federal Emergency Management Agency


ZONE A
ZONE C
TRAIL
HILLCREST AVENUE
HOOK AV
HOOK AV
AVE
LINCOLN
WEST
FELSITE
AV
ALEXANDER AVENUE
16
15
17
18
30TH ST
ZONE B
ZONE B
ROSAMOND
BOULEVARD
ST
LOCUST ST
POPLAR ST
CENTER ST
ELM ST
ORANGE ST
OAK ST
B ST
C ST
WAY
25TH ST WEST
EAGLE
ACACIA STREET
ORANGE ST
ELBERTA ST
10TH
22
ORANGE AV ST
21
PARK
ZONE C
ZONE A
ZONE B
SOUTHERN PACIFIC
SIERRA
15TH ST WEST
20TH ST WEST
FREEWAY
MARIE AV
MARIE AV
MARIE AV
PENGILLEY
ZONE C
28
EVENSON STREET
WILLOW AV
ZONE A
27
30
35TH ST
Sewage Disposal Ponds
Ditch
INDUSTRIAL STREET
VALLEY
PATTERSON
PATTERSON
ZONE C
HIGHWAY
WEST
PROJECT LOCATION
33
34
10TH ST
CYPRESS AVENUE
ANTELOPE
31
32
ZONE C



STATE OF CALIFORNIA



COUNTY OF KERN

ROSAMOND COMMUNITY SERVICES DISTRICT

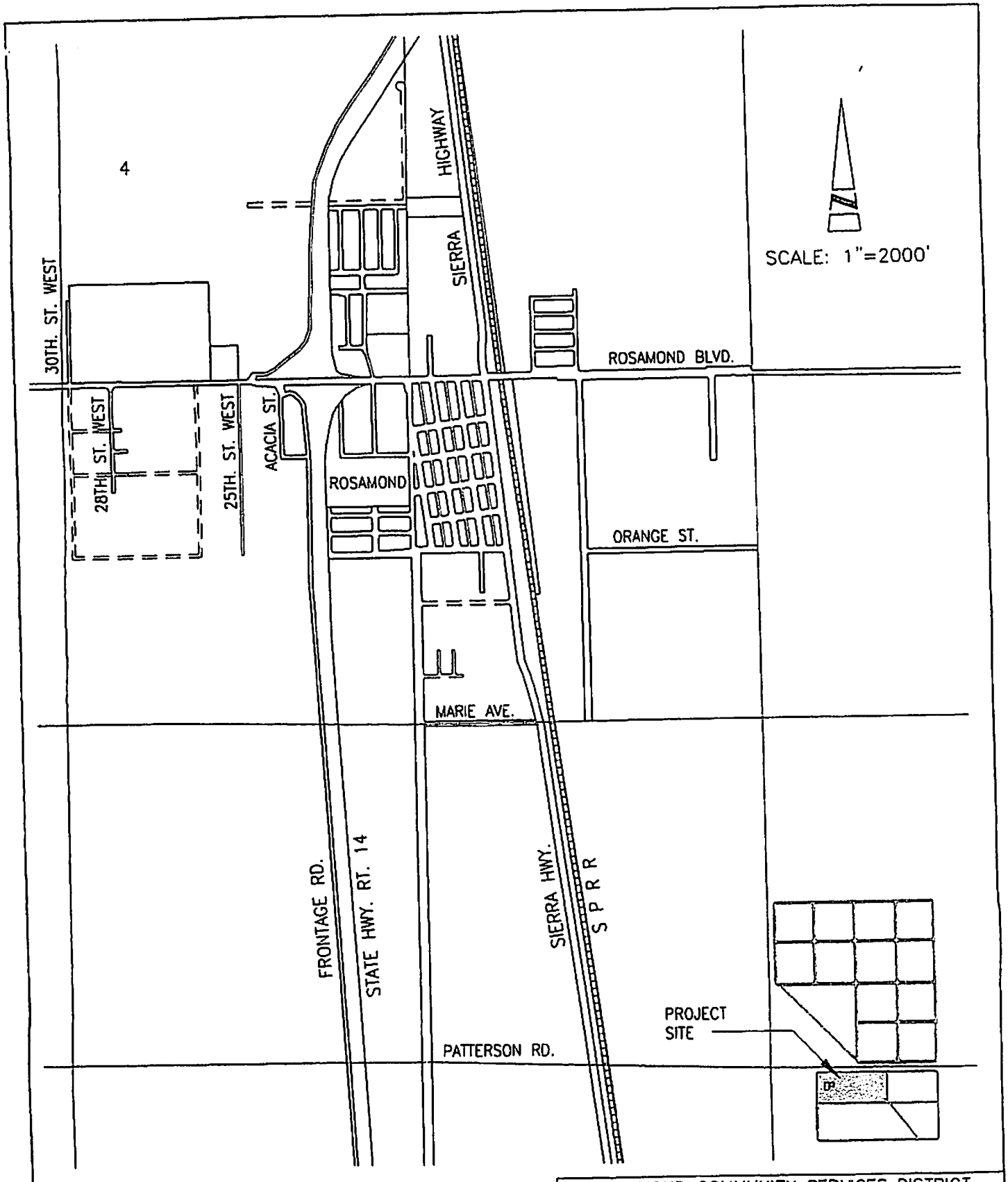
WWTP PROJECT REPORT

FIGURE 1.1

VICINITY MAP

BOYLE ENGINEERING CORPORATION

D1687-6\12-09-98\1=1



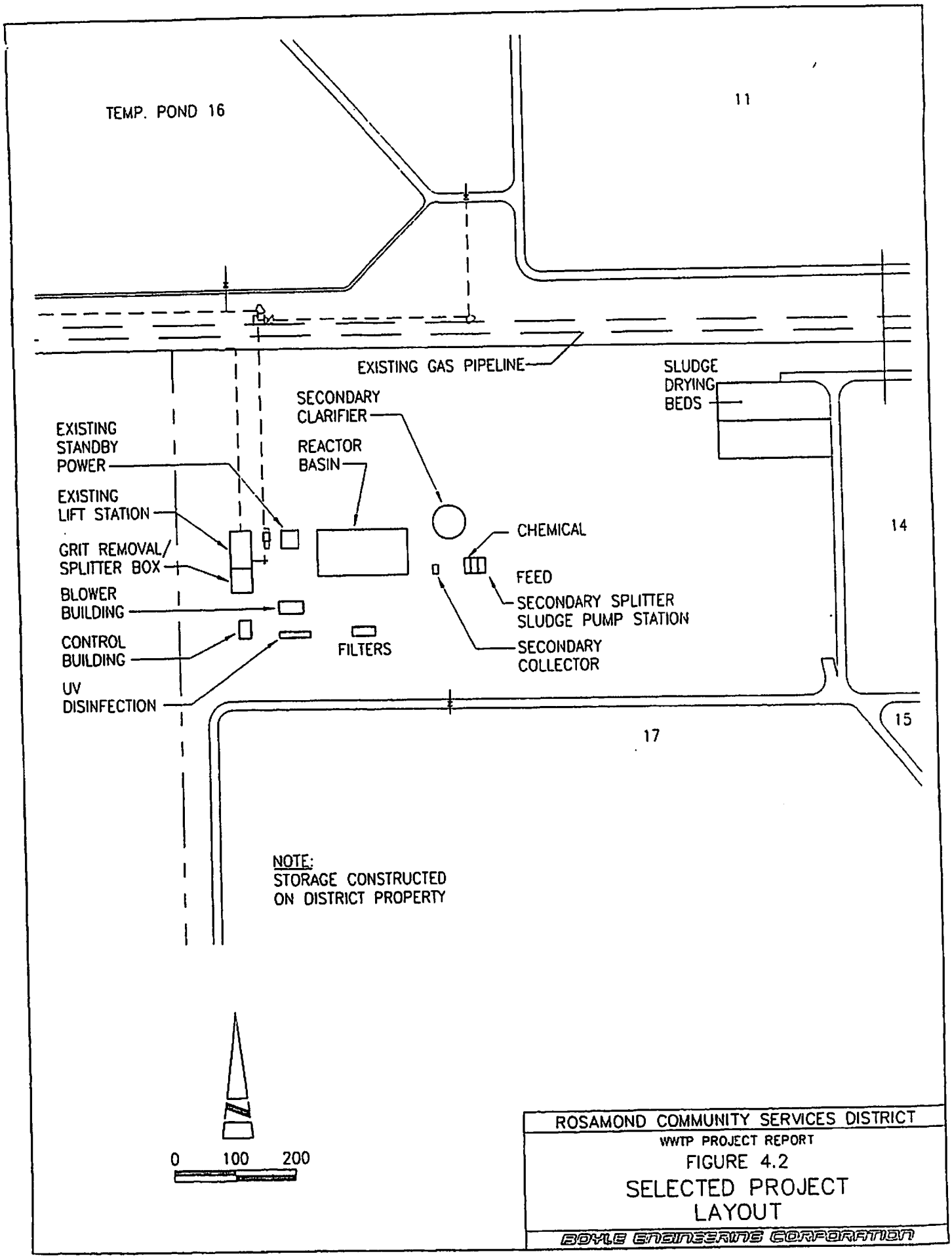
ROSAMOND COMMUNITY SERVICES DISTRICT

WWTP PROJECT REPORT

FIGURE 2.1

LOCATION MAP

BOYLE ENGINEERING CORPORATION


TEMP. POND 16
11
EXISTING GAS PIPELINE
SLUDGE DRYING BEDS
SECONDARY CLARIFIER
REACTOR BASIN
EXISTING STANDBY POWER
EXISTING LIFT STATION
GRIT REMOVAL/ SPLITTER BOX
BLOWER BUILDING
CONTROL BUILDING
UV DISINFECTION
FILTERS
CHEMICAL
FEED
SECONDARY SPLITTER SLUDGE PUMP STATION
SECONDARY COLLECTOR
14
15
17
NOTE:
STORAGE CONSTRUCTED ON DISTRICT PROPERTY
0
100
200
ROSAMOND COMMUNITY SERVICES DISTRICT
WWTP PROJECT REPORT
FIGURE 4.2
SELECTED PROJECT LAYOUT
BOYLE ENGINEERING CORPORATION

Tanya A. Gulesserian

From: Miriam Rodriguez [MRODRIGUEZ@dfg.ca.gov]
Sent: Thursday, May 27, 2010 3:44 PM
To: Lacy Bauer
Subject: PRA 10-05-153: California City
Attachments: content.pdf

Miriam Rodriguez
Staff Services Analyst
Department of Fish and Game
Central Region (Region 4)
1234 East Shaw Avenue
Fresno, California 93710
(559) 243-4005 Ext. 121
FAX (559) 243-4026
e-mail: mrodriguez@dfg.ca.gov

03/08/01

209145

ES-III COPY

PROJECT FILE LABEL: 3 .2 .2001 .1 .209145
KER. EXPANSION OF THE MUNICIPAL
WASTER WATER TREATMENT PLANT
10835 NELSON DRIVE, CALIFORNIA CITY

Lead Agency: CITY OF CAL
COUNTY: KERN COUNTY
Last DFG Action:

RECEIVED: 03/02/01
DUE OUT: 03/31/01

Attention/Action by: ~~[illegible]~~ Goss
DUE FOR ES TYPING: 032301

REQUESTED INFORMATION/ACTION:

This is a request for CESA Consultation. Should we require 7051 application?

DFG Action Taken: (what is the message?)

( ) Comments
( ) No Comments
( ) Unreviewed or prefer no record

DFG RESPONSE MODE: (how to send?)

( ) Letter (draft attached)
( ) Initial Study Form only (attached)
( ) I.S. Form + attachment (draft attached)
(X) No Response

Reviewer: Gordus
Date:

Fr: Andy Gordus - Applicant intends to amend project to avoid take

From: Jeffrey R. Single
To: Loudermilk, William
Date: 3/22/01 2:01PM
Subject: Re: Kern County and the WMP

Mike M and I are holding 1, maybe 2 interviews for the Caltrans ESIV on the 6th. 1 is at 11am. We will try to be there for the conf call

>>> William Loudermilk 03/22/01 04:48AM >>>
I'm available all day on 4/6 so far. I'll forward your message to Dale and Jeff- we've been transitioning these sorts of terrestrial issues to Jeff in his new role as Terrestrial Hab. Cons. EPM. Mulligan now reports to Jeff too. Jeff is also our lead on the Valley Floor HCP, the Metro-Bakersfiedl HCP, and a couple others which involve Kern Co. and he has good insight there.

RE. MGS issues, we have a war-tattered Assemblyman down there by the name of Roy Ashburn who went thru the MGS wars of the past and now sits on key committees, and whom I believe Kern Co. gets much of their support and strength. Assemblyman Dean Flores is there as well.

I'm happy to hear Bill H's and your perception of the WMP bottleneck, and your views on resolution. Having worked with Ted and others there for awhile I've found it useful to start out making sure we're working on the right scarecrow, and we have clear authority in place before we push.
L? Section 147

If you feel there is value in including any of Ron R's. branch chiefs or legal in a followup dialog re. internal policy and consistency lets do that- then you/Jeff can let Bill H know where we're at with a stronger basis-or not.

Alan Pickard 03/21/01 01:27PM >>>
Bill,
Will it be possible to arrange a short conference with you and Dale on Friday April 6. Bill Haigh (West Mojave Plan manager for the BLM) and I would like to chat about Kern County. Bill reports that Kern is still acting like they have a pretty good deal with DFG and the mojave ground squirrel and still see little value to buying in to the plan, at least for the mgs. I know they are still leading the delisting charge. With your and Dale's blessing, last fall I delivered a rather strong and clear message about the need for permits, mitigation, etc. in Kern County and the WMP may relieve a lot of that burden. Ted James was there and I believe he heard me clearly. Bill Haigh, I'm sure, will make himself available to meet with you, and talk to county managers and supervisors if necessary. But it may be time to have some dialog with them. Anyway, if you are available on the 6th, this would give Bill Haigh a chance to describe the situation with you (and me) and we can decide what to do. Bill and I are pretty flexible on the time. If that day is bad, we can try something else. I would call in and Bill could either be there or call in. It may be good if he were there to show you the latest versions of the maps etc.

Thanks,

alan

CC: Mulligan, Michael

Andy: If you plan to call or write to Calif City WWTF before we talk again please clear it with Jeff. We need to try to be consistent with SC Region
Mike ok. MM

State of California - The Resources Agency
ARNOLD SCHWARZENEGGER, Governor
DEPARTMENT OF FISH AND GAME
http://www.dfg.ca.gov
San Joaquin Valley and Southern Sierra Region
1234 East Shaw Avenue
Fresno, California 93710
(559) 243-4014

January 9, 2006

William Way, Jr.
City Manager
City of California City
21000 Hacienda Boulevard
California City, California 93505-2293

Dear Mr. Way:

Zone Change 174
General Plan Amendment 06-02
Tentative Tract Map 6632
SCH # 2005121064

The California Department of Fish and Game (Department) has reviewed the Initial Study and Environmental Checklist for the Zone Change 174, General Plan Amendment 06-02, and Tentative Tract Map 6632 (Project). The proposed Project will involve subdividing approximately 34.59 acres into 44 Neighborhood Commercial (C1) lots for offices on the perimeter of the tract map and 53 Community Commercial (C2) lots for retail businesses in the interior of the tract. The Project is located in the City of California City, Kern County (SE ¼ of Section 19, Township 32 South, Range 38 East, MDB&M).

Project impacts:

The Project has the potential to reduce the number or restrict the range of the following endangered, rare, or threatened species (as defined in Section 15380 of CEQA):

Species	Listing
Desert tortoise *Gopherus agassizii*	State-listed threatened Federally-listed threatened
Mohave ground squirrel *Spermophilus mohavensis*	State-listed threatened

In addition, the following sensitive species may be potentially impacted:

Species	Listing
Burrowing owl *Athene cunicularia*	State Species of special concern Federal Species of Concern
Le Conte's thrasher *Toxostoma lecontei*	State Species of Special Concern Federal Species of Concern
Alkali mariposa lily *Calochortus striatus*	CNPS List 1B
Barstow woolly sunflower *Eriophyllum mohavense*	CNPS List 1B
Desert cymopterus *Cymopterus deserticola*	CNPS List 1B

Trustee Agency Authority: The Department is a Trustee Agency with responsibility under the California Environmental Quality Act (CEQA) for commenting on projects that could impact plant and wildlife resources. Pursuant to Fish and Game Code Section 1802, the Department has jurisdiction over the conservation, protection, and management of fish, wildlife, native plants, and habitat necessary for biologically sustainable populations of those species. As a Trustee Agency for fish and wildlife resources, the Department is responsible for providing, as available, biological expertise to review and comment on environmental documents and impacts arising from project activities as those terms are used under CEQA.

As a Trustee Agency for fish and wildlife resources of this State, we believe the following Project-related impacts to sensitive plant and wildlife resources could occur:

- "Take" ("take" as defined in Fish and Game Code Section 86) of State-listed species and State Species of Special Concern.
- "Take" ("take" as defined in Section 3 of the Federal Endangered Species Act of 1973) of Federally-listed species and Federal species of concern.
- Loss of desert habitat due to land use conversion from agriculture to residential.
- Loss or degradation of wildlife habitat value from increased noise, traffic, and lighting.

- Restriction of wildlife movement or migration within the Project vicinity.
- Increased wildlife mortality from vehicle strikes.
- Increased human activity and garbage creating an attractive nuisance for ravens and other predators which prey upon the desert tortoise and other wildlife.
- Impacts to hydrology, including but not limited to, an increase in erosion, siltation, and pollution of ephemeral streams.
- Vehicle leaks of petroleum products and introduction of other substances toxic to wildlife

State Incidental Take Permitting and Responsible Agency Authority: State-listed species known to occur in the Project area vicinity include the State-listed threatened desert tortoise and State-listed threatened Mohave ground squirrel. The Department has regulatory authority over projects that could result in the "take" of any species listed by the State as threatened or endangered pursuant to Fish and Game Code Section 2081. If the Project could result in the "take" of any species listed as threatened or endangered under the California Endangered Species Act (CESA), the Department may need to issue an Incidental Take Permit for the Project. CEQA requires a Mandatory Finding of Significance if a project is likely to substantially impact threatened or endangered species (CEQA § 21001{c}, 21083, CEQA Guidelines § 15380, 15064, 15065). Impacts must be avoided or mitigated to less than significant levels unless the CEQA Lead Agency makes and supports Findings of Overriding Consideration (FOC) as part of an Environmental Impact Report (EIR). The CEQA Lead Agency's FOC does not eliminate the Project proponent's obligation to comply with Fish and Game Code Section 2080.

The issuance of an Incidental Take Permit is subject to CEQA review. The CEQA document prepared for this Project should identify the Department as a Responsible Agency and should fully describe and address the potential impacts to listed species; otherwise preparation of a supplemental CEQA document may be necessary prior to Incidental Take Permit issuance.

Stream Alteration Notification and Responsible Agency Authority: The Department also has regulatory authority with regard to activities occurring in streams (which includes ephemeral desert washes). Aerial photographs and topographic maps show that Cache Creek and other desert washes are present within the Project vicinity, and it is unclear from the Project description whether the Project will encroach upon or directly impact these streams. For any activity that will divert or obstruct the natural

flow, or change the bed, channel, or bank of a river or stream, or use material from a streambed, the Department may require a Stream Alteration Agreement (SAA), pursuant to Fish and Game Code Section 1600 et seq. The issuance of a SAA is subject to CEQA review. The Department, as a Responsible Agency under CEQA, would consider the CEQA document prepared for the Project. The CEQA document should fully identify the potential impacts to streams (including desert washes) and provide adequate avoidance, mitigation, monitoring and reporting commitments for completion of the SAA. We recommend contacting Annette Jennings, Staff Services Analyst, at (559) 243-4593 or Gerald Hatler, Environmental Scientist, at (559) 243-4014 extension 231 for further information regarding notification requirements.

Bird Protection: The Department has jurisdiction over any actions which may result in the disturbance or destruction of active nesting sites for a variety of bird species. Removal of active nests could be considered a violation of Fish and Game Code Sections 3503 (regarding unlawful take, possession or needless destruction of the nest or eggs of any bird), 3503.5 (regarding take, possession or destruction of any birds-of-prey or their nests or eggs), and 3513 (regarding unlawful take or possession of any migratory non-game bird). Project-related activities could disturb sensitive avian species including the burrowing owl and Le Conte's thrasher.

Unlisted Species: Species of plants and animals need not be officially listed as Endangered, Rare, or Threatened (E, R, or T) on any State or Federal list to be considered E, R, or T under CEQA. If a species can be shown to meet the criteria for E, R, or T as specified in the CEQA Guidelines (California Code of Regulations, Title 14, Chapter 3, and Section 15380) it should be fully considered in the environmental analysis for the Project. Species of Concern that occur in the Project vicinity include burrowing owl, Le Conte's thrasher, alkali Mariposa lily, Barstow woolly sunflower, and desert cymopterus.

Water Pollution: Pursuant to Fish and Game Code Section 5650, it is unlawful to deposit in, permit to pass into, or place where it can pass into the "Waters of the State" any substance or material deleterious to fish, plant life, or bird life, including non-native species. The Regional Water Quality Control Board also has jurisdiction regarding discharge and pollution to "Waters of the State".

General Comments:

CEQA Compliance: CEQA Guidelines §15378 defines "project" to mean the whole of an action that may result in either a direct or reasonably foreseeable indirect physical change in the environment. Further, CEQA prohibits "piecemealing," dividing one project into several separate parts, and conducting an independent environmental review of some or all of the parts rather than for the project as a whole. The CEQA

document should adequately address the impacts to natural resources from the proposed development of Project-related access routes and infrastructure (water, electric, natural gas, sewer, and telephone).

The Lead Agency (California City) made findings that no environmental factors, including biological resources, will be affected or impacted by this Project. The Initial Study and Environmental Checklist did not provide information on how California City made their determination of "no impact" to biological resources. The Department does not concur that the Project will not impact biological resources. At a minimum, development of the Project site will result in an incremental loss of 34.5 acres of desert habitat that is suitable to support the State and Federally-listed threatened desert tortoise and State-listed threatened Mohave ground squirrel. CEQA Guidelines § 15064 (b) states, "The determination of whether a project may have a significant effect on the environment calls for careful judgment on the part of the public agency involved, based to the extent possible on scientific and factual data."

California City should re-circulate the Initial Study and Environmental Checklist with a complete Project description and an explanation justifying the "no impact" determination for biological resources. The justification should be based on factual data and other supporting evidence, as stipulated in the CEQA Guidelines. The Biological Resource Assessment that was furnished with this CEQA document supplies data that conflicts with a "no impact" finding for biological resources. The Biological Resource Assessment states that there is a potential for desert tortoise to occupy the Project area and that adjacent habitat is also suitable.

The Department has recently provided written comments on several projects for which California City has made a finding of "no impact" for biological resources, without the factual data required by CEQA to justify these determinations. The Department believes that it would be beneficial to have a meeting with California City planning staff to discuss these issues. We recommend that you contact Annette Tenneboe, Environmental Scientist, or Julie Vance, Senior Environmental Scientist, to arrange such a meeting.

Desert Tortoise: Included with the Initial Study was a Biological Resource Assessment of APN 212-010-28 (Biological Assessment) prepared and dated November 4, 2005, by Mark Hagan, Wildlife Biologist. A line transect survey was conducted on October 25, 2005, to inventory the biological resources on the Project site. Desert tortoise sign was not observed, however protocol-level surveys for desert tortoise were not conducted. The Biological Assessment states that although desert tortoises were not observed there is a potential for this species to occupy the area, and that habitat in adjacent areas appear suitable to support desert tortoise. The Department believes that it is reasonable to conclude that desert tortoise exist within the Project vicinity and can

utilize the Project site as part of their home range. The Department recommends that California City condition the Project to require protocol-level presence/absence surveys for desert tortoise conducted by qualified individuals. The survey results should be submitted to both the Department and the United States Fish and Wildlife Service (USFWS) for review and approval. The results of presence/absence surveys for desert tortoise are considered valid up to one year after survey completion. The applicant has the alternative of foregoing surveys, presuming presence, and acquiring State and Federal incidental take permits. The results of presence/absence surveys for desert tortoise are considered valid up to one year after survey completion. Project-specific protective measures and mitigation for impacts to desert tortoise and other special status species should be developed in consultation with the Department and the USFWS well in advance of Project implementation.

Mohave Ground Squirrel: The visual surveys conducted for Mohave ground squirrel are not adequate to conclude the species is present or absent from the Project site. Protocol surveys designed to evaluate the presence/absence of Mohave ground squirrel are species specific, single-purpose surveys utilizing crews trained and deployed for this purpose. The Department recommends that a protocol-level survey be conducted for Mohave ground squirrel by a qualified, permitted individual. The applicant has the alternative of foregoing surveys, presuming presence, and acquiring a State Incidental Take Permit. The results of Mohave ground squirrel protocol surveys are valid up to one year from survey completion. It is important to note that the USFWS has recently been petitioned to list the Mohave ground squirrel under the Federal Endangered Species Act.

Rare Plant Surveys: The Biological Assessment stated that most annual plant species were desiccated and that some species were probably not visible at the time the field survey was performed. Botanical surveys are conducted in order to determine the environmental effects of proposed projects on all botanical resources, including special status plants and plant communities. Botanical surveys should be conducted in a manner that will locate any special status or locally significant plants or plant communities that may be present. Specifically, botanical surveys should be conducted in the field at the proper times of year when special status plants are both evident and identifiable; usually this is when the plants are flowering. When special status plants are known to occur in the type of habitat type present in the Project area, nearby accessible occurrences of the plants (reference sites) should be observed to determine that the plants are identifiable at the time of survey. The Department recommends that California City require botanical surveys be conducted at an appropriate time to year to identify special status plant species. Special status plant species which may occur in the Project vicinity include the alkali mariposa lily, Barstow woolly sunflower, and the desert cymopterus.

State Incidental Take: Given the Project's proximity to known occurrences of desert tortoise and Mohave ground squirrel, and that appropriate habitat exists on the site, it is reasonable to conclude that individual tortoises and Mohave ground squirrels could utilize the Project site as part of their home range, and that the Project could result in their "take" ("take" as defined in Fish and Game Code Section 86). If the results of biological surveys indicate that State-listed species are indeed present, and if full "take" avoidance measures cannot be implemented, an Incidental Take Permit would be required. The Department would require avoidance, minimization, and mitigation measures in order to fully mitigate the Project's impacts to State-listed species.

Federal Jurisdiction: The Project is within the range of the Federally-listed threatened desert tortoise. We recommend that the City of California City or the applicant initiate consultation well in advance of Project implementation with the Ventura Office of the USFWS to determine their jurisdiction and authority regarding this Project. The USFWS may require additional protocol biological surveys, species avoidance, impact minimization, and compensation for impacts to Federally-listed species or their habitat, including the desert tortoise. The Ventura Office of the USFWS can be reached at (805) 644-1766.

Filing Fees: State law requires that the Department collect filing fees to defray the cost of managing and protecting fish and wildlife trust resources (Fish and Game Code Section 711.4). The purpose of these fees is to help fund the cost of consulting with other public agencies, reviewing environmental documents, recommending mitigation measures, developing monitoring requirements, and carrying out other activities to protect public trust resources under CEQA. Regardless of whether the above Project will have a significant effect on the environment or whether the Project warrants specific or general mitigation measures, we maintain the Project will result in the destruction of wildlife habitat and should therefore not be considered "De Minimis" in its effect on fish and wildlife. The payment of filing fees is required for the preparation of a Negative Declaration or an EIR.

MANDATORY FINDINGS AND ADDITIONAL INFORMATION

A Mandatory Findings of Significance and the preparation of an EIR by the Lead Agency is required for a project that will substantially reduce the number or restrict the range of endangered, rare, or threatened species, or result in effects that are individually limited but cumulatively considerable (CEQA Guidelines § 15065). The Department believes that the development and subsequent loss of 35 acres of desert habitat is cumulatively significant and that the preparation of an EIR would be appropriate in this instance. Use of a Mitigated Negative Declaration may be appropriate if all potential environmental effects are avoided or mitigated to a level of

below significant (CEQA Guidelines § 15070). Prior to making an environmental determination the Department should be provided with the following information:

- The CEQA document should adequately address all impacts to natural resources of the Project site. Proposed development of access routes and infrastructure (water, electric, natural gas, sewer, and telephone) related to this Project should be delineated and analyzed for impacts to natural resources.

- The results of Department approved botanical surveys conducted to determine presence of special status plant species. These surveys should be conducted by a qualified biologist or botanist and be timed appropriately such that an identifiable characteristic stage for each sensitive plant species would be present.

- The results of protocol surveys conducted for Mohave ground squirrel and desert tortoise. These surveys should be conducted by a qualified biologist at the appropriate time of year, using Department and USFWS approved methodologies.

- The results of surveys designed to delineate all streams located within the site, including ephemeral desert washes.

SUGGESTED MITIGATION MEASURES

We will need to review additional biological surveys prior to making a final determination regarding appropriate mitigation measures; however, avoidance, minimization, and mitigation measures required by California City as a condition of Project approval should include the following:

- The purchase of additional lands or conservation easements to compensate for resources that are lost or disturbed by the Project.

- Avoidance of sensitive species and habitats with appropriate buffer areas or setbacks.

- Limiting outdoor lighting.

- Department approved measures designed to deter the use of the site by ravens.

If you have any questions regarding these comments, or would like to arrange a meeting, please contact Annette Tenneboe, Environmental Scientist, or Julie Vance, Senior Environmental Scientist, at the address or telephone number (extensions 220 or 222 respectively) provided on this letterhead.

Sincerely,

For W. E. Loudermilk
Regional Manager

cc: United States Fish and
Wildlife Service
Ventura Office
2493 Portola Road, Suite B
Ventura, California 93003

Terry Roberts, Director
State Clearinghouse
1400 Tenth Street
Sacramento, California 95814

Annette Tenneboe
Department of Fish and Game

Julie Vance
Department of Fish and Game

Streambed Alteration Program
Department of Fish and Game

CITY OF CALIFORNIA CITY
NOTICE OF INTENT
PREPARATION AND CONSIDERATION OF NEGATIVE DECLARATION

NOTICE IS HEREBY GIVEN that the City of California City, California, has under taken and completed an Initial Study of Zone Change 174, General Plan Amendment 06-02 and Tentative Tract Map 6632 known to be located within the boundaries of California City and in accordance with the provisions of the California Environmental Quality Act (CEQA) and the Guidelines for Implementation of CEQA which have been adopted by the California Resources Agency. This Initial Study was undertaken for the purpose of deciding whether Zone Change 174, General Plan Amendment 06-02 and Tentative Tract Map 6632 might have a significant effect on the environment. On the basis of such Initial Study, the City's staff has concluded that Zone Change 174, General Plan Amendment 06-02 and Tentative Tract Map 6632 could not have a significant effect on the environment and a Negative Declaration has been prepared. A copy of the Initial Study and Negative Declaration is on file at the City Hall, 21000 Hacienda Boulevard, California City, California, and is available for public view.

NOTICE IS FURTHER GIVEN that the Planning Commission of California City at its meeting on Tuesday, January 24, 2006, at 6:00 p.m., in the Council Chambers located at 21000 Hacienda Boulevard, California City, California 93505, will consider the Initial Study and proposed Negative Declaration, which has been prepared. If the Planning Commission finds that Zone Change 174, General Plan Amendment 06-02 and Tentative Map 6632 could not have a significant effect on the environment, and nothing further is required it may forward the Negative Declaration to the City Council of California City at its meeting on Tuesday, February 7, 2006, at 6:00 p.m. in the Council Chambers located at 21000 Hacienda Boulevard, California City, California 93505, for consideration and adoption of the Negative Declaration.

ANY PERSON WISHING TO BE HEARD on this matter may appear and speak at the Planning Commission and City Council meeting or may submit their comments in writing, directly to the City.

Dated: December 5, 2006

for Ronna Greene
William W. Way, Jr.,
City Manager/Planning Director

NOTICE OF AVAILABILITY FOR PUBLIC REVIEW
AN INITIAL STUDY, NEGATIVE DECLARATION,
ZONE CHANGE 174, GENERAL PLAN AMENDMENT 06-02 AND
TENTATIVE TRACT MAP 6632
BY PLANNING COMMISSION AND CITY COUNCIL

This is to advise that the City of California City Planning Department has prepared a Negative Declaration for the project identified below. As mandated by State law, the minimum public review period for this document is 45 days. The comment period closes on Monday, January 23, 2006 at 5:00 p.m., COB. The Initial Study and proposed Negative Declaration are available for review at the Planning Department, City of California City, 21000 Hacienda Boulevard, California City, CA 93505.

A public hearing has been scheduled with the California City Planning Commission on Tuesday, January 24, 2006, at 6:00 p.m., Council Chambers, City of California City, 21000 Hacienda Boulevard, California City, CA 93505.

A subsequent public hearing is scheduled with the City Council on Tuesday, February 7, 2006, at 6:00 p.m., Council Chambers, City of California City, 21000 Hacienda Boulevard, California City, CA 93505.

Testimony at future public hearings may be limited to those issues raised during the public review period either orally or submitted in writing by 5:00 p.m. the day the comment period closes.

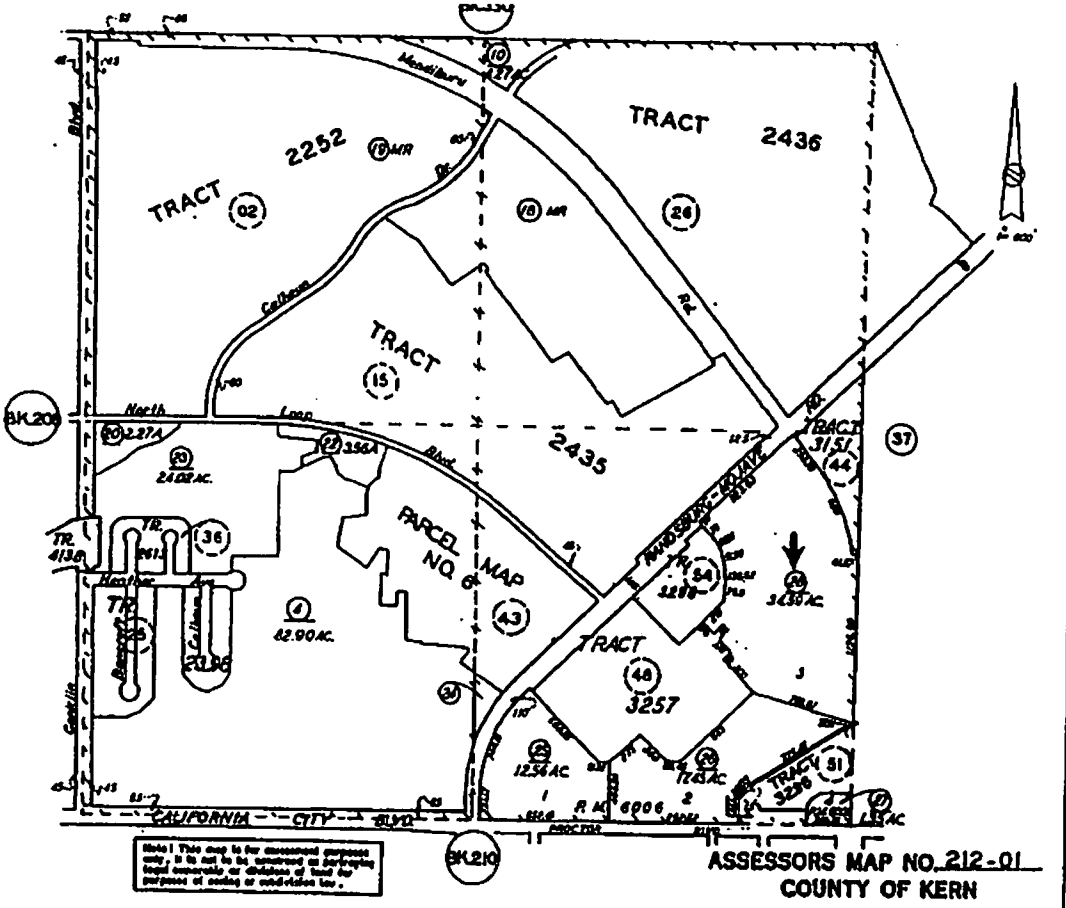
Project Title: Zone Change 174, General Plan Amendment 06-02 and Tentative Tract Map 6632.

Project Location: Located in the City of California City, County of Kern, being a portion of Section 19, Township 32 South, Range 38 East, M.D.B.&M., APN 212-010-28 (34.59 acres), located on Randsburg-Mojave Road.

Project Description: The project involves constructing 44 Neighborhood Commercial (C1) lots for offices and 53 Community Commercial (C2) lots for retail businesses. "Will Serve" letters from all major utilities have been received for this project. Zone Change 174 re-zones the property from O/RA Open Space/Residential Agricultural to C1 Community Commercial and C2 Neighborhood Commercial and General Plan Amendment 06-02 will amend the City's General Plan to incorporate this project.

For further information, please contact William W. Way, Jr., City Manager/ Planning Director (760) 373-7170.

WWW:rg (12/5/05)



ASSESSORS MAP NO. 212-01
COUNTY OF KERN

Address Book – Mailing for state clearing house and utilities
25 copies total: broke down as follows:

STATE CLEARING HOUSE x 15
State Clearing House
1400 Tenth Street
Sacramento Ca 95812-3044

THE GAS COMPANY x 1
Southern California Gas Company
Attn: Russ Pope
New Business Project Manager
44416 North Division Street
Lancaster Ca 93535-2552

SOUTHERN CALIFORNIA EDISON x 1
Southern California Edison
Attn: Alis Clausen
Regional Manager Public Affairs
42060 10st West
Lancaster Ca 93534

EDWARDS AIR FORCE BASE x1
Mr. Dwight Deakin
Logistics Management Specialist
Plans and Policies Division
AFFTC/XPX
1 South Rosamond Boulevard
Edwards CA 93524-1036

KERN COUNTY CLERK x 2
County Clerk
County of Kern
1115 Truxtun Avenue – First Floor
Bakersfield Ca 93301-4639

VERIZON x 1
Verizon
Attn: Alan Bailey, Outside Plant Engineer
520 South China Lake Boulevard
Ridgecrest Ca 93555

DEPARTMENT OF TRANSPORTATION (CAL-TRANS) x 1
Department of Transportation
F. Katy Walton Deputy District Director
Attn: Gayle Rosander IGR/CEQA Coordinator
500 S Main Street, District 9
Bishop Ca 93514

Applicant x1 – (mail to applicant address)

Archive x1 (place in archive file)

Consultant x1 (If need be)

INITIAL STUDY AND ENVIRONMENTAL CHECKLIST FORM

Initial Study:

1. Project Title: Tentative Tract Map 6632.

2. Lead Agency Name and Address: City of California City, 21000 Hacienda Boulevard, California City, California 93505-2293

3. Contact Person and Phone Number: William W. Way, Jr., City Manager/Planning Director, (760) 373-7170.

4. Project Location: A portion of the SE ¼ of Section 19, T32S, R38E, MDB&M, APN 212-010-28 (34.59 acres) located on Randsburg-Mojave Road, California City, County of Kern, California.

5. Project Sponsor's Name and Address: Dong Hoa Ta, 2063 West Avenue K-6, Lancaster, California 93536.

6. General Plan Designation: Open Space/ Residential Agriculture.

7. Zoning: O/RA.

8. Description of the Project: (Describe the whole action involved, including but not limited to later phases of the project, and any secondary, support, or off-site features necessary for its implementation. Attach additional sheets if necessary)

Total lots for Tentative Tract Map 6632 is 97 that will involve subdividing the 34.59 acres into 44 Neighborhood Commercial (C1) lots for offices on the perimeter of the tentative tract and 53 Community Commercial (C2) lots for retail businesses in the interior of the tract.

9. Surrounding Land uses and Setting:(Briefly describe the project's surroundings). The property is located within the Central Core of the City and the surrounding land uses are Neighborhood Commercial (C1), Residential Multiple Family (RM2) and Single Family Residential (R1). The surrounding properties are improved and major utilities have provided "will serve" letters.

10. Other public agencies whose approval is required (e.g., permits, financing approval, or participation agreement). Edwards Air Force Base, Development Review Committee has reviewed this project (DRC 05-17), Planning Commission, City Council, and building permits.

ENVIRONMENTAL FACTORS POTENTIALLY AFFECTED:
The environmental factors checked below (_) would be potentially affected by this
project, involving at least one impact that is a "Potentially Significant Impact" as indicated by the checklist on the following pages.

	Aesthetics		Hazards & Hazardous Materials		Public Services
	Agriculture Resources		Hydrology/Water Quality		Recreation
	Air Quality		Land Use/Planning		Transportation/Traffic
	Biological Resources		Mineral Resources		Utilities/Service Systems
	Cultural Resources		Noise		Mandatory Findings of Significance
	Geology/Soils		Population/Housing		

DETERMINATION: (To be completed by the Lead Agency). On the basis of this initial evaluation:

I find that the proposed project COULD NOT have a significant effect on the environment, and a NEGATIVE DECLARATION will be prepared.	X
I find that although the proposed project could have a significant effect on the environment, there will not be a significant effect in this case because revisions in the project have been made by or agreed to by the project proponent. A MITIGATED NEGATIVE DECLARATION	
I find that the proposed project MAY have a significant effect on the environment, and an ENVIRONMENTAL IMPACT REPORT is required.	
I find that the proposed project MAY have a "potentially significant impact" or "potentially significant unless mitigated" impact on the environment, but at least one effect (1) has been adequately analyzed in an earlier document pursuant to applicable legal standards, and (2) has been addressed by mitigation measures based on the earlier analysis as described on attached sheets. An ENVIRONMENTAL IMPACT REPORT is required, but it must analyze only the effects that remain to be addressed.	
I find that although the proposed project could have a significant effect on the environment, because all potentially significant effects (a) have been analyzed adequately in an earlier EIR or NEGATIVE DECLARATION pursuant to applicable standards and (b) have been avoided or mitigated pursuant to that earlier EIR or NEGATIVE DECLARATION, including revisions or mitigation measures that are imposed upon the proposed project, nothing further is required.	

Signature

12/9/05
Date

William W. Way, Jr.
Printed Name

City Manager/Planning Director
Title

EVALUATION OF ENVIRONMENTAL IMPACTS:

1) A brief explanation is required for all answers except "No Impact" answers that are adequately supported by the information sources a lead agency cites in its explanation following each question. A "No Impact" answer is adequately supported if the referenced information sources show that the impact simply does not apply to projects like the one involved (e. g. the project falls outside a fault rupture zone). A "No Impact" answer should be explained where it is based on project-specific factors as well as general standards (e. g. the project will not expose sensitive receptors to pollutants, based on a project-specific screening analysis).

2) All answers must take account of the whole action involved, including off-site as well as on-site, cumulative as well as project-level, indirect as well as direct, and construction as well as operational impacts.

3) Once the lead agency has determined that a particular physical impact may occur, then the checklist answers must indicate whether the impact is potentially significant, less than significant with mitigation incorporated, or less than significant. "Potentially Significant Impact' is appropriate if there is substantial evidence that an effect may be significant. If there are one or more "Potentially Significant Impact" entries when the determination is made, an EIR is required.

4) "Negative Declaration: Less Than Significant With Mitigation Incorporated" applies where the incorporation of mitigation measures has reduced an effect from "Potentially Significant Impact" to a "Less Than Significant Impact." The lead agency must describe the mitigation measures, and briefly explain how they reduce the effect to a less than significant level (mitigation measures from Section 17, "Earlier Analysis," may be cross-referenced).

5) Earlier analysis may be used where, pursuant to the tiering, program EIR, or other CEQA process, an effect has been adequately analyzed in an earlier EIR or negative declaration. Section 15063 (c) (3) (D). In this case, a brief discussion should identify the following:

(a) Earlier Analysis Used. Identify and state where they are available for review.

(b) Impacts Adequately Addressed. Identify which effects from the above checklist were within the scope of and adequately analyzed in an earlier document pursuant to applicable legal standards, and state whether such effects were addressed by mitigation measures based on the earlier analysis.

(c) Mitigation Measures. For effects that are "Less than Significant with Mitigation Incorporated," describe the mitigation measures which were incorporated or refined from the earlier document and the extent to which they address the site-specific conditions for the project.

6) Lead agencies are encouraged to incorporate into the checklist references to information sources for potential impacts (e.g. general plans, zoning ordinances). Reference to a previously prepared or outside document should, where appropriate, include a reference to the page or pages where the statement is substantiated.

7) Supporting Information Sources: A source list should be attached, and other sources used or individuals contacted should be cited in the discussion.

8) This is only a suggested form, and lead agencies are free to use different formats; however, lead agencies should normally address the questions from this checklist that are relevant to a project's environmental effects in whatever format is selected.

9) The explanation of each issue should identify: (a) the significance criteria or threshold, if any, used to evaluate each question; and (b) the mitigation measure identified, if any, to reduce the impact to less than significant.

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
1. AESTHETICS. Would the project:				
a) Have a substantial adverse effect on a scenic vista?				X
b) Substantially damage scenic resources, including, but not limited to trees, rock outcroppings, and historic buildings within a state scenic highway				X
c) Substantially degrade the existing visual character or quality of the site and its surroundings?				X
d) Create a new source of substantial light or glare which would adversely affect day or nighttime views in the area?				X
2. AGRICULTURE RESOURCES: In determining whether impacts to agricultural resources are significant environmental effects, lead agencies may refer to the California Agricultural Land Evaluation and Site Assessment Model (1997) prepared by the California Department of Conservation as an optional model to use in assessing impacts on agriculture and farmland. Would the project:				
a) Convert Prime Farmland, Unique Farmland, or Farmland of Statewide Importance (Farmland) as shown on the maps prepared pursuant to the Farmland Mapping and Monitoring Program of the California Resources Agency, to non-agricultural use?				X
b) Conflict with existing zoning for agricultural use, or a Williamson Act contract?				X
c) Involve other changes in the existing environment which, due to their location or nature, could result in conversion of Farmland, to non-agricultural use?				X
3. AIR QUALITY: Where available, the significance criteria established by the applicable air quality management or air pollution control district may be relied upon to make the following determinations. Would the project:				
a) Conflict with or obstruct implementation of the applicable air quality plan?				X
b) Violate any air quality standard or contribute substantially to an existing or projected air quality violation?				X
c) Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)?				X
d) Expose sensitive receptors to substantial pollutant concentrations?				X
e) Create objectionable odors affecting a substantial number of				X

Issues and Supporting Information Sources	Potentially Significant Impacts	Lese than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
people?				
4. BIOLOGICAL RESOURCES. Would the project:				
a) Have a substantial adverse effect, either directly or through habitat modifications, on any species identified as a candidate, sensitive, or special status species in local or regional plans, policies, or regulations, or by the California Department of Fish and Game or U. S. Fish and Wildlife Service?				X
b) Have a substantial adverse effect on any riparian habitat or other sensitive natural community identified in local or regional plans, policies, regulations or by the California Department of Fish and Game or U. S. Fish and Wildlife Service?				X
c) Have a substantial adverse effect on federally protected wetlands as defined by Section 404 of the Clean Water Act (including, but not limited to, marsh, vernal pool, coastal, etc.) through direct removal, filling, hydrological interruption, or other means?				X
d) Interfere substantially with the movement of any native resident or migratory fish or wildlife species or with established native resident migratory wildlife corridors, or impede the use of native wildlife nursery sites?				X
e) Conflict with any local policies or ordinances protecting biological resources, such as a tree preservation policy or ordinance?				X
f) Conflict with the provisions of an adopted Habitat Conservation Plan, Natural Conservation Community Plan, other approved local, regional, or state habitat conservation plan?				X
5. CULTURAL RESOURCES. Would the project:				
a) Cause a substantial adverse change in the significance of a historical resource as defined in Section 15064.5?				X
b) Cause a substantial adverse change in the significance of an archaeological resource pursuant to Section 15064.5?				X
c) Directly or indirectly destroy a unique paleontological resource or site or unique geologic feature?				X
d) Disturb any human remains, including those interred outside of formal cemeteries?				X
6. GEOLOGY AND SOILS. Would the project				
a) Expose people or structures to potential substantial adverse effects, including the risk of loss, injury, or death involving:				
i) Rupture of a known earthquake fault, as delineated on the most recent Alquist-Priolo Earthquake Fault Zoning Map issued by the State Geologist for the area or based on other substantial evidence of				X

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a known fault? Refer to Division of Mines and Geology Special Publication 42.				
ii) Strong seismic ground shaking?				X
iii) Seismic-related ground failure, including liquefaction?				X
iv) Landslides?				X
b) Result in substantial soil erosion or the loss of topsoil?				X
c) Be located on a geologic unit or soil that is unstable, or that would become unstable as a result of the project, and potentially result in on- or off-site landslide, lateral spreading, subsidence, liquefaction or collapse?				X
d) Be located on expansive soil, as defined in Table 18-1-B of the Uniform Building Code (1994), creating substantial risks to life or property?				X
e) Have soils incapable of adequately supporting the use of septic tanks or alternative waste water disposal systems where sewers are not available for the disposal of waste water?				X
7. **HAZARDS AND HAZARDOUS MATERIALS.** Would the project:				
a) Create a significant hazard to the public or the environment through the routine transport, use, or disposal of hazardous materials?				X
b) Create a significant hazard to the public or the environment through reasonably foreseeable upset and accident conditions involving the release of hazardous materials into the environment?				X
c) Emit hazardous emissions or handle hazardous or acutely hazardous materials, substances, or waste within one-quarter mile of an existing or proposed school?				X
d) Be located on a site which is included on a list of hazardous materials sites compiled pursuant to Government Code Section 65962.5 and, as a result, would it create a significant hazard to the public or the environment?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project result in a safety hazard for people residing or working in the project area?				X
f) For a project within the vicinity of a private airstrip, would the project result in a safety hazard for people residing or working in the project area?				X

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
g) Impair implementation of or physically interfere with an adopted emergency response plan or emergency evacuation plan?				X
h) Expose people or structures to a significant risk of loss, injury or death involving wildland fires, including where wildlands are adjacent to urbanized areas or where residences are intermixed with wildlands?				X
8. HYDROLOGY AND WATER QUALITY. Would the project:				
a) Violate any water quality standards or waste discharge requirements?				X
b) Substantially deplete groundwater supplies or interfere substantially with groundwater recharge such that there would be a net deficit in aquifer volume or a lowering of the local groundwater table level (e.g., the production rate of pre-existing nearby wells would drop to a level which would not support existing land uses or planned uses for which permits have been granted)?				X
c) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, in a manner which would result in substantial erosion or siltation on- or off-site?				X
d) Substantially alter the existing drainage pattern of the site or area, including through the alteration of the course of a stream or river, or substantially increase the rate or amount of surface runoff in a manner which would result in flooding on- or off-site?				X
e) Create or contribute runoff water which would exceed the capacity of existing or planned stormwater drainage systems or provide substantial additional sources of polluted runoff?				X
f) Otherwise substantially degrade water quality?				X
g) Place housing within a 100-year flood hazard area as mapped on a federal Flood Hazard Boundary or Flood Insurance Rate Map or other flood hazard delineation map?				X
h) Place within a 100-year flood hazard area structures which would impede or redirect flood flows?				X
i) Expose people or structures to a significant risk of loss, injury or death involving flooding, including flooding as a result of the failure of a levee or dam?				X
j) Inundation by seiche, tsunami, or mudflow?				X
9. LAND USE AND PLANNING. Would the project:				

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
a) Physically divide an established community?				X
b) Conflict with any applicable land use plan, policy or regulation of an agency with jurisdiction over the project (including, but not limited to the general plan, specific plan, local coastal program, or zoning ordinance) adopted for the purpose of avoiding or mitigating an environmental effect?				X
c) Conflict with any applicable habitat conservation plan or natural communities conservation plan?				X
10. MINERAL RESOURCES. Would the project:				
a) Result in the loss of availability of a known mineral resource that would be of value to the region and the residents of the state?				X
b) Result in the loss of availability of a locally-important mineral resource recovery site delineated on a local general plan, specific plan or other land use plan?				X
11. NOISE. Would the project result in:				
a) Exposure of persons to or generation of noise levels in excess of standards established in the local general plan or noise ordinance, or applicable standards of other agencies?				X
b) Exposure of persons to or generation of excessive groundborne vibration or groundborne noise levels?				X
c) A substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project?				X
d) A substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project?				X
e) For a project located within an airport land use plan or, where such a plan has not been adopted, within two miles of a public airport or public use airport, would the project expose people residing or working in the project area to excessive noise levels?				X
f) For a project within the vicinity of a private airstrip, would the project expose people residing or working in the project area to excessive noise levels?				X
12. POPULATION AND HOUSING. Would the project:				
a) Induce substantial population growth in an area, either directly (for example, by proposing new homes and businesses) or indirectly (for example, through extension of roads or other infrastructure)?				X
b) Displace substantial numbers of existing housing,				X

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
necessitating the construction of replacement housing elsewhere?				
c) Displace substantial numbers of people, necessitating the construction of replacement housing elsewhere?				X
13. PUBLIC SERVICES. Would the project result in substantial adverse physical impacts associated with the provision of new or physically altered government facilities, need for new or physically altered governmental facilities, the construction of which could cause significant environmental impacts, in order to maintain acceptable service ratios, response times or other performance objectives for any of the public services:				
a) Fire protection?				X
b) Police protection?				X
c) Schools?				X
d) Parks?				X
e) Other public facilities?				X
14. RECREATION.				
a) Would the project increase the use of existing neighborhood or regional parks or other recreational facilities such that substantial physical deterioration of the facility would occur or be accelerated?				X
b) Does the project include recreational facilities or require the construction or expansion of recreational facilities which might have an adverse physical effect on the environment?				X
15. TRANSPORTATION/TRAFFIC. Would the project:				
a) Cause an increase in traffic which is substantial in relation to the existing traffic load and capacity of the street system (i.e., result in a substantial increase in either the number of vehicle trips, the volume to capacity ratio on roads, or congestion at intersections)?				X
b) Exceed, either individually or cumulatively, a level of service standard established by the county congestion management agency for designated roads or highways?				X
c) Result in a change in air traffic patterns, including either an increase in traffic levels or a change in location that results in substantial safety risks?				X
d) Substantially increase hazards to a design feature (e.g., sharp curves or dangerous intersections) or incompatible uses (e. g. farm equipment)?				X
e) Result in inadequate emergency access?				X
f) Result in inadequate parking capacity?				X

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
g) Conflict with adopted policies supporting alternative transportation (e.g., bus turnouts, bicycle racks)?				X
16. UTILITIES AND SERVICE SYSTEMS. Would the project:				
a) Exceed wastewater treatment requirements of the applicable Regional Water Quality Control Board?				X
b) Require or result in the construction of new water or wastewater treatment facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
c) Require or result in the construction of new storm water drainage facilities or expansion of existing facilities, the construction of which could cause significant environmental effects?				X
d) Have sufficient water supplies available to serve the project from existing entitlements and resources, or are new or expanded entitlements needed?				X
e) Result in a determination by the wastewater treatment provider which serves or may serve the project that it has adequate capacity to serve the project's projected demand in addition to the provider's existing commitments?				X
f) Be served by a landfill with sufficient permitted capacity to accommodate the project's solid waste disposal needs?				X
g) Comply with federal, state, and local statutes and regulations related to solid waste?				X
17. MANDATORY FINDINGS OF SIGNIFICANCE.				
a) Does the project have the potential to degrade the quality of the environment, substantially reduce the habitat of a fish or wildlife species, cause a fish or wildlife population to drop below self-sustaining levels, threaten to eliminate a plant or animal community, reduce the number or restrict the range of a rare or endangered plant or animal or eliminate important examples of the major periods of California history or prehistory?				X
b) Does the project have impacts that are individually limited, but cumulatively considerable? ("Cumulatively considerable" means that the incremental effects of a project are considerable when viewed in connection with the effects of past projects, the effects of other current projects, and the effects of probable future projects)?				X
c) Does the project have environmental effects which will				X

Issues and Supporting Information Sources	Potentially Significant Impacts	Less than Significant With Mitigation Incorporated	Less Than Significant Impact	No Impact
cause substantial adverse effects on human beings, either directly or indirectly?				

Biological Resource Assessment
of APN 212-010-28,
California City, California

November 4, 2005

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Biological Resource Assessment of APN 212-010-28, California City, California

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Abstract

Development of single-family residences has been proposed for APN 212-010-28. The approximately 35 acre (14 ha) study area was located north of Proctor Boulevard and east of Randsburg-Mojave Road, T32S, R38E, a portion of the SE1/4 of Section 19, M.D.B.M. A line transect survey was conducted on 25 October 2005 to inventory biological resources. The proposed project area was characteristic of a moderately disturbed, ecotone between saltbush (Atriplex sp.) and creosote bush (*Larrea tridentata*) scrub plant communities. A total of thirty-four plant species and ten wildlife species or their sign were observed during the line transect survey. If at all possible, construction activities should occur outside the nesting season (spring) for birds. If construction activity will occur during the nesting season, a survey should be conducted within one week prior to the removal of trees. If active bird nests are found, impacts should be avoided unless the proper permits are obtained. No desert tortoises (*Gopherus agassizii*) or their sign were observed during the field survey. However, development of protective measures that would support a no affect determination for desert tortoise are recommended. No burrowing owls (*Athene cunicularia*) or their sign were observed during the line transect survey. Prairie falcons (*Falco mexicanus*), Le Conte's thrashers (*Toxostoma lecontei*), Barstow woolly sunflowers (*Eriophyllum mohanense*), alkali mariposa lilies (*Calochortus striatus*), and desert cymopterus (*Cymopterus deserticola*) are not expected to occur within the study area. The proposed project site was located within the geographic range of the Mohave ground squirrel (*Spermophilus mohavensis*). However, habitat within the study area did not appear potentially suitable to support Mohave ground squirrels. No other state or federally listed species are expected to occur within the proposed project area. This project is not expected to result in a significant adverse impact to biological resources.

Development of single-family residences has been proposed for APN 212-010-28 (Figure 1). It is assumed that development would include installation of paved access roads and utilities (natural gas, water, sewer, electric, telephone). The entire project area would likely be graded as a result of construction activities.

An environmental analysis should be conducted prior to any development project. An assessment of biological resources is an integral part of environmental analyses (Gilbert and Dodds 1987). The purpose of this study was to provide an assessment of biological resources potentially occurring within, or utilizing the proposed project area. Specific focus was on the presence/absence of rare, threatened and endangered species of

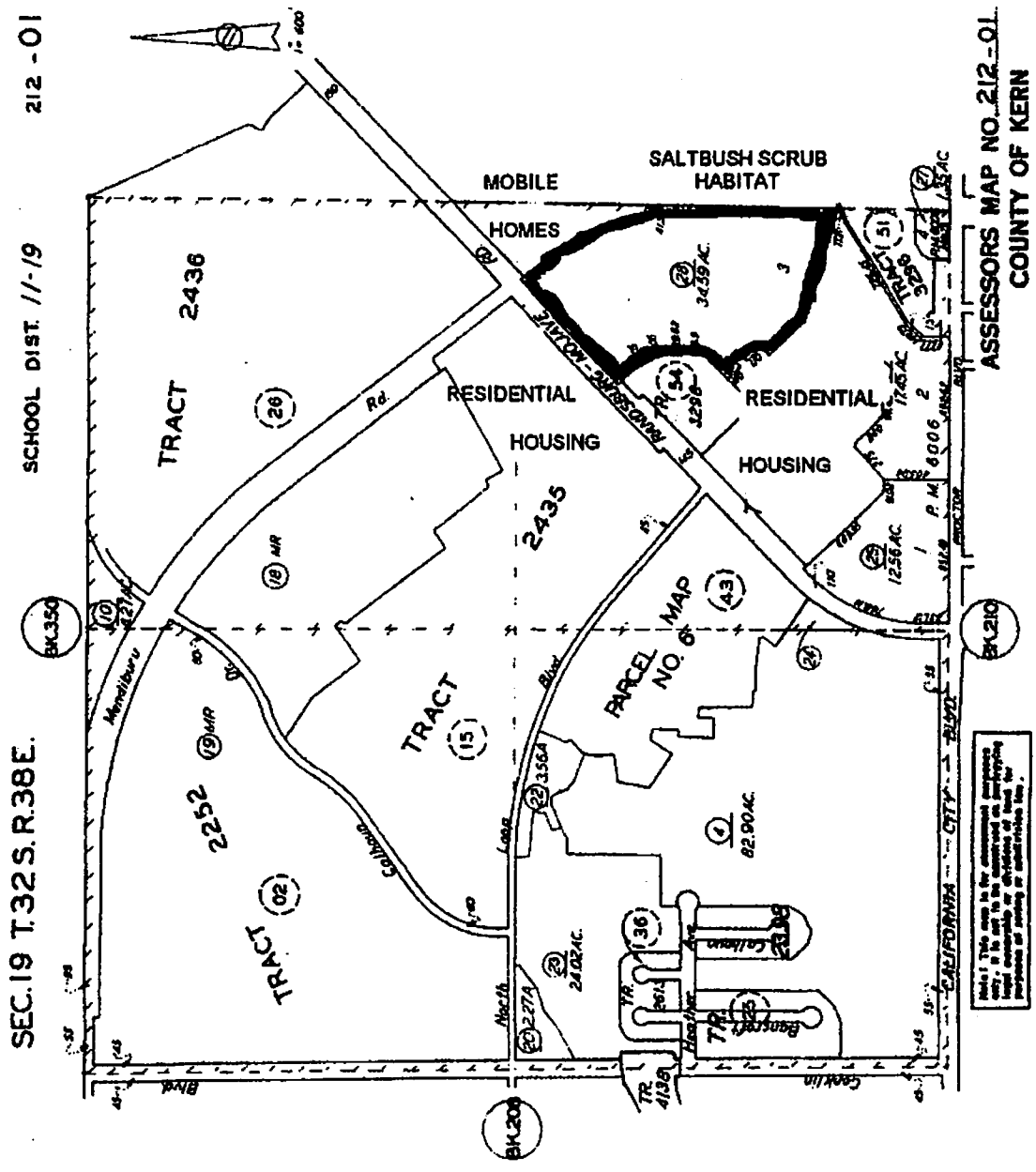

Figure 1. Location of proposed project area as depicted on APN map.

plants and wildlife. Species of concern included the desert tortoise (*Gopherus agassizii*), Mohave ground squirrel (*Spermophilus mohavensis*), burrowing owl (*Athene cunicularia*) Le Conte's thrasher (*Toxostoma lecontei*), prairie falcon (*Falco mexicanus*), desert cymopterus (*Cymopterus deserticola*), Barstow woolly sunflower (*Eriophyllum mohanense*) and alkali mariposa lily (*Calochortus striatus*).

Study Area

The approximately 35 acre (14 ha) study area was located north of Proctor Boulevard and east of Randsburg-Mojave Road, T32S, R38E, a portion of the SE1/4 of Section 19, M.D.B.M. (Figure 2). The western boundary of the site was formed by Randsburg-Mojave Road. Residential housing occurred to the west of Randsburg-Mojave Road. Saltbush (*Atriplex* sp.) scrub habitat occurred adjacent to the eastern boundary of the study area. Residential housing occurred adjacent to the southern boundary of the study area. A mobile home residential area occurred adjacent to the northern boundary of the study area. Topography of the study area ranged 2,340 feet (755 m) above sea level.

Methods

A line transect survey was conducted to inventory plant and wildlife species occurring within the proposed project area (Cooperrider et al. 1986, Davis 1990). Line transects were walked in an east-west orientation. Line transects were approximately 1,320 feet (426 m) long and spaced about 40 feet (13 m) apart (U.S. Fish & Wildlife Service 1990).

All observations of plant and animal species were recorded in field notes. Field guides were used to aid in the identification of plant and animal species (Arnett and Jacques 1981, Borror and White 1970, Burt and Grossenheider 1976, Gould 1981, Jaeger 1969, Knobel 1980, Robbins et al. 1983, Stark 2000). Observations of animal tracks, scat, and burrows were also utilized to determine the presence of wildlife species inhabiting the proposed project area (Cooperrider et al. 1986, Halfpenny 1986, Murie 1974).

Results

A total of fifty line transects were walked on 25 October 2005. Weather conditions consisted of moderate temperatures (estimated 60-65 degrees F), 0% cloud cover, and a light wind. A sandy loam surface soil texture was characteristic throughout the study area.

The proposed project area was characteristic of a moderately disturbed, ecotone between saltbush (*Atriplex* sp.) and creosote bush (*Larrea tridentata*) scrub plant

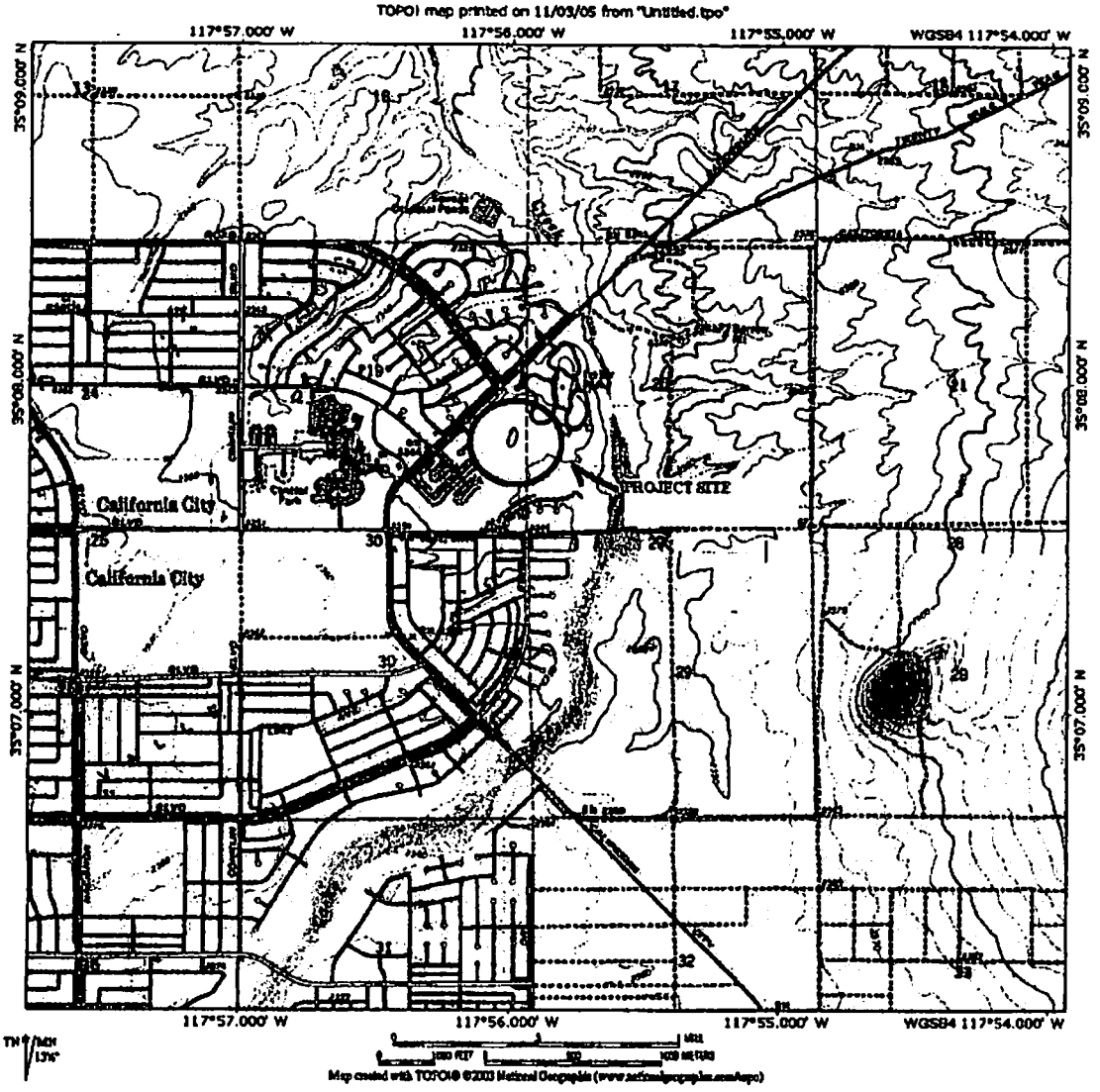

Figure 2. Approximate location of study area as depicted on excerpt from USGS Quadrangle, California City, North, California, 7.5' 1973.

communities (Barbour and Major 1988). A total of thirty-four plant species were observed during the line transect survey (Table 1). The dominant shrub species throughout the entire study area was creosote bush (*Larrea tridentata*). Schismus (*Schismus* sp.), annual burweed (*Franseria acanthicarpa*), and apricot mallow (*Sphaeralcea ambiqua*) were the dominant annual species throughout the study area. Several cottonwood (*Populus fremontii*), pine (*Pinus* sp.), and salt cedar (*Tamarix aphylla*) trees were observed within the northern portion of the study area. Three alder (*Alnus* sp.) trees were observed in the southwestern portion of the study area.

A total of ten wildlife species, or their sign were observed during the line transect survey (Table 2). No desert tortoises (*Gopherus agassizii*) or their sign were observed during the field survey. No burrowing owls (*Athene cunicularia*) or their sign were observed during the line transect survey. No bird nests were observed within the study area.

Several off road vehicle trails intersect the study area. Off road vehicle tracks were observed throughout the study area. Large amounts of trash were observed throughout the study area. Domestic dog (*Canis familiaris*) sign was observed throughout the study area.

Discussion

Most annual plant species were desiccated at the time the field survey was performed. It is probable that some annual plant species were not visible during the time the field survey was performed. Although not observed, several wildlife species would be expected to occur within the proposed project area (Table 3).

Human impacts are expected to increase as urban development continues to occur near and adjacent to the study area. Habitat in the general area will continue to become degraded and fragmented. Burrowing animals within the proposed project area are not expected to survive construction activities. More mobile species, such as lagomorphs (rabbits and hares), coyotes (*Canis latrans*), and birds are expected to survive, but they will have less cover and foraging habitat available.

The Mohave ground squirrel is a state listed threatened species. The proposed project area was located within the geographic range of the Mohave ground squirrel (*Spermophilus mohavensis*). However, habitat within the study area did not appear potentially suitable to support Mohave ground squirrels.

The desert tortoise is a state and federally listed threatened species. Although desert tortoises or their sign were not observed during the field survey, there is a potential for this species to occur in habitat located adjacent to east study area. Densities in this general area are estimated to be 20-50 desert tortoises per square mile (Woodman 2000).

Table 1. List of plant species that were observed during the line transect survey of APN 212-010-28, California City, California.

Common Name	Scientific Name
Native Trees and Shrubs	
Creosote bush	*Larrea tridentata*
Burrobush	*Ambrosia dumosa*
Anderson thorn	*Lycium andersonii*
Peachthorn	*Lycium cooperi*
Felt thorn	*Tetradymia stenolepis*
Winter fat	*Eurotia lanata*
Shadscale	*Atriplex confertifolia*
Allscale	*Atriplex polycarpa*
Cheesebush	*Hymenoclea salsola*
Rabbit brush	*Chrysothamnus nauseosis*
Native Annuals	
Mojave aster	*Xylorhiza tortifolia*
Skeleton weed	*Eriogonum* sp.
Autumn vinegar-weed	*Lessingia germanorum*
Blue mantle	*Eriastrum diffusum*
Apricot mallow	*Sphaeralcea ambiqua*
Turkey mullein	*Eremocarpus setigerus*
Fiddleneck	*Amsinckia tessellata*
Coyote melon	*Cucurbita palmata*
Loco weed	*Astragalus* sp.
Jimson weed	*Datura meteloides*
Indian ricegrass	*Oryzopsis hymenoides*
Cacti	
Silver cholla	*Opuntia echinocarpa*

Table 1 Continued. List of plant species that were observed during the line transect survey of APN 212-010-28, California City, California.

Non-Native Trees

Alder	*Alnus* sp.
Cottonwood tree	*Populus fremontii*
Pine tree	*Pinus* sp.
Salt cedar	*Tamarix aphylla*

Exotic Annuals

Annual burweed	*Franseria acanthicarpa*
Russian thistle	*Salsola iberica*
Barb-wire tumble weed	*Salsola paulensii*
Tumble mustard	*Sisymbrium altisissiimum*
Red stemmed filaree	*Erodium cicutarium*
Schismus	*Schismus* sp.
Red brome	*Bromus rubens*
Bermuda grass	*Cynodon dactylon*

Table 2. List of wildlife species, or their sign, that were observed during the line transect survey of APN 212-010-28, California City, California.

Common Name	Scientific Name
Desert cottontail	*Sylvilagus auduboni*
Black-tailed jackrabbit	*Lepus californicus*
Antelope ground squirrel	*Ammospermophilus leucurus*
Rodents	Order: Rodentia
Coyote	*Canis latrans*
Domestic dog	*Canis familiaris*
Mourning dove	*Zenaida macroura*
Common raven	*Corvus corax*
Northern mockingbird	*Mimus polyglottos*
Ants	Order: Hymenoptera

Table 3. List of wildlife species that may occur within the study area, APN 212-010-28, California City, California.

Common Name	Scientific Name
Deer mouse	*Peromyscus maniculatus*
Merriam kangaroo rat	*Dipodomys merriami*
Rock dove	*Columba livia*
Horned lark	*Eremophila alpestris*
House finch	*Carpodacus mexicanus*
Sage sparrow	*Amphispiza belli*
White crowned sparrow	*Zonotrichia leucophrys*
Side blotched lizard	*Uta stansburiana*
Western whiptail	*Cnemidophorus tigris*
Leopard lizard	*Gambelia wislizenii*
Gopher snake	*Pituophis melanoleucus*
Mojave rattlesnake	*Crotalus scutulatus*
Spider	Order: Araneida
Grasshopper	Order: Orthoptera
Bees	Order: Hymenoptera
Fly	Order: Diptera
Butterfly (orange, black, white)	Order: Lepidoptera
Darkling beetle	*Coelocnemis californicus*
Tarantula wasp	*Pepsis formosa*

The proposed project site was not located in critical habitat designated for the Mojave population of the desert tortoise. Based on the lack of live animals and sign, it is unlikely that desert tortoises currently occupy the study area. However, development of protective measures that would support a no affect determination is recommended. Protective measures might include worker education programs, surveys prior to grading, exclusion fencing, strict trash control to prevent feeding ravens (*Corvus corax*) and coyotes, well defined work areas, and procedures for halting work if a desert tortoise enters the project area and allowing the animal to leave on its own volition. Under a no affect alternative, movement, harassment, harm, or mortality of desert tortoises must be avoided. Other protective measures might also be applicable depending on the timing of grading and construction. A no affect alternative should include development of a mitigation plan that includes all appropriate protection measures to ensure no affect to desert tortoises. A no affect alternative may not be feasible if desert tortoises reoccupy the study area prior to development.

Based on the results of this survey, burrowing owls, prairie falcons, Le Conte's thrashers, alkali mariposa lilies, Barstow woolly sunflowers, and desert cymopterus are not expected to occur within the study area. No other state or federally listed threatened or endangered species are expected to occur within the proposed project area (California Department of Fish and Game 2002, Smith and Berg 1988, U.S. Fish & Wildlife Service 1990).

Many species of birds and their active nests are protected under the Migratory Bird Treaty Act. The various trees within the study area provide nesting sites for birds. If at all possible, construction activities should occur outside the nesting season (spring) for birds. If construction activity will occur during the nesting season, a survey should be conducted within one week prior to removal of the trees. If active bird nests are found, impacts should be avoided unless the proper permits are obtained.

Landscape design should incorporate the use of native plants to the maximum extent feasible. Native plants that have food and cover value to wildlife should be used in landscape design (Adams and Dove 1989). Diversity of native plants should be maximized in landscape design (Adams and Dove 1989). This project is not expected to result in a significant adverse impact to biological resources.

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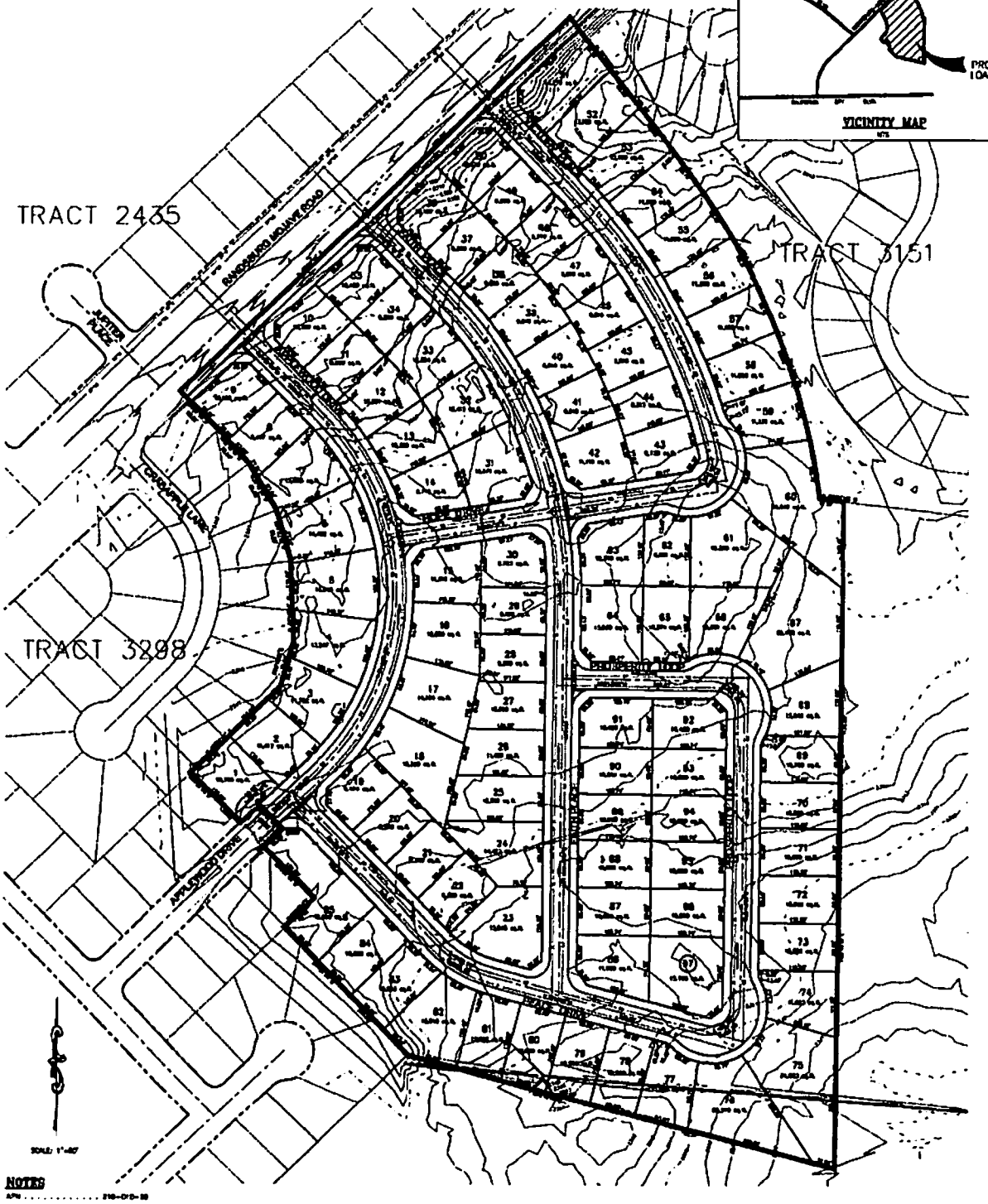
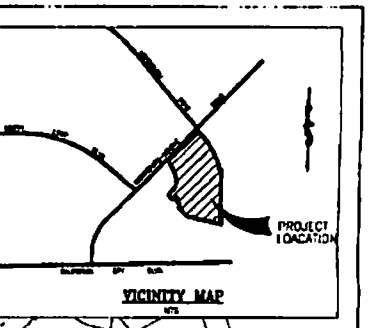
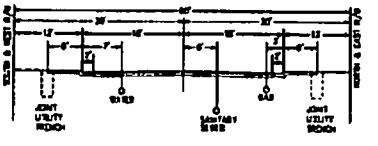
TENTATIVE MAP
NO. 6632





NOTES

APN	210-010-30
AREA	34.90 ACRES
TOTAL LOTS	97 LOTS/97 BUILDABLE
NET DENSITY	2.7 LOTS/ACRE
ZONING	O/RA (EXISTING) C-1 & C-2 (PROPOSED)
ELECTRIC	SOUTHERN CALIFORNIA EDISON
GAS	SOUTHERN CALIFORNIA GAS COMPANY
SEWER	CITY OF CALIFORNIA CITY
WATER	CITY OF CALIFORNIA CITY
STORM DRAIN	CITY OF CALIFORNIA CITY
CABLE	CHARTER CABLE
FLOOD ZONE	"C" PANEL NO. 0604400097C



TYPICAL STREET SECTION

LEGEND:

- PROPERTY BOUNDARY
- DIRECTION OF FLOW
- EXISTING WATER
- EXISTING SEWER
- PROPOSED BLOCK WALL

LEGAL DESCRIPTION:

PARCEL 3 IN THE CITY OF CALIFORNIA CITY, COUNTY OF KERN, STATE OF CALIFORNIA, AS SHOWN ON PARCEL MAP [illegible], RECORDED APRIL 28, 1981 IN BOOK 38 PAGE 101 OF PARCEL MAPS, IN THE OFFICE OF THE COUNTY RECORDER OF SAID COUNTY.

JUNE [illegible]

WILLIAM ROSE & ASSOC., INC.
8051 BAY AVENUE
CALIFORNIA CITY, CALIFORNIA 93505
(760) 373-1919 FAX (760) 373-1818

OWNER/DEVELOPER
DONG HOA TA
CALIFORNIA CITY SANDSBURG PLAZA LIMITED PARTNERSHIP
[illegible] WEST AVENUE G-8
LANCASTER, CA [illegible]

G. WILLIAM ROSE, L.S. [illegible]
WILLIAM ROSE & ASSOCIATES
LICENSE EXPIRES JUNE 30, [illegible]

SHEET 1 OF 1

PREPARING FOR ANY ACTION THAT MAY OCCUR WITHIN THE RANGE OF THE MOJAVE DESERT TORTOISE (*Gopherus agassizii*)

The Mojave population of the desert tortoise (*Gopherus agassizii*) was listed by the U.S. Fish and Wildlife Service (USFWS) as threatened on April 2, 1990 (USFWS 1990) and by the State of California on August 3, 1989. Subsequently, proposed actions within the range of the desert tortoise fall under purview of the Endangered Species Act 1973, as amended (ESA), in addition to State regulations, including the California Endangered Species Act (CESA). For detailed information on the ecology of the Mojave desert tortoise, please see USFWS (2009).

This protocol provides recommendations for survey methodology to determine presence/absence and abundance of desert tortoises for projects occurring within the species range on Federal and non-Federal lands, and to provide a standard method for reporting survey results. Information gathered from these procedures will: 1) help determine the appropriate level of consultation with USFWS and the appropriate state agency; 2) help determine the incidental take of desert tortoises resulting from proposed projects as defined by the ESA and CESA; and 3) help minimize and avoid take.

This guidance includes:

- Site Assessment
- Pre-project Field Survey Protocol for Potential Desert Tortoise Habitats
- USFWS 2009 Desert Tortoise Pre-project Survey Data Sheet

This guidance is subject to revision as new information becomes available. Before initiating the protocols described below, please check with your local USFWS and appropriate state agency offices to verify that you are implementing the most up-to-date methods. To ensure quality and reduce the likelihood of nonconcurrence with survey results, we recommend that the names and qualifications of the surveyors be provided to USFWS and appropriate state agency for review prior to initiating surveys.

In Arizona:

U.S. Fish and Wildlife Service
Arizona Ecological Services
323 N. Leroux St., Suite 201
Flagstaff, AZ 86001
(928) 226-0614

In California, for Inyo, Kern, Los Angeles, and San Bernardino Counties:

U.S. Fish and Wildlife Service
Ventura Fish and Wildlife Office
2493 Portola Road, Suite B
Ventura, California 93003
(805) 644-1766

In California, for Imperial and Riverside Counties, and Joshua Tree National Park and the San Bernardino National Forest in San Bernardino Co:

U.S. Fish and Wildlife Service
Carlsbad Fish and Wildlife Office
6010 Hidden Valley Road
Carlsbad, California 92009
(760) 431-9440

In Nevada:

U.S. Fish and Wildlife Service
Southern Nevada Field Office
4701 North Torrey Pines Drive
Las Vegas, Nevada 89130
(702) 515-5230

In Utah:

U.S. Fish and Wildlife Service
Utah Ecological Services Field Office
2369 West Orton Circle
West Valley City, Utah 84119
(801) 975-3330

State Agencies

Arizona Game & Fish Department
State Headquarters--Nongame Branch
5000 W. Carefree Highway
Phoenix, AZ 85086
623-236-7767

California Department of Fish and Game (CDFG)
For Fresno, Kern, Kings, Madera, Mariposa, Merced, Monterey, San Benito, San Luis Obispo, Stanislaus, Tulare and Tuolumne Counties:
Central Region Headquarters Office
1234 E. Shaw Avenue
Fresno, CA 93710
(559) 243-4005 ext. 151

For Imperial, Inyo, Mono, Riverside and San Bernardino Counties:
Inland Deserts Regional Office
3602 Inland Empire Boulevard, Suite C-220
Ontario, CA 91764
(909) 484-0167

For Los Angeles, Orange, San Diego, Santa Barbara and Ventura Counties:
South Coast Regional Office
4949 Viewridge Avenue
San Diego, CA 92123
(858) 467-4201

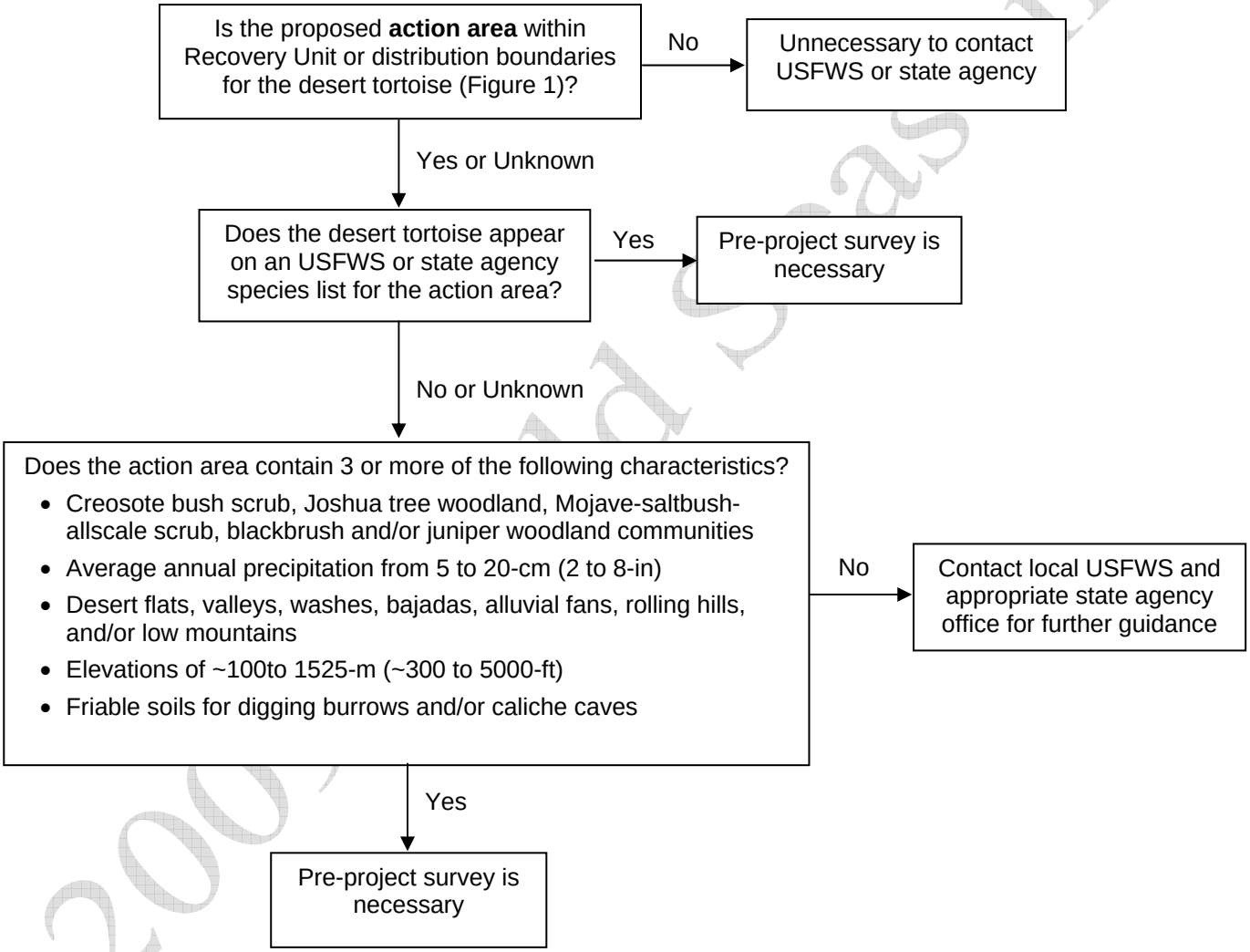
Nevada: Department of Wildlife:
Southern Region
4747 Vegas Dr.
Las Vegas, NV 89108
(702) 486-5127

Utah Division of Wildlife Resources:
Southern Region
1470 N Airport Rd
Cedar City, UT 84720
(435) 865-6100

2009 Field Season

Site Assessment

Use the below key to assess if desert tortoises may be present within or near the action area and determine survey and consultation requirements[1]. The **action area** is defined by regulation as all areas to be affected directly or indirectly and not merely the immediate area involved in the action (50 CFR §402.02). The extent of the action area is not limited to the "footprint" of the action nor is it limited by the authority of the Federal, state, or local agency or any other entity proposing the project. The environmental baseline, the analysis of the effects of the action, and the amount or extent of incidental take are based upon the action area. If you cannot access the entire action area during your surveys for some reason (e.g. access to private property is unavailable), please note that in your survey report.



[1] If determined that the proposed project is not likely to adversely affect the desert tortoise and a tortoise or tortoise sign (shells, bones, scutes, limbs, burrows, pallets, scats, egg shell fragments, tracks, courtship rings, drinking sites, mineral licks, etc.) is found in the action area during implementation of the proposed project, the proposed action should *immediately* stop and then it must be determined whether further or formal consultation is necessary to comply with the ESA or CESA in California. It is recommended that the USFWS and CDFG in California be notified in writing within three days of the discovery. This short notification period will help ensure a prompt response by USFWS and CDFG to facilitate ESA and CESA compliance.

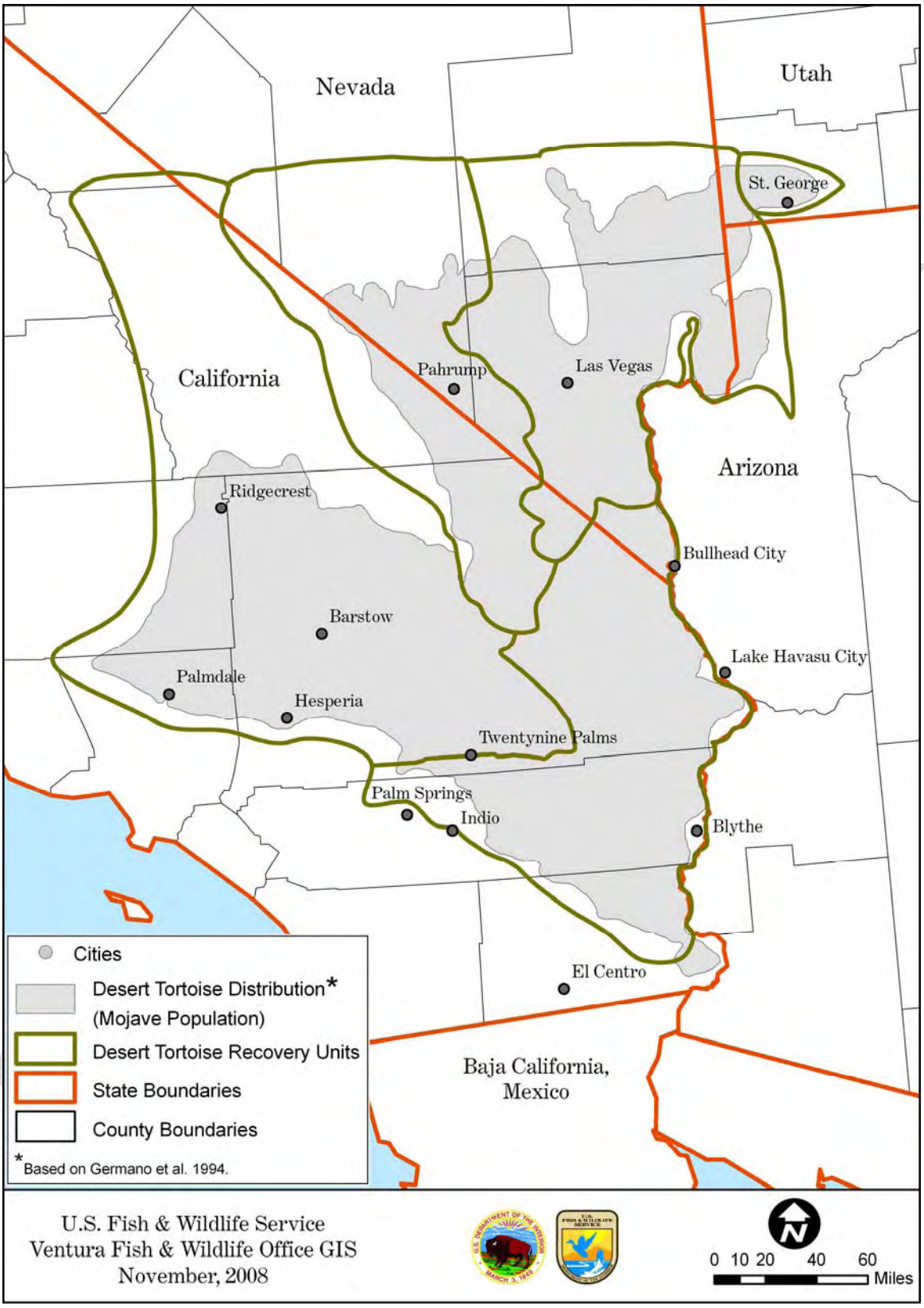


Figure 1: Known Range of the Desert Tortoise (Mojave Population)

Pre-project Field Survey Protocol for Potential Desert Tortoise Habitats

Objectives of survey

- Determine presence or absence of desert tortoises within the action area
- Estimate the number of tortoises (abundance) within the action area
- Assess the distribution of tortoises within the action area to inform take avoidance and minimization

The **action area** is defined by regulation as all areas to be affected directly or indirectly and not merely the immediate area involved in the action (50 CFR §402.02). The action area is not limited to the "footprint" of the action or jurisdiction. Rather, it is a biological determination of the reach of the proposed action on listed species.

Field Methods

This protocol takes into account the fact that not all tortoises within the action area are seen by the surveyor. Provided is an equation which accounts for tortoises that are below ground at the time of surveys and for above-ground tortoises that are cryptic and may be missed.

$$\begin{pmatrix}\text{Estimated number of tortoises}\\ \text{within action area}\end{pmatrix} = \frac{\begin{pmatrix}\text{Number of tortoises}\\ \text{observed above ground}\end{pmatrix}}{\begin{pmatrix}\text{Probability that}\\ \text{a tortoise is}\\ \text{above ground } (P_a)\end{pmatrix}\begin{pmatrix}\text{Probability of}\\ \text{detecting a tortoise,}\\ \text{if above ground } (P_d)\end{pmatrix}}\begin{pmatrix}\dfrac{\text{Action area}}{\text{Area surveyed}}\end{pmatrix}$$

Surveys of 100% coverage, or probabilistic sampling where appropriate, should utilize this equation to estimate the number of tortoises within the action area (see below; Table 1, P_a and P_d).

- Information to determine presence/absence *and* estimate number of tortoises within the action area is collected during the same survey effort. Surveyed objects include all tortoises that are above ground (both out of burrows and within burrows but still visible), as well as all tortoise sign (burrows, scats, carcasses, etc). Record all locations of tortoises and sign encountered during the survey effort using the USFWS 2009 Desert Tortoise Pre-Project Survey Data Sheet (attached). Please submit a copy of the original datasheets with results of the survey to your local USFWS office.
- Surveys should be conducted during the tortoise's most active periods (April through May or September through October) (Nussear and Tracy 2007; Inman 2008; USFWS 2009). Surveys outside these time periods may be approved by USFWS, and CDFG in California (e.g., warm weather in March or rainfall in August stimulating increased tortoise activity).
- Desert tortoises utilize burrows to avoid daily and annual thermal extremes (Woodbury and Hardy 1948). Therefore, surveys should take place when air temperatures are below 40°C (104°F) (Zimmerman et al. 1994; Walde et al. 2003; Inman 2008). Air temperature is measured ~5-cm from the soil surface in an area of full sun, but in the shade of the observer.
- Ten-meter (~30-ft) wide belt transects should be used during surveys. For all projects, surveys which cover the entire project area with the 10-m belt transects (100% coverage) are always an acceptable option. For very large action areas, probabilistic sampling may also be an option, such that the appropriate proportion of the action area is surveyed (Table 2). If probabilistic sampling is an option for the project site, each transect should be chosen either systematically or randomly ensuring that the entire action area has an equal probability of being included in the sample. Transects should be completed in a random order, oriented in a logistically convenient pattern (e.g., lines, squares, or triangles). Any sampling design other than simple systematic or random sampling must be approved by USFWS (e.g. stratification). See *Frequently Asked Questions* section for a discussion of 100% coverage and probabilistic sampling.
- USFWS considers the results of a pre-project survey to be valid for no more than one year. If survey results are older than one year, please contact the local USFWS office.

2009 Field Season

Presence or absence of desert tortoises within the project vicinity

- Occurrence of either live tortoises or tortoise sign (burrows, scats, and carcasses) in the action area indicates desert tortoise presence and therefore requires formal consultation with USFWS.
- If neither tortoises nor sign are encountered during the action area surveys and the project, or any portion of project, is ≤ 0.8 km^2 (200 acres) or linear, three additional 10-m (~30-ft) belt transects at 200-m (~655-ft) intervals parallel to and/or encircling the project area perimeter (200-m, 400-m, and 6000-m from the perimeter of the project site) should be surveyed. These transects are employed only as part of the presence/absence determination; they are not included in the estimation of tortoise abundance. See *Frequently Asked Questions* section below for an explanation of why additional surveys are needed.
- If neither tortoises nor sign are encountered during the action area surveys, as well as project perimeter surveys where appropriate, please contact your local USFWS office. Informal consultation with the USFWS may be required even though no desert tortoises or sign are found during surveys.

Number of tortoises within the action area

The attached Table 3 spreadsheet will estimate the number of adult tortoises (>160 mm MCL) within the action area using the "Number of tortoises within the action area" equation from above.

Enter the requested information into the Table 3 spreadsheet, as follows:

1. Enter the total project area.
2. Enter the appropriate value from Table 1 for the term "probability that a tortoise is above ground" (P_a).
3. Enter the number of adult tortoises (>160-mm midline carapace length) found during the survey of the action area for the term "number of tortoises observed above ground" (n).

Table 1. Probability that a desert tortoise is above ground (P_a) relative to the previous winter's rainfall (October through March)

Use amount of rainfall from the winter preceding the pre-project survey to determine which value of P_a *is appropriate for the project*

To find this amount of rainfall, go to the Western Regional Climate Center site: http://www.wrcc.dri.edu/summary/Climsmsca.html; click on your location and scroll down to "monthly totals"

Previous Winter Rain	Probability (P_a)	Variance(P_a)
<40 mm (~1.5 inches)	0.64	0.08
≥40 mm (~1.5 inches)	0.80	0.05

The estimate for the term "probability of detecting a tortoise if above ground (P_d)" is already included in spreadsheet Table 3 (P_d = 0.63; variance = 0.011). See *Frequently Asked Questions* section below for how P_a and P_d and their associated variances were estimated.

See *Appendix 1* for a detailed description of the method used to estimate desert tortoise abundance.

2009 Field Season

100% Coverage or Probabilistic Sampling?

100% coverage surveys are always an acceptable option, regardless of the size of the action area. For very large action areas, probabilistic sampling may be an additional option, such that the appropriate proportion of the action area is surveyed as detailed below.

For the 2009 field season, probabilistic sampling is not an option for desert tortoise pre-project surveys in California due to the requirement of CESA to avoid, minimize, and fully mitigate (CDFG code section 2081).

Table 2. Is probabilistic sampling an appropriate option for the proposed action area?

Is your action area smaller than the area given below for the recovery unit in which the project occurs?

Recovery Unit	Threshold Action Area to Allow Sampling
Western Mojave	7.2 km^2 (1777 acres)
Eastern Mojave	10.8 km^2 (2676 acres)
Colorado Desert	6.4 km^2 (1573 acres)
Northeastern Mojave	23.3 km^2 (5764 acres)
Upper Virgin River	2.0 km^2 (490 acres)

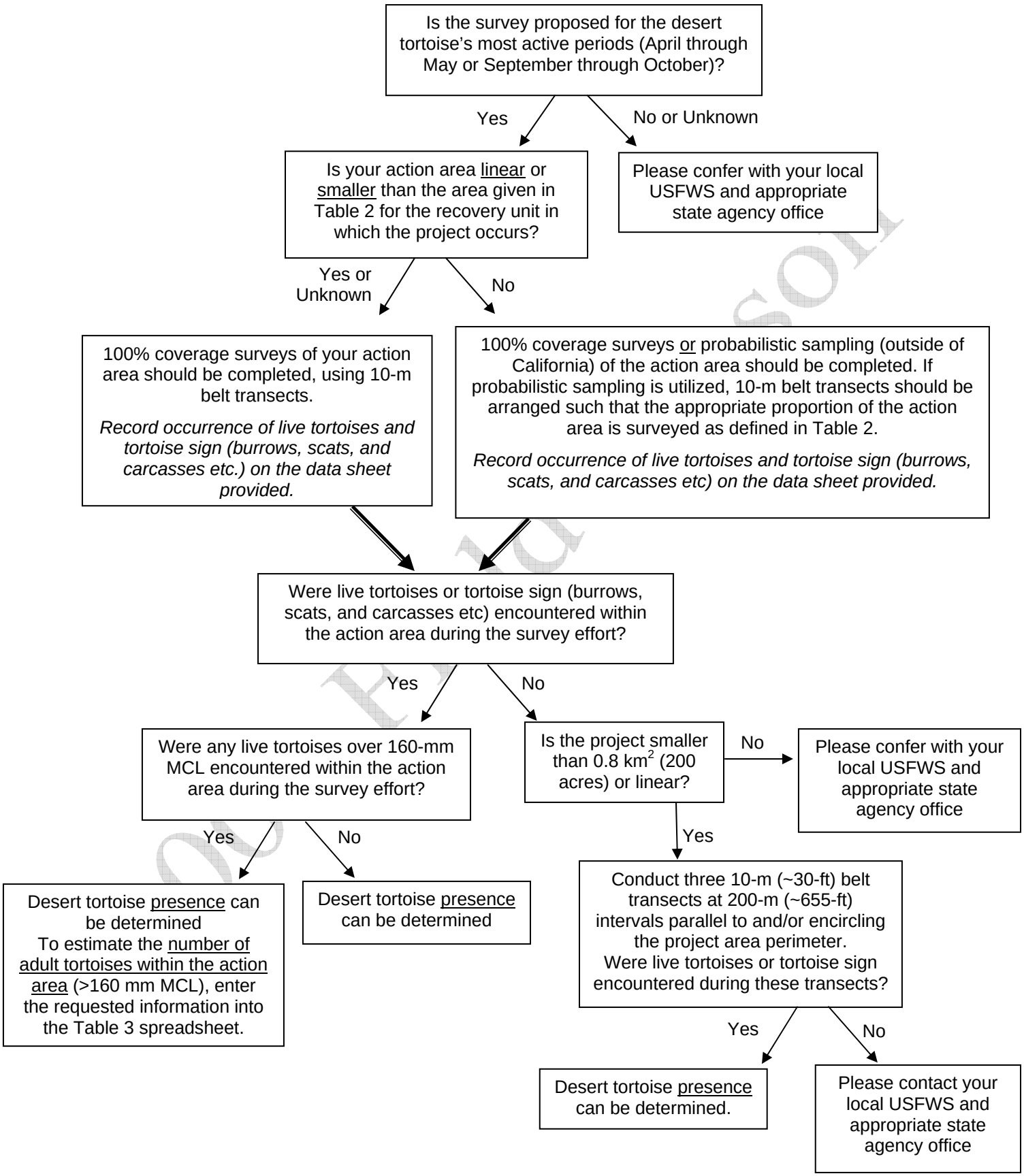
If yes: 100% coverage surveys of your action area must be completed.

If no, total transect lengths that must be surveyed are given below. 100% coverage surveys are also an option, regardless of the size of the project.

Recovery Unit	Total Transect Length (km) to Sample
Western Mojave	719
Eastern Mojave	1083
Colorado Desert	637
Northeastern Mojave	2333
Upper Virgin River	198

2009 Field Season

Decision Tree for Pre-project Field Survey Protocol for Potential Desert Tortoise Habitats



Frequently Asked Questions: Desert Tortoise Pre-project Field Survey Protocol

Why did USFWS revise the 1992 USFWS Desert Tortoise Pre-project Survey Protocol?

Desert tortoises occur at low densities across most of the Mojave Desert (USFWS 2006). They are cryptic and spend much of their time underground in burrows (Burge 1977; Nagy and Medica 1986; Bulova 1994) and therefore not all animals within an area will be seen by even the best trained surveyors. Tortoises underground in burrows, as well as individuals hidden above ground, need to be included in estimates.

The 1992 USFWS Desert Tortoise Pre-project Survey protocol was based on a Bureau of Land Management protocol from the mid-1970s, which utilized the best available information at the time, but did not take into account that some tortoises will be underground and missed during the survey effort. The data collected during the extensive USFWS range-wide monitoring program (currently <7,000-km of transects each year; USFWS 2006) have allowed us to improve pre-project survey methods. Data about the proportion of tortoises underground in burrows, as well as the probability that an above-ground tortoise will be observed by the surveyor are included in the estimate of the number of tortoises within the action area (P_a and P_d).

This protocol also addresses the potential for using probabilistic sampling when the action area is above the size limits given in Table 2. 100% coverage surveys are *always* an acceptable option, regardless of the size of the action area. For very large action areas, sampling may be an additional option, such that the abundance estimates can be calculated when an appropriate proportion of the action area is surveyed. Estimates of tortoise densities within recovery units from the range-wide monitoring program have been used to calculate how many km^2 of a project site must be surveyed to produce a statistically robust abundance estimate (Table 2).

What happened to the zone of influence transects recommended in the 1992 protocol?

This revised protocol requires that the entire action area, rather than just the project footprint, be included in the survey effort. The **action area** is defined by regulation as “all areas to be affected directly or indirectly by the Federal action and not merely the immediate area involved in the action” (50 CFR §402.02). The action area is therefore not limited to the "footprint" of the project nor is it limited by the Federal agency's authority. Rather, the action area is a biological determination of the reach of the proposed action on listed species, which must, by definition, encompass the zone of influence of the project.

How did USFWS determine the values for the “probability that a tortoise is above ground”?

The USFWS range-wide monitoring program estimated the proportion of the desert tortoise population that is visible using telemetered animals from focal areas in spring 2001-2005 (USFWS 2006). This probability is related to the previous winter’s rainfall, as illustrated in Table 1. The range of fall above-ground activity is similar to spring numbers, but the variability is much higher (Nussear and Tracy 2007; Inman 2008). Until more robust estimates of fall above-ground activity are available, spring estimates based on the previous winter’s rainfall (October through March) are used for surveys conducted in either active period.

How did USFWS establish the value for the “probability of detecting a tortoise, if above ground”?

For the past five years, surveyors in the USFWS range-wide monitoring program have undergone training on established transects with artificial tortoises. Trained surveyors detected an average of ~63% of model tortoises that were within 5-m of either side of the transect center-line (USFWS unpublished).

Why are only tortoises over 160-mm MCL used to estimate the number of tortoises within the action area?

The values of P_a and P_d used in the equation to estimate the number of tortoises within the action area are based on USFWS range-wide monitoring data collected for adult tortoises ≥160-mm MCL.

2010 Field Season

What is the purpose of 100% coverage surveys versus probabilistic sampling?

The purpose of surveying is to determine presence/absence and estimate the abundance of desert tortoises within the action area. For 100% coverage surveys, transects are placed across the entire action area; thus, the entire area for which abundance is estimated is surveyed. A probabilistic sampling approach, on the other hand, uses data from randomly or systematically placed transects to draw inferences about locations where surveys are not conducted. All locations for which abundance will be estimated *must* have an equal probability of being included in the sample.

How were the threshold project sizes calculated for determining whether 100% coverage or probabilistic sampling is appropriate?

The validity of probabilistic sampling requires that all locations for which abundance will be estimated have an equal probability of being included in the sample, as well as the expected sample size. Estimating the number of tortoises within the project area using probabilistic sampling is limited by the number of tortoises encountered during the survey effort. Therefore, whether or not the project area must be surveyed using 100% coverage or can be probabilistically sampled is based on the area expected to yield a survey count of 20 tortoises (Krzysik 2002). Table 2 uses tortoise densities and detection probabilities estimated from 2001-2005 range-wide line-distance sampling efforts for each tortoise Recovery Unit (USFWS 2006) to calculate that area of a project site that must be surveyed to produce a statistically robust estimate. If the project area is large enough to allow the option of probabilistic sampling, Table 2 provides the minimum transect kilometers (10-m wide) that must be surveyed.

What if the minimum length of 10-m wide transect kilometers are completed but 20 tortoises were not found in the action area?

If probabilistic sampling is used and < 20 tortoises are found after surveying the total transect length prescribed by Table 2, number of tortoises within the action area may be estimated using number found.

Do I keep surveying if 20 tortoises are found before the minimum transect kilometers that must be surveyed are completed?

If probabilistic sampling was used and the transects have been completed in a random order, project area surveys may be considered complete when 20 tortoises have been found or the specified number of kilometers have been sampled, whichever happens first. It is okay if more that 20 tortoises are found, this will decrease the width of the 95% confidence interval for the abundance estimate.

Why do small and linear projects where no tortoises were found have to do additional surveys at 150-m (~500-ft) intervals parallel to the project area perimeter?

Even though neither tortoises nor tortoise sign were found within the action area at the time of the survey, the area may be part of an animal's home range. The home range of a female desert tortoise averages around 0.15 to 0.16 km^2 (35 to 40 acres), about one third the size of male home ranges, which are variable and can be > 2 km^2 (O'Conner et al. 1994; Duda et al. 1999; Harless et al. In press). Therefore, projects that are ≤ 0.8 km^2 (200 acres) or linear may overlap only part of a tortoise's home range and the possibility that a resident tortoise was outside the project area at the time surveys were conducted must be addressed. In these cases, USFWS recommends three additional 10-m (~30-ft) belt transects at 200-m (~655-ft) intervals parallel to and/or encircling the project area perimeter (200-m, 400-m, and 600-m from the perimeter of the project site). Record any tortoises or sign encountered during these surveys. These transects are employed only as part of the presence/absence determination; they are not included in the estimation of tortoise abundance within the project area.

What does the 95% confidence interval for the number of tortoises within the action area mean?

Confidence intervals are used to indicate the reliability of an estimate. The interval gives an estimated range of values, calculated from a set of sample data, which is likely to include an unknown population parameter (in this case, the true number of tortoises within the action area). A wider confidence interval indicates that less certainty is associated with the estimate (see Appendix 2). The Table 3 spreadsheet calculates the abundance and associated 95% confidence interval for the estimated number of tortoises within the project area (Buckland et al. 2001).

Spring Field Season

Acknowledgments

The USFWS Desert Tortoise Recovery Office is grateful to the many individuals and agencies that were instrumental in development and review of this revised protocol. Specifically, we thank Jim Nichols (USGS) and Tony Krzysik (Prescott Audubon Society) for assistance with concept design; Alice Karl (independent tortoise biologist) and Andrew Thompson (USFWS) for development discussion, and Kirk Waln (USFWS) for GIS support.

This protocol has undergone extensive review. We would like to thank the 2008/2009 USFWS desert tortoise coordination group (Ashleigh Blackford, Ray Bransfield, Michael Burroughs, Renee Chi, Brian Croft, Tannika Engelhard, Tyler Grant, Michael Glenn, Judy Hohman, Leilani Takano, and Brian Wooldridge) for invaluable thoughts and suggestions. We would also like to thank Bob Steidl (University of Arizona), Kathy Ralls (Smithsonian National Zoo), Alice Karl (independent tortoise biologist), Andrew Thompson (USFWS), Bill Boarman (Conservation Science Research & Consulting), Phil Medica (USGS), Paulette Conrad (NDOW), Steve Ferrand (Nevada Biological Consulting), and the California Department of Fish and Game (including Kim Nicol, Julie Vance, Scott Flint, and Becky Jones) for insightful comments on the document.

2009 Field Season

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2009 Field Season

Appendix 1. Detailed description of desert tortoise abundance and CI estimation

The estimated abundance of adult desert tortoises within the action area is given by:

$$\begin{pmatrix}\text{Estimated number of tortoises}\\ \text{within action area}\end{pmatrix} = \frac{\begin{pmatrix}\text{Number of tortoises}\\ \text{observed above ground}\end{pmatrix}}{\begin{pmatrix}\text{Probability that}\\ \text{a tortoise is}\\ \text{above ground}\end{pmatrix}\begin{pmatrix}\text{Probability of}\\ \text{detecting a tortoise,}\\ \text{if above ground}\end{pmatrix}}\begin{pmatrix}\dfrac{\text{Action area}}{\text{Area surveyed}}\end{pmatrix},$$

which is equivalent to:

$$\hat{N} = \left[\frac{(n)}{(Table2)(0.63)}\right]\left[\frac{(A)}{(a)}\right],$$

where $\hat{N}$ = estimated abundance within entire action area, *n* = number of tortoises observed above ground, *A* = total action area, and *a* = actual area surveyed (= total # km surveyed * 0.01). For 100% coverage surveys, *A/a* = 1.

Table 3 uses the following equations to calculate the 95% confidence interval for the estimate of tortoise abundance within the action area (Buckland et al. 2001), assuming all replicate transect lines are the same length, 10-km.

$$\hat{\text{var}}(n) = L\sum_{i=1}^{k} l_i\left(\frac{n_i}{l_i} - \frac{n}{L}\right)^2 /(k-1)$$

where $\hat{\text{var}}(n)$ = the spatial variation in the number of tortoises detected through the total transect length L, n_i = the number of tortoises seen on transect *i*, l_i = the length of individual transect *i*, and *k* = total number of transects walked.

Putting the sources of variability together, the variance of density is:

$$\text{var}\,\hat{D} = \hat{D}^2\left[\frac{\text{var}(n)}{n^2} + \frac{\text{var}(\hat{P}_a)}{(\hat{P}_a)^2} + \frac{\text{var}(\hat{P}_d)}{(\hat{P}_d)^2}\right]$$

Because the tortoise density sampling distribution is positively skewed, the confidence interval is calculated using a log-distribution for density and built with division and multiplication, rather than addition and subtraction from the mean as with a symmetrical interval (Buckland et al. 2001).

Thus, the 95% confidence interval for $\hat{N}$ is:

$$\left(\hat{N}/C_N, \hat{N}\cdot C_N\right),$$

where $C_N = \exp\left[z_\alpha\sqrt{\text{var}(\log_e \hat{D})}\right]$ and $\text{var}(\log_e \hat{D}) = \log_e\left[1 + \frac{\text{var}(\hat{D})}{\hat{D}^2}\right]$.

Given the simplifying assumptions in this protocol, the 95% confidence interval around the estimated number of tortoises within the action area will be wide (e.g., the estimate of the number of tortoises will be imprecise). While this level of imprecision would not be appropriate for recovery planning and decision making at large scales, this protocol provides estimates at local scales that most efficiently utilize the best information that is available to provide statistically defensible results.

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Appendix 2. Example

Project location = near Beatty, NV (within the Eastern Mojave RU)

Action area = 12 km^2 (3,000 acres)

According to this protocol's Site Assessment key, the proposed action is within the known range of the desert tortoise. The local USFWS and appropriate state agency offices were contacted and a species list, which includes the desert tortoise, was obtained for the action area. Therefore, pre-project survey and consultation are necessary.

The project footprint is only 10 km^2, but since the project will include blasting, the reach of the proposed action on listed species extends to 12 km^2. Thus, the action area (and therefore the area which needs to be surveyed for desert tortoises) is 12 km^2 (which is more inclusive than the 10 km^2 project footprint).

According to Table 2 of the pre-project survey protocol, the project size of 12 km^2 is above the threshold project area to allow probabilistic sampling in the Western Mojave RU (10.8 km^2 threshold). Therefore, at a minimum, 1,083 km of transects must be walked. For this example, 108 10-km transects (10-m wide) were placed systematically across the project site and were completed in a random order. Surveys of 100% coverage in which 10-m wide transects were placed across the entire 12 km^2 action area would also have been acceptable.

Transects totaling 1,083 km were conducted and 19 adult tortoises (> 160 mm carapace length) were found (as well as tortoise sign, both of which were catalogued using the USFWS 2009 DT pre-project survey protocol data sheet). If 20 adult tortoises had been encountered before the 1,083 km of transects were completed, and transects were conducted in a random order, then surveys could have been considered complete after the 20th tortoise was catalogued.

Data collected from the108 transects (live animals encountered <160-mm MCL)

Number of tortoises (n_i)	Number of transects on which n_i tortoises were seen
0	93
1	11
2	4

Using the Western Regional Climate Center website, it was determined that the Beatty area had received 97-mm (3.8 inches) of rain in the October through March preceding the survey effort, which is above the 40-mm (1.5 inches) in Table 1. Therefore, P_a of 0.80 will be used in this estimation.

Thus, from

$$\hat{N} = \left[\frac{(n)}{(Table2)(0.63)}\right]\left[\frac{(A)}{(a)}\right]$$, we get $$\hat{N} = \left[\frac{(19)}{(0.80)(0.63)}\right]\left[\frac{(12\,km^2)}{(10.8\,km^2)}\right]$$, or $\hat{N} =\sim 42$ tortoises

$$\text{Density} = \frac{(\hat{N})}{(A)}$$, we get $$\hat{D} = \frac{(42)}{(12\,km^2)}$$, or $\hat{D} =\sim 3.5$ tortoises/km^2

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To calculate the 95% confidence interval for our abundance estimate, we use:

$$\hat{\text{var}}(n) = L\sum_{i=1}^{k} l_i\left(\frac{n_i}{l_i} - \frac{n}{L}\right)^2 /(k-1)\,,$$

we get $\hat{\text{var}}(19) = 1080\left[(93)(10)\left(\frac{0}{10} - \frac{19}{1080}\right)^2 + (11)(10)\left(\frac{1}{10} - \frac{19}{1080}\right)^2 + (4)(10)\left(\frac{2}{10} - \frac{19}{1080}\right)^2\right]/(108-1)$, or

$\hat{\text{var}}(19) = 23.88$

And for,

$\text{var}\,\hat{D} = \hat{D}^2\left[\frac{\text{var}(n)}{n^2} + \frac{\text{var}(\hat{P}_a)}{(\hat{P}_a)^2} + \frac{\text{var}(\hat{P}_d)}{(\hat{P}_d)^2}\right]$, we get $\text{var}\,\hat{D} = 3.5^2\left[\frac{23.88}{19^2} + \frac{0.05}{0.80^2} + \frac{0.011}{0.63^2}\right]$, or $\text{var}\,\hat{D} = 2.107$

Using our log-transformation because the tortoise density sampling distribution is positively skewed,

$\text{var}(\log_e \hat{D}) = \log_e\left[1 + \frac{\text{var}(\hat{D})}{\hat{D}^2}\right]$, we get $\text{var}(\log_e \hat{D}) = \log_e\left[1 + \frac{2.107}{3.5^2}\right]$, or $\text{var}(\log_e \hat{D}) = 0.15$

Then,

$C_N = \exp\left[z_\alpha\sqrt{\text{var}(\log_e \hat{D})}\right]$, we get $C_N = \exp\left[(1.96)\sqrt{0.15}\right]$, or $C_N = 2.18$

And,

$\left(\hat{N}/C_N, \hat{N}\cdot C_N\right)$, we get $\left((42/2.18), (42\cdot 2.18)\right)$, or ~$(19, 92)$.

Summary

Using the Site Assessment key, it was determined that survey and consultation were necessary for the proposed action. Thus, the pre-project field survey protocol was implemented. In this case, probabilistic sampling with equal length transects (10-km long) was used and 19 adult tortoises and tortoise sign were found during the sampling of the action area, indicating presence. Using the equations and data presented in Appendix 1 of this protocol, Table 3 estimated the actual number of tortoises within the project was estimated to be ~42, with a 95% confidence interval of ~(19, 92).

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USFWS 2009 DESERT TORTOISE PRE-PROJECT SURVEY DATA SHEET

Date of survey: _____ Survey biologist(s): _____
(day, month, year)

Site description: _____
(project name and size; general location)

County:_____ Quad:_____ Location:_____
(UTM coordinates, lat-long, and/or TRS; map datum)

Transect #: ____ Transect length: _____ Type of survey: _____
(project area size to be surveyed; 100% coverage/probabilistic sampling)

GPS Start-point: _____ _____ Start time: _____am/pm
(easting, northing, elevation in meters)

GPS End-point: _____ End time: _____am/pm
(easting, northing, elevation in meters)

Start Temp: _____ºC Weather: _____

End Temp: _____ºC

Live Tortoises

Detection number	GPS location Easting	Northing	Time	Tortoise location (*in burrow*: all of tortoise beneath plane of burrow opening, or *not in burrow*)	Approx MCL >160-mm? (*Yes, No or Unknown*)	Existing tag # and color, if present
1						
2						
3						
4						
5						
6						
7						
8						

Tortoise Sign (burrows, scats, carcasses, etc)

Detection number	GPS location Easting	Northing	Type of sign (*burrows, scats, carcass, etc*)	Description and comments
1				
2				
3				
4				
5				
6				
7				
8				

Page: _____of_____

Date of survey: _____

Transect number: _____

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FIELD SURVEY PROTOCOL FOR ANY NON-FEDERAL ACTION THAT MAY OCCUR WITHIN THE RANGE OF THE DESERT TORTOISE

The Mojave population of the desert tortoise was listed as a federally endangered species on August 4, 1989 by emergency rule and as a threatened species by final rule on April 2, 1990. section 9 of the Endangered Species Act prohibits the "taking" of any federally listed threatened or endangered species without first obtaining necessary authority from the Fish and Wildlife Service. "Take" includes "harming, harassing, pursuing, hunting, shooting, wounding, killing, capturing, collecting, or attempting to engage in any such conduct" (section 3(19), Endangered Species Act 1973, as amended). Harm includes "significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or shelter" (50 CFR 17.3(c)). "Take" also includes modification of habitat that would result in harm to the desert tortoise.

In response to a demand for information and/or guidance on compliance with the Endangered Species Act, the Fish and Wildlife Service has developed a protocol for surveys within the range of the Mojave population of the desert tortoise which is listed as federally threatened. The purpose of this protocol is to provide technical assistance to entities to determine presence or absence of this animal and thus avoid "take" of the desert tortoise. Where avoidance is not possible, this protocol will provide information from which the project proponent can develop a "conservation plan" with guidance from the Fish and Wildlife Service. The conservation plan is the primary component of a section 10(a) (1) (B) permit application intended to obtain the necessary authorization to incidentally "take" a federally listed species as specified in the Endangered Species Act.

Please note that the presence of a desert tortoise within the project boundary is not necessary for the project to result in the take of the desert tortoise. Please see the Survey Need section below for more information.

If part or all of the project will be authorized, funded, or carried out by a federal agency or located on federal land, the project proponent, through the federal agency, will need to comply with section 7 of the federal Endangered Species Act rather than section 10. If you believe your project may have such a federal "connection", we urge you to contact the Fish and Wildlife Service for confirmation. Please see the "Field Survey Protocol for Any Federal Action that May Occur within the Range of the Desert Tortoise". If there is no federal "connection" in any part of the proposed project, you must ensure that your project either will not result in a "take" of the desert tortoise or obtain a section 10(a) (1) (B) incidental take permit from the Fish and Service prior to implementing your project.

We also recommend that you obtain a copy of "Procedures for Endangered Species Act Compliance for the Mojave Desert Tortoise" before you begin planning your project. This document is available from any of the five Fish and Wildlife Service offices listed below and provides more information on sections 7, 9, and 10 of the

Endangered Species Act.

This survey protocol is subject to revision as new information becomes available. Before initiating the survey protocol described below, we recommend checking with the Fish and Wildlife Service to verify that you are implementing up-to-date survey methods.

In Arizona:

Fish and Wildlife Service
Phoenix Field Office
3616 West Thomas, Suite 6
Phoenix, Arizona 85019
(602) 379-4720

In California, for Inyo, Kern, Los Angeles, and San Bernardino Counties:

Fish and Wildlife Service
Ventura Office
2140 Eastman, Suite 100
Ventura, California 93003
(805) 644-1766

In California, for Imperial and Riverside Counties:

Fish and Wildlife Service
Carlsbad Office
2730 Loker Avenue West
Carlsbad, California 92008
(619) 431-9440

In Nevada:

Fish and Wildlife Service
4600 Kietzke Lane, Building C-125
Reno, Nevada 89502
(702) 784-5227

In Utah:

Fish and Wildlife Service
2078 Administration Building
1745 West 1700 South
Salt Lake City, Utah 84104-5110
(801) 524-4430

Survey protocol includes six parts: (1) survey need, (2) survey types, (3) survey quality, (4) survey time period, (5) qualifications of the surveyor, and (6) reporting survey results.

Survey Need: The desert tortoise may occupy numerous habitat types within its range in the Mojave and Colorado deserts and below an elevation of 5000 feet. In these areas there is a likelihood of encountering desert tortoises or tortoise sign. Activities such as land clearing are likely to result in "take" of desert tortoises or tortoise habitat, unless site specific information indicates that no take of desert tortoises or tortoise habitat would occur.

The Fish and Wildlife Service recommends that the project proponent conduct a Presence-or-Absence Survey for tortoises and tortoise sign over the entire project area and the Zone of Influence adjacent to the project area. The Zone of Influence is defined as the area where tortoises on adjacent lands may be directly or indirectly affected by project exploration, construction, maintenance, operation, monitoring, dismantlement, enhancement, and project abandonment. The survey information would be part of the requirements of the federal Endangered Species Act section 1O(a)(1)(B) permit application. Tortoise sign would include shells, bones, scats, limbs, burrows, pallets, scats, egg shell fragments, tracks, courtship rings, drinking sites, mineral licks, etc.

Depending on the type of project, a Clearance Survey immediately prior to construction (see below) in recently occupied tortoise habitat may also be necessary. The Fish and Wildlife Service requests that all survey results, including copies of the completed transect forms, be submitted to the appropriate Fish and Wildlife Service office within 30 days. This information is vital to the ongoing management for recovery of the desert tortoise. Providing this information to the Fish and Wildlife Service will help ensure that the survey has been correctly completed and the data have been properly assessed. Submittal of survey results also allows the Fish and Wildlife Service to advise you of the appropriate requirements, if any, in accordance with the definition of "take" in the federal Endangered Species Act. This definition includes take of habitat.

Please note that all free-roaming desert tortoises located north and west of the Colorado River are protected under the Endangered Species Act. For example, the desert tortoise that on occasion occurs above 5000 feet or in pinyon-juniper woodland would be protected under the Endangered Species Act.

As mentioned above, the presence of a desert tortoise within the project boundary is not necessary for the project to result in the take of the desert tortoise For example, a desert tortoise may be present in the Zone of Influence and may use the project site for feeding, breeding, or shelter. Destruction of tortoise habitat used for feeding, breeding, or shelter is considered take under the Endangered Species Act.

Also note that planning agencies or other local or state agencies have not been delegated authority to determine if or when a section 10(a) (1) (B) incidental take permit is needed under the federal Endangered Species Act. The Fish and Wildlife Service is available to answer inquiries and make determinations on the need for an incidental take permit based on the submission of survey results.

Before initiating any activity that will result in surface disturbance within the range

of the desert tortoise including overland driving for land surveying or other forms of take, the Fish and Wildlife Service recommends that you contact one of the five offices listed above to determine if your action may require a section 1O(a)(1)(B) permit.

All requirements of the Endangered Species Act should be completed prior to the initiation of any part of the proposed project. Failure to submit survey forms to and coordinate directly with the Fish and Wildlife Service on the proposed project may result in delay or modification of the proposed project. We strongly suggest coordinating with the Service early in the planning process.

Projects that would not result in take of desert tortoises or tortoise habitat are not subject to the prohibitions of take of the desert tortoise as defined in the federal Endangered Species Act. However, in the event that a desert tortoise or tortoise sign (shells, bones, scats, limbs, burrows, pallets, scats, egg shell fragments, tracks, courtship rings, drinking sites, mineral licks, etc.) are found in the project area during construction, all surface disturbance should immediately stop. The Fish and Wildlife Service recommends that the project proponent notify us and the local planning and zoning department in writing within 3 days of the discovery. This short notification period will help ensure a timely response by the Fish and Wildlife Service to facilitate compliance with the federal Endangered Species Act and avoid unauthorized take.

If tortoise sign is found, a Presence-or-Absence Survey of the project area and a Clearance Survey immediately prior to construction may be necessary. Please see the discussion on Presence-or-Absence and Clearance surveys below.

Fish and Wildlife Service Survey Protocol for Desert Tortoises and Bureau of Land Management Categories of Desert Tortoise Habitat: The Bureau of Land Management has developed category maps for desert tortoises to assist the Bureau in managing public lands for the tortoise within the Bureau's multiple use mandate. Bureau maps were not developed to provide information on how to avoid take of the desert tortoise or comply with the federal Endangered Species Act. The Bureau has assigned three categories to their maps on desert tortoise habitat. These categories reflect the quality of tortoise habitat, quantity of tortoises present, and the Bureau's ability to manage these areas for the desert tortoise while minimizing resource conflicts. For example, Category 1 is considered better for tortoises than category 2. However, category 3 areas may contain high quality tortoise habitat and high density of tortoises, but because of resource conflicts the Bureau has assigned the area to category 3.

If an area is not classified on the Bureau's maps as category 1, 2, or 3, this does not mean that this area does not contain desert tortoises or is not considered desert tortoise habitat. The Bureau did not categorize lands that it does not manage such as military reservations or private lands. Also, the Bureau did not categorize lands in many areas that have densities of desert tortoises less than 20 per square mile. Thus, if a proposed project is not located in an area categorized as category 1, 2, or 3 by the Bureau, the project may still be located in desert tortoise habitat if it is in the desert and below 5000 feet.

Survey Types: Two types of surveys are recommended: 1) Presence-or-Absence and 2) Clearance. Neither survey utilizes the 1.5-mile triangular transect survey method developed by the Bureau of Land Management. The Bureau of Land Management's triangular transect method does not provide reliable information on the number of desert tortoises that would be taken as a result of implementation of the proposed project and thus is not adequate for meeting the requirements of the federal Endangered Species Act. Alternative methods for surveying for desert tortoises and their sign over very large areas may be submitted to the Fish and Wildlife Service for consideration.

Presence-or-Absence Survey: This survey type is recommended for areas below 5000 feet and within the known range of the desert tortoise. The purpose of this survey is to determine impacts of potential land disturbance activities to the local tortoise population. This includes identifying the number and location of all tortoises and tortoise sign that occur within a given project area and if any tortoises occur in adjacent areas (Zone of Influence) whose home range may overlap into the project area and thus be taken or lost by the proposed action.

The project area is defined as any area that will be cleared or partially cleared, with vehicles on or adjacent to it, temporarily or permanently used for equipment or materials storage, loading or unloading, or sites where soils/vegetation is damaged, fragmented, or disturbed (e.g., driving overland).

The entire project area is surveyed using belt transects 10 yards or 30 feet wide (100 percent coverage). In some locations, belt transects less than 30 feet wide may be appropriate (see below). In addition, the Zone of Influence is surveyed. The Zone of Influence is defined as the area where tortoises on adjacent lands may be directly or indirectly affected by project exploration, construction, maintenance, operation, monitoring, dismantlement, enhancement, and project abandonment. As a minimum, the belt transects in the Zone of Influence are located at 100, 300, 600, 1200, and 2400-foot intervals from and parallel to the edge of the project boundaries (See Figures 1 and 2.) All tortoise sign (live tortoises, shells, bones, scats, limbs, scats, burrows, pallets, tracks, egg shell fragments, courtship rings, drinking sites, mineral licks, etc.) within the project area and sign located on transects within the Zone of Influence should be mapped.

The extent of the Zone of Influence is dependent on the type of habitat alteration/development and its proximity to other developments. The extent of the Zone of Influence increases as the probability of increased use by domestic predators, potential human use in the Zone, road use, littering, waste disposal, etc. These uses result in increased take of desert tortoises through predation, collection as pets, vandalism, road kills, and attracting predators such as ravens, coyotes, and feral dogs to the area.

Additional transects may be recommended at 3600- and 4800-foot intervals from the perimeter of the project area for developments 1) located in or within one mile of categories 1 or 2 habitats as defined by the Bureau of Land Management or 2) associated with residential development, new or increased road use, landfills, or projects that would result in increases in human Use or litter.

Figure 1. Example of a proposed transmission line including areas with full (100 percent) survey coverage for desert tortoises (construction area) and locations of transects within the Zone of Influence.

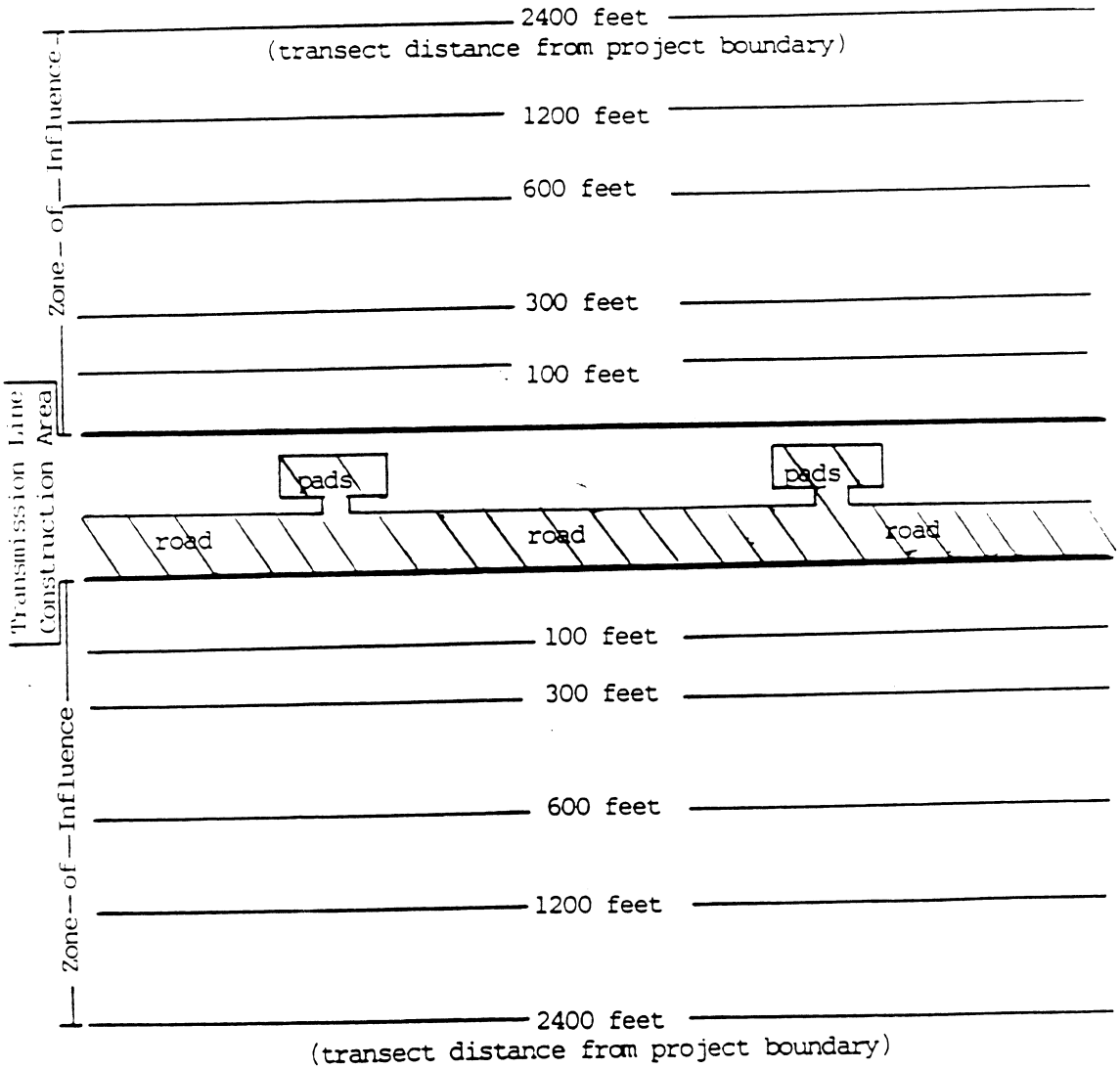
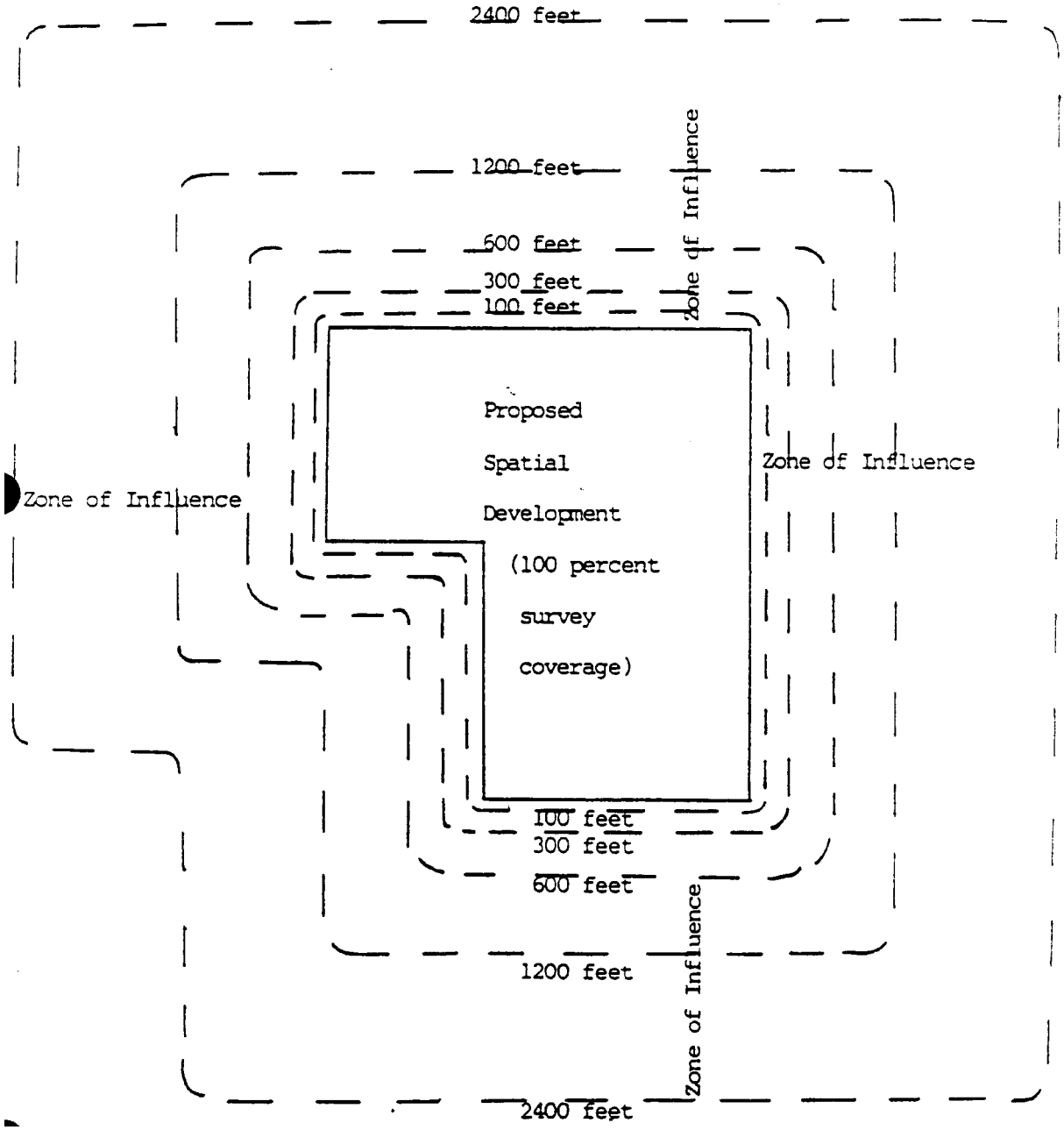


Figure 2. Example of a proposed spatial development (e.g., residential development, commercial development) with full (100 percent) survey coverage for desert tortoises and locations of transects within the Zone of Influence.



For example, if a project area is 640 acres or one square mile, 176 parallel transects each one mile long and 30 feet wide would be necessary to provide 100 percent coverage of the project area. Additional transects would be necessary to survey the adjacent areas or Zone of Influence.

If the project area contains locations with vegetation or topography that obscures or reduces that surveyor's ability to see tortoise sign at distances of up to 15 feet on the ground, the width of the survey should be reduced to 10 feet, that is, 5 feet on either side of the surveyor. Some examples of situations where a 10-foot wide transect should be conducted instead of a 30-foot wide transect would be: 1) foothills and slopes of mountains which contain rocks, boulders, and/or vegetation that obstruct the surveyor's view of the ground at distances greater than 5 feet, and 2) areas in which the vegetation density is greater than that of typical creosote or creosote/sage flats or bajadas in the Mojave Desert such as desert wash scrub or woodlands and ecotones between habitat types. In these areas the surveyor's view of the ground and tortoise sign, if present, would be obstructed and a 30-foot wide transect would not be acceptable.

When mapping tortoise sign, the recommended map scale is 1 inch = l00 feet, for plans involving ground; disturbance and 1 inch = 1000 fee t for preliminary planning (master-planning or specific planning). These map scales are based on those frequently required by city or county planning departments. The map should include locations and specific types of all tortoise sign found on the project area and Zone of Influence including the number live tortoises, reference to the corresponding transect form with additional information on tortoise sign found, significant landmarks, legal description of the project area, survey dates, and the range of elevation within the project boundaries. Please note that a federal Fish and Wildlife License/Permit is required before a surveyor can capture, touch, or "harass" a live desert tortoise even for the purposes of taking measurements or determining its sex. A permit may also be required from the appropriate state wildlife resource agency (e.g., Arizona Game and Fish Department, California Department of Fish and Game, Nevada Department of Wildlife, Utah Division of Wildlife Resources). The Fish and Wildlife Service emphasizes that the surveyor should only estimate the size of all live desert tortoises encountered.

If the surveyor wishes to use a fiber-optic scope or video camera that is placed inside a tortoise burrow instead of or in addition to a hand-held mirror to investigate the desert tortoise shelter sites, you should contact the Fish and Wildlife Service at one of the offices listed above. We will need information on the type of equipment you will be using and your qualifications to use it. Improper use of such equipment may disturb or injure tortoises, damage shelter sites, and may promote the spread of disease. These actions may be considered as take under the Endangered Species Act. You should refer to the Desert Tortoise Handling Protocols for information on when and how to utilize these scopes to avoid the possible transmission of disease between tortoises.

The following format is recommended for recording transect data. (See Figure 3.) This format has been modified from the Bureau of Land Management's Interim

Figure 3 - Desert Tortoise Survey Form For Presence-or-Absence and Clearance Surveys

nuary 1992

a 4 X 6 photograph showing the
where the transect was conducted)

is form should be completed for those
ansects that contain one or more desert
rtoise sign. After the project site and
ne of Influence have been surveyed for
rtoise sign, the results from the transect
rms should be compiled on a summary form.

no tortoise sign occurs on the project site
Zone of Influence, the summary form should
completed. Please fill in all sections on
e top 2/3 of the page of the summary form.

M/D/Y
Date _____
Transect No. _____
State _____
County _____
City _____
Recorder _____
Address _____
Project Name _____
Type of Project _____
_____
Quad Name _____
Scale _____
Site Name _____
T_____ R_____ Sec____
¼ Sec_____ ¼¼ Sec_____
UTM Zone _____
Northing _____
Easting _____
Parcel No. _____

DESERT TORTOISE HANDBOOK 1992:
FORM FOR PRESENCE-OR-ABSENCE AND CLEARANCE SURVEYS

Project Site | | Zone of Influence | | _____ft from Project Site
ansect Length: _____ft Width: 30 ft Other _____ft Time _____
ather: Airtemp at: 5 cm_____°C Surface_____°C Cloud cover_____%
Rainfall_____in Wind speed_____ Rainfall in last 30 days_____in
r Form (e.g., mesa, bajada, wash)_____
% Slope: high_____ low_____ Aspect_____ Elevation_____ft
its_____
getation: dominant perennials_____
_____
dominant annuals_____
_____
jacent Land Use: up to 1 mi_____
Soils_____
Vegetation_____

Corrected Sign	Live Tortoises Adult/Juv.	TOTAL NUMBER OF Shelter Sites Pallet/Burrow/Den Active/Inactive [1]	Scats [2]	Shell Remains [3]
	A= J=		M= F= Unk=	A= J= Unk=

Tracks	Eggshell Fragments	Drinking Sites	Courtship Rings	Other	Neotoma Middens w/sign	:w/o sign
					:	

SIGNS OF HUMAN DISTURBANCE - NUMBER AND TYPES SEEN

Tire Tracks	Human Footprints	Dog Sign	Trash	Dump Sites	Shotgun/ Rifle Shells	Blading	Ravens	Other

January 1992

M/D/Y
Date_____
Transect No._____
State_____
County_____
City_____
Recorder_____
Project Name_____
_____
Parcel No._____

==========

INFORMATION ON SHELTER SITES

(Please indicate why you believe a shelter site is active or inactive[1])

Sign No.	Type	Location	Width	Estimated Length	Other Sign

Condition of Shelter Site[1]/Comments

==========

CONDITION OF SCATS[2] - COMMENTS (See below)

==========

CONDITION OF SHELL REMAINS[3] - COMMENTS (See below)

==========

SIGNS OF HUMAN DISTURBANCE-COMMENTS

January 1992

Show locations of types of tortoise sign on transect line below:

Drawing: Scale 1 in = _____ft Drawing or Map Reference No._____ Transect No. _____

Recorder_____ Date_____ Parcel No._____ Location_____

Techniques Handbook for Collecting and Analyzing Data on Desert Tortoise Populations and Habitats. One form is used for each transect where tortoise sign occurs. Pages 1, 2, and 3 of the form would be completed for each transect in the project site and the Zone of Influence where tortoise sign occurs. If additional space is needed, more forms may be used for each transect and stapled together.

If no tortoise sign is located during Presence-or-Absence Surveys for a proposed project, we recommend that the surveyor complete and submit a summary form (Figure 4) to the appropriate Fish and Wildlife Service office listed above.

Clearance Survey: For projects located in areas with habitat used by desert tortoises, especially those projects with a linear band of disturbance (e.g. pipelines, roads, transmission lines), a Clearance Survey may be required as part of a section 10 (a) (1) (B) permit. The purpose of the survey would be to temporarily relocate or salvage tortoises from the area of construction and any other areas deemed necessary to avoid or minimize the death of desert tortoises that may be caused by the project. A Clearance Survey would require full coverage of the project area and would focus on locating all desert tortoises above and below ground within the project area. The removal of tortoises would be conducted immediately prior to surface disturbance within the project area. The survey period would be stipulated in a section 10(a) (1) (B) permit.

Survey Time Period: Survey time for Presence-or-Absence Surveys is limited to the following approximate activity period of the desert tortoise, March 25 to May 31. This survey time may be extended by the Fish and Wildlife Service if tortoises on or near the project area have been observed above ground prior to March 25 or after May 31.

This survey window is based on the activity period for the desert tortoise throughout its range during a typical year and equates to the period of time when a tortoise is not brumating or aestivating. During dry years this activity period may be shorter and in wet years it may be longer. Desert tortoises may also become active during and after summer rains.

Surveys conducted outside this window will be subject to close scrutiny by the Fish and Wildlife Service. The Service may consider the results of these surveys as under-representing the number of tortoises on and use of the project site by desert tortoises.

Presence-or-Absence or Clearance surveys should only be conducted during daylight hours. Please do not collect any desert tortoise sign. Tortoise scats may be used by tortoises to mark or identify travel areas and shelter sites. Tortoise shells may be an important source of minerals for reptiles and mammals.

Qualifications of Surveyor: The Fish and Wildlife Service does not endorse any individual or company with respect to their abilities to conduct satisfactory surveys. We recommend the following criteria for selecting someone to conduct surveys to determine presence or absence of desert tortoises in a given area or recent use of the area by the desert tortoise.

Figure 4 - Desert Tortoise Survey Form For Presence-or-Absence and Clearance Surveys

January 1992

(Place a 4 X 6 photograph showing the area where the transect was conducted)

If no tortoise sign occurs on the project site or Zone of Influence, the summary form should be completed. Please fill in all sections on the top 2/3 of the page of the summary form.

M/D/Y
Date _____
Transect No. _____
State _____
County _____
City _____
Recorder _____
Address _____
Project Name _____
Type of Project _____
_____
Quad Name _____
Scale _____
Site Name _____
T_____ R_____ Sec__
¼ Sec_____ ¼¼ Sec___
UTM Zone _____
Northing _____
Easting _____
Parcel No. _____

SUMMARY FORM
FOR PRESENCE-OR-ABSENCE AND CLEARANCE SURVEYS
FOR DESERT TORTOISE SIGN

% Slope: high_____ low_____ Aspect_____ Elevation_____ft.
Land Form (e.g., mesa, bajada, wash)_____
Soils_____
Vegetation: dominant perennials_____
other species_____
dominant annuals_____
other species_____
Adjacent Land Use: immediate_____
Within 1 mi._____
Soils_____
Vegetation_____

Weather: Temperature - Air at 5 cm_____°C Surface_____°C Cloud cover_____%
Wind speed_____ Rainfall_____in. Rainfall in last 30 days_____in.

Corrected Sign	Live Tortoises Adult/Juv.	TOTAL NUMBER OF Shelter Sites Pallet/Burrow/Den Active/Inactive [1]	Scats [2]	Shell Remains [3]
	A= J=		M= F=	A= J= Unk= Unk=

Tracks	Eggshell Fragments	Drinking Sites	Courtship Rings	Other	Neotoma Middens w/sign	:w/o sign
					:	

SIGNS OF HUMAN DISTURBANCE - NUMBER AND TYPES SEEN

Tire Tracks	Human Footprints	Dog Sign	Trash	Dump Sites	Shotgun/ Rifle Shells	Blading	Ravens	Other

January 1992

SUMMARY FORM (continued)
FOR PRESENCE-OR-ABSENCE AND CLEARANCE SURVEYS
FOR DESERT TORTOISE SIGN

Comments/Drawings

As a general rule, a qualified desert tortoise surveyor is a biologist with a bachelors degree or graduate degree in biology, ecology, wildlife biology, herpetology, or related fields. He/she must have demonstrated prior field experience using accepted resource agency techniques to survey for desert tortoises. Field experience may mean a minimum of 60 days field experience searching for desert tortoises and tortoise sign.

The surveyor should have the following qualifications for the survey results to be accepted by the Fish and Wildlife Service:

1) ability to recognize and accurately identify all types of desert tortoise sign listed above, and 2) ability to carefully, legibly, and completely record all sign including size of shelter sites, shells, and estimated size of live tortoises.

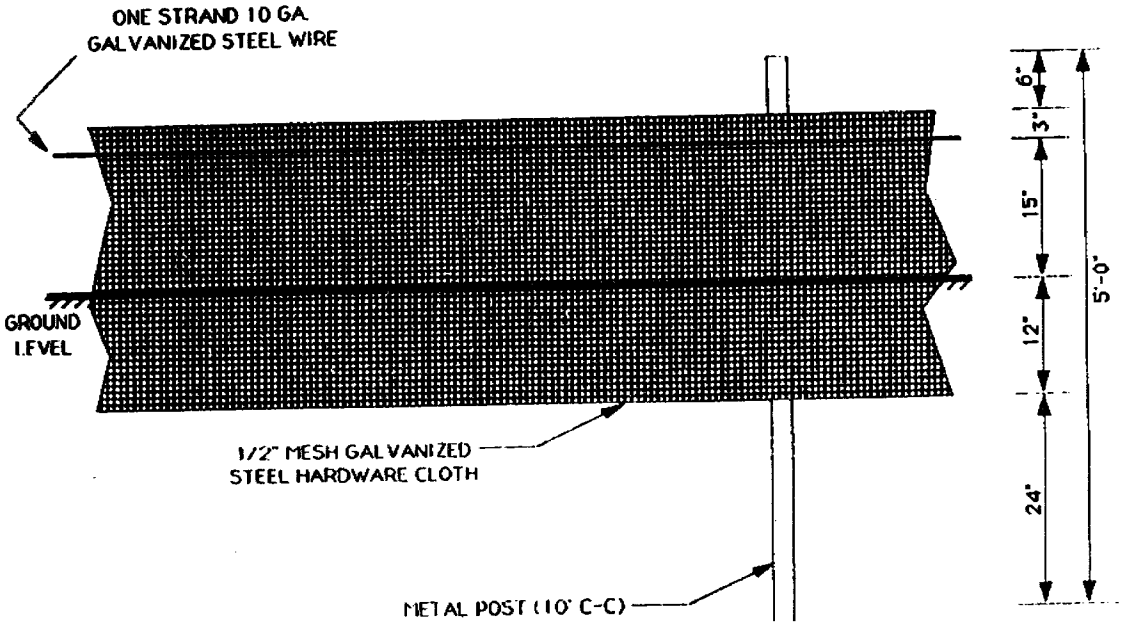
Reporting Survey Results (Survey Quality): To determine the accuracy of the surveyor in locating desert tortoise sign during Presence-or-Absence Surveys for each project area, the Fish and Wildlife Service recommends that the surveyor conduct an intensive survey in a portion of the project area following completion of the 100 percent survey. The size of the intensive survey area is 5 percent of the size of the project area. The intensive survey area would also receive 100 percent coverage using transects 10 feet wide rather than 30 feet or 5 feet wide rather than 10 feet wide. The location of the intensive survey would be plotted on the map and a comparison made between the sign recorded in this area during the 100 percent survey effort and the intensive survey effort. The quality or accuracy of the survey for the project area will be determined by comparing these two data sets for this area.

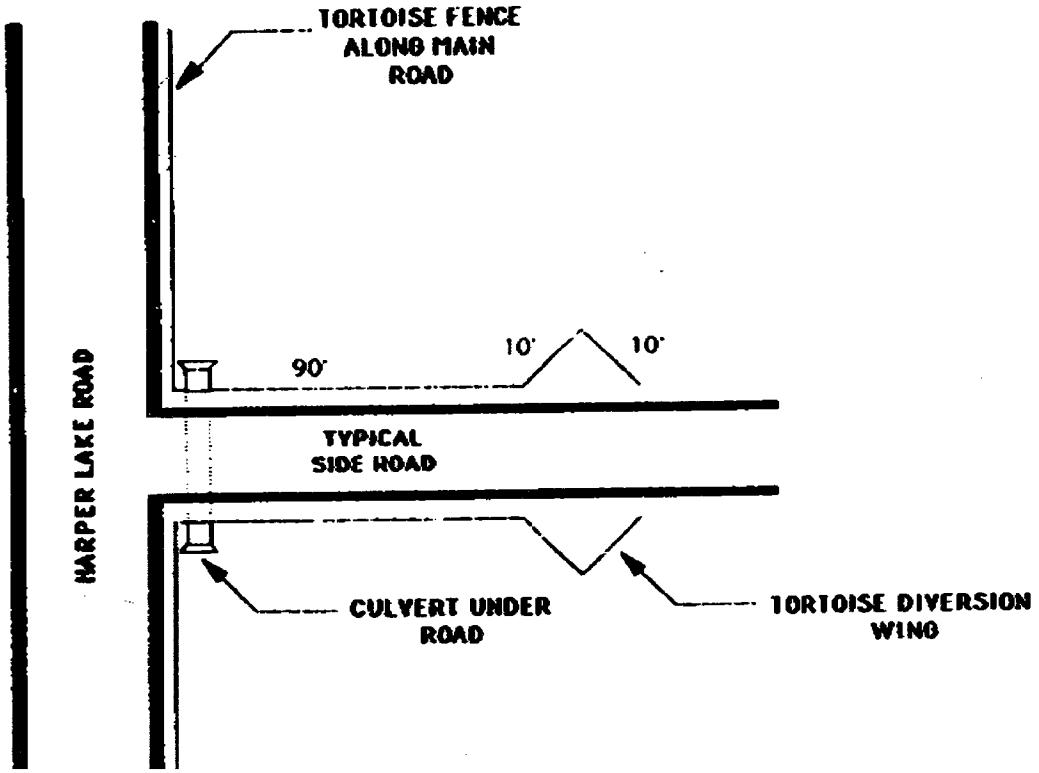
If the surveyor does not meet the minimal qualifications stated below or if there is a major difference in number of sign recorded between the intensive survey effort and the 100 percent survey effort, the survey may not be deemed adequate by the Fish and Wildlife Service.

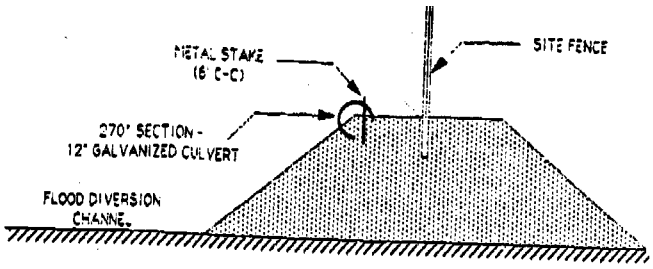
If the survey results do not include the Zone of Influence, the Fish and Wildlife Service may not concur with the survey results.

Tortoise Fence and Barrier Design

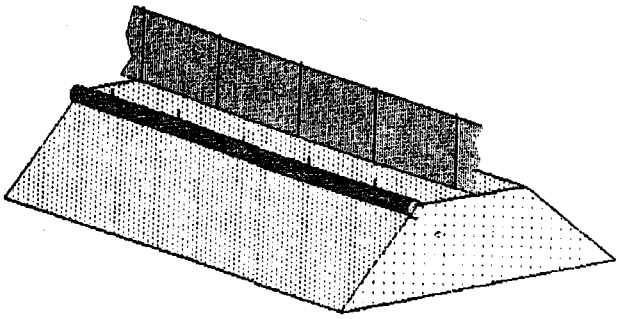
TORTOISE FENCE DESIGN





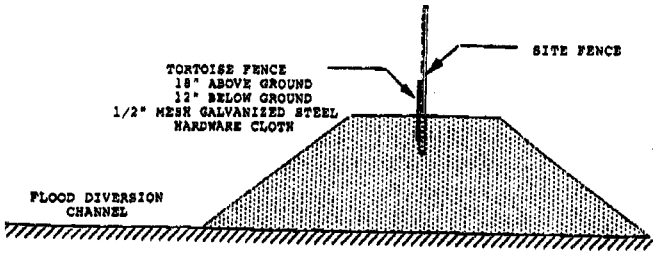


CROSS SECTION OF BERM

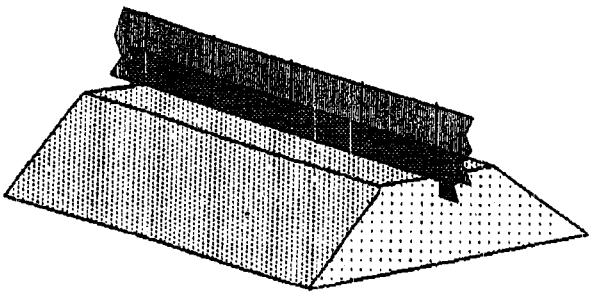


FLOOD DIVERSION BERM TORTOISE BARRIER

OPTION 1 - CULVERT BARRIER



CROSS SECTION OF BERM



FLOOD DIVERSION BERM TORTOISE BARRIER

OPTION 2 - TORTOISE FENCE

Evaluation of Evidence Supporting the Effectiveness of Desert Tortoise Recovery Actions

Scientific Investigations Report 2006–5143

U.S. Department of the Interior
U.S. Geological Survey

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Evaluation of Evidence Supporting the Effectiveness of Desert Tortoise Recovery Actions

By William I. Boarman[1], and William B. Kristan[2]

Scientific Investigations Report 2006–5143

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Abbreviations

BLM, U.S. Bureau of Land Management
BO, biological opinions
CMBC, Circle Mountain Biological Consultants
DMG, Desert Managers Group
DTNA, Desert Tortoise Natural Area
DTRPAC, Desert Tortoise Recovery Plan Assessment Committee
EAFB, Edwards Air Force Base
ESA, Endangered Species Act
Exper, Experimental
GAO, General Accounting Office
NA, not available
NPS, National Park Service
Observ, Observation
OHV, off-highway vehicles
RMP, resource management plan
USFWS, U.S. Fish and Wildlife Service

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1. Introduction

1.1. Statement of problem

As a federally threatened species, the desert tortoise's (*Gopherus agassizii*) recovery is required under the Endangered Species Act (ESA). According to the criteria established by the Desert Tortoise Recovery Plan (U.S. Fish and Wildlife Service 1994) for delisting the tortoise from ESA protection, the species as a whole will be considered recovered when tortoises have exhibited a statistically significant upward trend for at least one tortoise generation (25 years), enough habitat is protected to allow persistence, provisions are in place to maintain discrete population growth rates at or above 1.0, regulatory measures are in place to ensure continued management of tortoise habitat, and there is no longer reason to believe that the species will require ESA protection in the future. Just as species extinction can be thought of as the cumulative extinction of all populations, species recovery can be thought of as recovery of constituent populations; management efforts for recovery generally are implemented and assessed at the population level. A recent review of the Desert Tortoise Recovery Plan, including an exhaustive literature search, has been compiled by the Desert Tortoise Recovery Plan Assessment Committee (Tracy et al. 2004).

An important step in recovery planning is to identify known causes of mortality or reductions in fecundity, and to propose actions that will reduce or eliminate these threats to population persistence. Because populations change in size as individuals are added (through births or immigration into a population) or subtracted (through deaths or emigration out of a population), threats are identified by establishing that they cause reductions in births, increases in deaths, or changes in movements into or out of a population. However, once a threat has been identified there are several sources of uncertainty in formulating recovery actions. First, the severity of a threat may not be well established. For example, roads can be identified as a threat to tortoises by observing road-killed tortoises on highways, but the amount of road mortality observed may or may not be sufficient to reduce populations. If road mortality is not sufficient to cause a population decline, then reducing road mortality may have no effect on population recovery. Second, even if a threat is known to be sufficiently severe to cause tortoise population declines, there may be more than one possible approach to reducing the threat. For example, if road mortality is shown to be associated with reduced population size, building tortoise-proof fencing along highways is one possible (and commonly used) approach to reducing this threat. Other approaches are also possible, however. Roads could be closed, speed limits could be reduced, tortoise monitors could be employed to safely move tortoises across roads, or underpasses could be constructed to allow safe crossing. Each approach involves some investment of resources, and some may be more effective than others. Additionally, some approaches, such as speed limits and road closures, involve imposing changes on human behavior that may not be welcomed by the public.

Because of the diversity of possible approaches to desert tortoise recovery, it is important to assess whether the effectiveness of recovery actions is well supported. Additionally, because every recovery action entails costs (in dollars, time, resources, or public goodwill), it is important to evaluate whether actions are achieving the intended benefit. It also is important to evaluate how well managers' needs for scientific support are being met by the current state of knowledge. These issues were identified by a General Accounting Office (GAO) report in 2002, and remain issues today.

This current (2006) report was commissioned by the Desert Managers Group (DMG) to evaluate the state of knowledge about the effectiveness of desert tortoise recovery actions. To do this, we gathered and then critically examined the best available evidence of the effectiveness of recovery actions related to major threats to desert tortoises. This document can be viewed as an extension of Boarman's (2002) report in which the major threats to desert tortoise populations were described based on a thorough review of the literature.

1.2. Need for scientific basis for management actions

Population-level responses to recovery actions are intrinsically difficult to study in desert tortoises owing to their long generation time and low detectability (Tracy et al. 2004). However, recovery actions are likely to be most effective when they are based on scientific principles and reliable data. There are two typical situations in which knowledge about the effectiveness of recovery actions would be beneficial to resource managers. The first situation is that in which a manager must decide among several possible recovery actions. If studies of the effectiveness of various management options had been conducted, they would provide invaluable information in making such decisions, as well as in explaining and justifying the management action to line employees and the public. The second situation is one in which a recovery action has already been implemented, but the expected recovery has not occurred. Lacking reliable information about the effectiveness of the action, the manager cannot tell whether the action does not work in general, or has failed in the particular context because of other problems, such as additional threats that have not been addressed. However, if the effectiveness of the action has been conclusively documented, then the lack of recovery can be treated as de facto evidence that other threats are present, and the manager can immediately direct attention to identifying and reducing them. For example, if fencing along a road does not help in increasing tortoise populations (studies have shown that fencing reduces the incidence of road kills), then it becomes clear that other factors, such as disease, predation, or collecting, may be derailing the recovery. To have this level of confidence in a recovery action, however, ample supporting evidence must exist.

The GAO drew the distinction between demonstration of threat and demonstration of effectiveness of recovery (General Accounting Office 2002), and pointed out that the effectiveness of recovery actions already implemented was not known. In the absence of this knowledge, it was not possible to know if the limited resources were being wisely spent (General Accounting Office 2002). The effectiveness of particular recovery actions should be tested scientifically whenever possible. Pullin and Knight (2001) describe the "effectiveness revolution" in the British health-care system in which analysis of the effectiveness of different treatment courses is advocated to improve future decision-making. The authors point out a parallel to conservation biology, in which science and statistical analysis of the effectiveness of historic practices should serve as a guide for future efforts. The parallels they cite between medical and conservation practitioners are strong and bear repeating. Doctors treat their patients' critical health conditions under time pressure with limited information. Treatment decisions are based on an understanding of the relevant science (such as human anatomy and physiology), but prior to the effectiveness revolution there often was little basis for choosing the best treatment from among a range of possibilities. Personal experience was an important driver of treatment choices under these circumstances. However, personal experience may be of little use in detecting treatments that are ineffective because a patient's health can spontaneously improve, even in the absence of treatment; conversely, treatments effective in a majority of cases may fail to work for a given patient. Additionally, personal memory can subjectively review only a limited number of cases, which are probably an inadequate number of cases on which to draw conclusions, especially without filtering the data through statistical methods that eliminate biases. Similarly, resource managers must decide which recovery actions to implement from a range of possibilities and how to implement them, in spite of uncertainty. Basing management decisions on sound ecological principles is helpful, but more than one possible approach may be defensible.

1.3. Specific questions addressed

1.3.a. How much information is available to support recovery actions, and what kind of information is it?

One measure of whether resource managers are receiving adequate guidance from scientists in their management decisions is the number and type of studies that address the effectiveness of recovery actions. We searched available literature to determine whether studies of effectiveness were being conducted and to assess whether the information available to managers is based on scientific evidence. In the process, we attempted to gauge whether effectiveness evaluation and monitoring efforts taking place at local levels could be performed in a manner more conducive to scientific interpretation.

1.3.b. Is the effectiveness of recovery actions well supported by scientific evidence?

The results of well-planned scientific studies ultimately will be more useful in guiding management actions than will reports of an observational or anecdotal nature. Therefore, we rated the supporting evidence for the effectiveness of recovery actions and the reliability of the evidence relative to the scientific principles outlined in sections 2.1.a–d.

2. Conceptual approaches

2.1. Variables examined

Evaluating the effectiveness of management actions is a complicated process, with two important issues for managers to consider. The first issue to consider is the reliability of studies used to demonstrate effectiveness, which depends on the experimental methods employed. Before implementing an action based on previous studies, a manager should decide if the conclusions of the studies are justified based on the methods used to collect and analyze the data. The second issue is can effectiveness be evaluated at different levels? On the basis of the measures of impact that an investigator chooses, a study can document effects at the individual level or at the population level. The generality of the results can also be evaluated: results can be reliable at the level of a particular project ("project level") and at the level of the action in general ("action level"). If studies are to meet the needs of managers, the difference between action and project levels should be carefully considered at the experimental design stage, as demonstrating effectiveness at one level does not imply effectiveness at another (see section 2.1.c, below). In other words, a management action may reduce impacts to tortoises at a particular project site, but one cannot assume that the action will be effective for the entire population of tortoises that may be subject to that action.

2.1.a. Classification of kinds of information

Managers have a wide range of information available to employ in their decision-making. Boarman (2002) classified this information by type and by source as a guide to judging its scientific validity and reliability. Data types, described below, include experiments, correlations, descriptions or observations, anecdotes, and speculations.

Experiments: Experiments involve changing one or more variables and observing the result on one or more other variables. Experiments are widely considered to be the most reliable form of scientific information because direct manipulation gives the investigator greater certainty that the results are due to the manipulation, and not to some other unknown factor. Though experiments are the most reliable form of study, they are often impractical or impossible at the spatial and temporal scales required for population-level assessments and may be considered unethical or illegal for endangered species. For example, studying mortality factors on desert tortoises experimentally could require exposing tortoises to predators, a practice that would be at odds with recovery goals. Furthermore, experiments are often open to the criticism that their manipulations are not sufficiently similar to naturally-occurring situations to allow their conclusions to be readily applied to real populations.

Correlations: Correlational studies make observations of sets of variables that are not under the investigator's control, and infer the relationships among the variables based on patterns observed. Because the investigator does not make direct manipulations of variables, it is logically impossible to determine which variables are causing changes in others. For example, if A and B are correlated, it is possible that A causes change in B, that B causes change in A, or that changes in both A and B are caused by changes in another unmeasured variable, but have no causal relationship with one another. In practice this limitation is dealt with by applying additional biological knowledge to the system (for example, it is logical to hypothesize that raven predation could cause a decline in tortoise population sizes, but it is not logical to hypothesize that tortoise population declines are causing raven predation), and by studying problems from multiple perspectives with multiple independent data sets. A great advantage of correlational studies is that they capture and reflect natural variation, so that their applicability to real populations is easy to justify. Generally, it is considered best to conduct experiments when they are possible, to use correlational studies when experiments are not feasible, and ideally to use each to complement the other.

Description/observation: Observations are fundamental to science, but isolated observations made outside of a designed study are of limited value. Observations play a prominent role in developing scientific theories and testable hypotheses, and good, objective, detailed observations can make unique contributions to the descriptive scientific knowledge base (for example the first description of a new species). However, tests of hypotheses require designed studies.

Anecdotes and speculation: Anecdotes are stories, usually including both observations and conclusions about the meaning of the observations. Anecdotes are intrinsically less reliable than designed studies. Speculation is an unsupported, untested assertion, and clearly cannot substitute for designed studies as the basis for reliable management.

2.1.b. Tenets of reliable study design

Whether scientific studies are experimental or correlational, their reliability increases when they follow certain tenets of study design. These include control of extraneous variables, use of control groups, isolation of effects, and replication. Each of these practices addresses particular problems.

Controlling extraneous variables: From a purely theoretical perspective, the ideal experimental subjects are completely homogeneous and have identical reactions to experimental manipulation. However, real experimental subjects differ for a variety of reasons. At best, differences among experimental subjects make results less clear (and require statistics to detect experimental effects), and at worst, differences among subjects can be inadvertently confounded with an experimental treatment so that the apparent effect of the treatment is actually due to unrelated differences among subjects. Scientists deal with this problem by holding as many variables constant as possible, randomly assigning subjects to experimental groups, and by measuring variables that cannot be controlled so that their effects can be accounted for statistically. Field studies of wild populations must compromise on several of these guidelines; environmental variables cannot be held constant, but major sources of variation can be controlled by the experimental design. For example, the potentially confounding effects of habitat differences among sites can be minimized by careful site selection; likewise, temporal effects can be controlled by making observations of different treatments over an identical time frame. Environmental variation that cannot be eliminated through design choices can often be measured and removed statistically as "covariates" or "block effects."

Controls: In ecological studies "control" is used interchangeably with the term "comparison group," and is generally meant to signify the group that is not subjected to an experimental treatment. For example, in a study of the effects of fencing on road mortality, areas with fences would be designated "treatment" areas, and areas without fences would be the controls. Though this classic experimental concept of a control can be found in some scientific studies, there are also many variations. Sometimes it is logical to substitute "before and after" for "control and treatment," that is, to use the conditions before a treatment is applied as the control. However, this design does not control for changes over time, which in a temporally highly-variable environment such as the Mojave Desert, can cause problems of interpretation. Some studies have more than one type of control; for example, making comparisons between treated and untreated sites before and after a treatment is applied provides a control both for spatial and temporal differences among subjects. Finally, it is also valid to compare subjects that have received different levels of a treatment without a true untreated control.

Isolation of effects: Just as it is necessary to control extraneous variables, multiple variables of interest can interfere with one another and make results difficult to interpret. For example, a fence that simultaneously reduces road mortality, removes off-highway vehicles (OHVs), and removes livestock may increase tortoise population size, but it will not be possible to tell whether the improvement is due to the removal of one single threat or due to some combination of the three; only a general treatment effect can be claimed. If the desired effect is achieved in a management context, this problem may not be viewed as important; for example, if fencing always reduces the same set of threats, and desert tortoises always respond positively, then the details of how the effect was achieved may be uninteresting. However, studies that fail to isolate effects can provide little guidance if the action is applied and a recovery does not occur. Additionally, when effects are not isolated, studies provide little basis for resolving disputes among stakeholders who may only be responsible for an unknown proportion of the overall problem.

Replication: Different experimental subjects may respond differently to treatments. The best way to ensure that observed results are reliable is to apply the treatment to a number of different subjects, in other words to "replicate" the experiment. Although this is conceptually straightforward, what constitutes replication changes depending on the question being asked or the population about which conclusions are to be drawn. This problem was highlighted by Hurlburt (1984), who coined the term "pseudoreplication" to describe replication at the wrong level. For example, repeated observations (e.g., multiple transects, multiple individual tortoise home ranges, etc.) of the effects of a single project on a population can be considered replicates only if the conclusions are limited to the population of individuals exposed to that particular project (i.e., "project level"; see 2.1.c, below). However, to draw general conclusions about the effectiveness of the action (i.e., "action level"; see 2.1.c, below), the projects themselves are considered replicates, and although multiple observations within a project may increase the precision of measurement, only observations of additional projects are truly replicates that can be used to statistically assess the action.

2.1.c. Generality of results: Effectiveness at action and project levels

The effectiveness of recovery actions can be demonstrated at two levels: action level and project level. Action level refers to the broad area in which an action is applicable (e.g., all tortoise habitat can be subject to an action such as removal of grazing); project level refers to a specific place or study area (e.g., the Pilot Knob grazing allotment). To determine effectiveness at an action level, studies of the effects of the action must be conducted across a variety of conditions, with the action serving as the experimental unit (Hurlburt 1984). For example, a study of the effectiveness of 1 cm^2 hardware cloth used as a tortoise-proof fencing material can be conducted, and the results can then be generalized to any case in which conditions are expected to match those of the study. However, conditions at a project site may be sufficiently different from those of the original study so that the fencing material may work poorly; for example, the material may degrade and develop holes too rapidly, local populations may exhibit a different behavioral response to the material, or the material may clog with debris so that animals can climb over it. At a specific project level, then, the material may prove not to be effective. Conversely, studies of single projects can show that actions were effective under conditions present at the site, but may not generalize well to other circumstances. For example, studies of the effects of fencing at a single location with a single fence type, based on measurements of mortality at several locations within the fenced area, can yield reliable information about the effectiveness of that particular project, but the results may not generalize well to fencing as an overall recovery action, and thus may be weak evidence of effectiveness at the action level. As Pullin and Knight (2001) point out, results from several project-level studies can sometimes be combined (using a statistical technique called "meta-analysis") to demonstrate effectiveness across a variety of conditions, and collectively the results may form strong evidence of effectiveness at an action level.

2.1.d. Ecological level of effectiveness: Individual or population

Individuals die, mate, reproduce, and encounter barriers, whereas populations increase, decrease, or remain stable. Removal of threats that are known to impact individuals is a logical approach to species recovery, but whether reduction in individual impacts actually translates into increased population size depends on multiple factors (see section 2.3). Studies of individual impacts, therefore, can be well-designed and reliable, but not qualify as a demonstration of effectiveness at a population level. For example, experimental studies of effectiveness of barrier fencing at blocking tortoise movements and reducing tortoise road mortality may be highly reliable, but without additional data on changes in population size or demographic health of a fenced population, such studies cannot indicate effectiveness at the population level.

2.1.e. Sources of scientific information

Outlets for scientific information are numerous and diverse. Following the classification used by Boarman (2002), sources of information include (1) peer-reviewed open literature, (2) technical books, (3) theses and dissertations, (4) non peer-reviewed open literature, (5) technical reports, (6) unpublished data, (7) professional judgment, and (8) "science lore." The first major division among these sources of information is between information that is based on designed scientific

studies (sources 1 to 5, possibly 6) and information that is based on personal opinion (sources 7 and 8). Sources 1 through 6 differ primarily in the degree of peer review. Peer review is the primary mechanism by which the quality of scientific information is judged and controlled. Though peer review is a highly individualistic exercise, reviewers are expected to evaluate whether the methods employed were appropriate, the samples sizes were adequate and the conclusions drawn follow logically from the experimental results. Although peer review does not guarantee quality, knowing that other experts have found the methods to be appropriate and that the conclusions are supported by the data substantially enhances confidence in a study, particularly if it is outside of one's area of expertise.

2.2. Desert tortoises have a life history that greatly complicates studies of the effectiveness of recovery

The most definitive evidence of the effectiveness of a recovery action is the demonstration that a population has recovered after an action was implemented. Although this level of support for recovery is desirable, desert tortoise managers frequently either will have to accept less stringent support for an action or be paralyzed by uncertainties. Demonstrating effectiveness of a recovery action is complicated by the life history of the desert tortoise. Tortoises are slow-growing and have delayed sexual maturity (Woodbury and Hardy 1948). Mortality, fecundity (summarized by Doak et al. 1994), physiology (Naegle 1976), and movements (Coombs 1977, Berry 1978) are all age and size dependent, yet younger, smaller tortoises are notoriously difficult to study (Berry and Turner 1986). Viability analysis requires large amounts of data, but the necessary parameters are rarely available for single populations that are exposed to a recovery action (Doak et al. 1994). Sensitivity of population growth to changes in demographic parameters varies by size class, and in desert tortoises, survival of older, reproductive individuals is most important for population growth (Doak et al. 1994). Consequently, reducing a threat to juveniles may have little effect on population recovery unless accompanied by a reduction in adult mortality (Congdon et al. 1993). Finally, tortoise populations grow slowly, and thus population-level responses to recovery actions may not be observed until many years after the action is taken, which is in sharp contrast with studies documenting threats (Boarman 2002). Many threats to tortoises, such as mortality and habitat damage, can be documented as they are occurring. It is often possible to observe immediate changes in levels of a threat after a recovery action is implemented (for example, tortoise-proof fencing should immediately reduce road mortality), but to document population-level recovery, data must be collected and analyzed for longer time periods. In this sense, it is intrinsically more difficult to measure the effectiveness of recovery actions on desert tortoises than it is to identify threats.

Another reason that documenting the effectiveness of recovery actions for desert tortoises is difficult is that they are subject to multiple threats simultaneously in many parts of their range, making the effectiveness of actions designed to address single threats difficult to gauge (Tracy et al. 2004). When multiple threats are affecting a population, removing a single threat will not increase the population size if other limiting factors remain; removing a single threat may be necessary to increase population size, but it alone may not be sufficient. As Leibig's Law of the Minimum (Huston 2002) states, a population will increase only to the point that the most limiting factor allows; consequently, removing a threat that is not the limiting factor will not increase the population size. Under these circumstances, the effectiveness and necessity of removing a single threat would be masked. For example, desert tortoise populations have continued to decline in the Desert Tortoise Natural Area (DTNA) in spite of perimeter fencing, with disease possibly being the leading cause of the decline (Berry 1997). The lesson from the DTNA is not that perimeter fencing was an unnecessary action, but that it was not sufficient in the face of other uncontrolled threats to the population. Similarly, the concept of compensatory mortality is commonly used in wildlife population biology to explain how mortality from harvesting can be sustained without reducing population size in a density-dependent population (Nichols et al. 1984). Under this paradigm, when animals die from human causes that would have died anyway from density-dependent natural causes, human-caused mortality is considered "compensatory" and will not reduce population size. Applied in the context of population recovery, compensatory mortality implies that if one mortality factor is removed there may be no net gain if other factors remain in place. Under both Leibig's Law and compensatory mortality, it is conceivable that a recovery action could reduce a threat without recovering the population. In either case, known threats should not be left in place. Multiple threats should be addressed simultaneously and as many threats as possible removed to affect population recovery.

Table 1 lists recovery actions that are commonly used or that have been proposed for use for desert tortoises. Many actions, such as fencing, affect multiple threats simultaneously (e.g., vehicle traffic and grazing), whereas other actions, such as predator control, are targeted at specific threats. For still other threats, such as disease, there currently are no recovery actions available to remove the threats, though preventative measures, such as safe handling procedures and public education, may be implemented (Berry 1997). Finally, threats may interact, such that removing anthropogenic threats could hypothetically reduce disease mortality by reducing stress on the tortoises.

Table 1. Recovery actions and the threats that these actions are expected to reduce or eliminate.

Action	Threat
Fencing (for animals)	Grazing, wild horses and burros, road mortality, wild dog or coyote mortality, utility corridors
Stocking level reduction	Grazing
Closures (to humans, seasonal or permanent)	OHVs, mining, military operations, agriculture, recreation, waste disposal, poaching, utility corridors, noise and vibrations
Habitat restoration	Grazing, OHVs, construction, mining, recreation, wild horses and burros, utility corridors, invasive plants, drought
Reduction of vehicle speed limits	Construction, mining, recreation, waste disposal
Translocation	Construction, mining, low population size or local extirpation, disease, military activities
Choosing prescribed burn season	Fire-caused mortality
Predator control	Mortality from feral dogs, ravens, or coyotes.
Feral animal control	Wild horses and burros, feral dogs
Law enforcement	Poaching, handling, collection, unauthorized OHVs
Culvert installation	Road mortality, population fragmentation
Land acquisition	Inadequate protection from many of the threats listed above

Taken together, the slow response of desert tortoise populations to recovery actions, along with the compounding effects of having multiple threats acting in concert or multiple recovery actions implemented simultaneously, make the effectiveness of individual recovery actions difficult to discern. These complexities should be taken into account when interpreting data, with sophisticated statistical methods used to isolate effects.

2.3. Demonstration of effectiveness and tortoise recovery relationships

It is important to define the goals of recovery actions so that their effectiveness can be assessed. For example, the recovery action of fencing the perimeter of the DTNA, which provides protection from OHVs and grazing and habitat destruction, is meant to maintain existing, fairly healthy populations. Successfully implementing actions and maintaining closed areas may be sufficient for success in this instance. In contrast, other recovery actions, such as habitat restoration and individual animal translocation, are meant to increase the size of a previously reduced population, and in these cases, success is judged by whether the population increases in response to the action.

Pullin and Knight (2001) describe a hierarchical system of judging the reliability of evidence of effectiveness based on study design criteria. For this current study, in addition to considering design issues, we also considered whether previous studies addressed individual-level effects or population-level effects. *Table 2* identifies the necessary assumptions in considering a result to be a demonstration of effectiveness of a recovery action, by combining both the reliability of studies and the level (individual vs. population) at which effectiveness is assessed. To illustrate, the intended outcome of fencing a road with hardware cloth designed to exclude tortoises is to increase the tortoise population by reducing road mortality. If the fence is constructed but the effects are not monitored, then confidence that the action is effective depends on (1) the assumption that road mortality is a real threat to tortoise populations; (2) that this mortality is the primary factor limiting a local tortoise population increase; and (3) that this recovery action effectively removes or reduces the limitation (Table 2, rows 2 and 3). If a declining incidence of road mortality is observed by follow-up monitoring, then fewer assumptions are needed to consider the fence effective. The action of fencing thus represents a step toward recovery only if road mortality was previously known, or can be assumed, to reduce the tortoise population in the first place (Table 2, row 3). If road mortality has been demonstrated to be associated with reduced tortoise populations, then confidence that reducing road mortality is necessary for recovery is increased (Table 2, row 4). However, this step alone may not be sufficient if other threats are limiting population recovery. Adding information about population size behind the fence increases confidence that the action has released the population from a limiting factor (Table 2, row 5). However, increases

in population size could be due to changes in movements and immigration rather than to changes in mortality rates. Demographic monitoring can demonstrate that local mortality rates have declined, and estimates of the expected effects on population growth rate can be estimated (Table 2, row 6). The assumptions necessary to conclude that the fence has been effective become much less stringent, but might include the assumption that improvements in local demographic performance are contributing to local recruitment rather than to increasing emigration rates. If increased demographic performance is coupled with increased population sizes, then the only remaining assumption would be that the population is viable (Table 2, row 7). Finally, if the assumption that the population is viable is supported by a population viability analysis, this confirms that the population has recovered as a result of the action taken (Table 2, row 8).

Table 2. Relationship between observations of measures of effectiveness and the assumptions made.

[The rows are arranged in order of increasing reliability. Each successive row includes additional observations that more strongly support the effectiveness of an action. See section 2.3 for further explanation]

Observation	Assumptions needed to conclude action was effective
An action is implemented to address a putative threat, but effect is not observed	Putative threat is really a threat, is the limiting factor, and the action removes the limitation.
An action is implemented to address a known threat, but effect is not observed	Threat is the limiting factor, and the action removes the limitation.
Reduction or elimination of a putative threat	Putative threat is a real threat and is the limiting factor.
Reduction or elimination of a known threat	Threat is the limiting factor.
Increased population size	Increased numbers are due to improved demographic performance, rather than re-distribution of tortoises, changes in observability, etc.
Improved demographic performance	Assumes that the change in survival and/or fecundity will increase the population, rather than increasing emigration, etc.
Improved demographic performance and increased population size	Assumes that the improvements create a viable population.
Improved demographic performance, increased population size, and viable population (Population Viability Analysis, PVA, observations over time)	None (recovery is observed)

3. Methods

3.1. Kinds of information collected

Information was collected from a variety of sources. We searched peer-reviewed journals and books for studies that dealt with the effects of recovery actions on desert tortoises or with the effectiveness of recovery methods in general that might be applied to desert tortoise recovery. These included title and keyword searches in the BIOSIS Previews database (which covers materials published from 1969 to the present), and Web of Science searches for articles that cited papers dealing with desert tortoise recovery (coverage from 1975 to the present). We looked through all proceedings of symposia published by the Desert Tortoise Council, which is the primary source of scientific information about desert tortoise management. Additionally, Ed LaRue (U.S. Bureau of Land Management) visited biologists' offices at the U.S. Bureau of Land Management (BLM), the U.S. Fish and Wildlife Service (USFWS), the National Park Service (NPS), the California Department of Parks and Recreation, the U.S. Marine Corps, and the U.S. Navy, which are located throughout the Mojave Desert in California (*Table 3*). During these visits, biologists' files were examined, and two kinds of documents were obtained. The first type of document reported on scientific studies that could be used as support for the effectiveness of recovery actions. These included published articles, unpublished reports, and monitoring reports that were based on a designed sample (as opposed to qualitative observations). Reviewers of drafts of this current report suggested additional documents that could be used for support. These documents were assessed for reliability (see section 3.2 below). The second type of document detailed monitoring efforts at a particular management unit, such as memos and internal reports of permit compliance. These documents were not assessed individually, but were used as a measure of the observation effort expended on desert tortoises across the region. Ed LaRue also interviewed representatives at each office to determine whether any additional monitoring was conducted that would be useful that had not been documented or that was documented elsewhere (for example, by independent researchers conducting studies within the management unit). The entire bibliographic database of these documents is available in the U.S. Department of Interior, BLM files.

Table 3. Offices visited by E. LaRue for document collection, and key personnel providing assistance and verbal input.

Agency, City	Key Personnel Providing Input
Bureau of Land Management, Barstow	C. Sullivan, A. Chavez, C. Burns
Bureau of Land Management, Needles	G. Meckfessel, K. Allison, L. Smith
Bureau of Land Management, Ridgecrest	J. Aardahl, B. Parker, J. McEwan
California Department of Parks and Recreation	M. Faull
U.S.Marine Corps, Marine Corps Air-Ground Combat Center	R. Evans, B. Husung
U.S. Navy, China Lake	T. Campbell
U.S. Air Force, Edwards Air Force Base	M. Hagan
U.S. Army, Fort Irwin	M. Quillman
National Park Service, Joshua Tree National Park	A. Fesnock, C. Collins
U.S. Fish and Wildlife Service, Carlsbad	M. McDonald, D. Miles
U.S. Fish and Wildlife Service, Ventura	R. Bransfield

3.2. Document assessment

For each document collected, we recorded the kind of action taken, following categories described by Boarman (2002), and the findings and conclusions of the study. Documents reporting on designed studies were evaluated for reliability and on whether the individual study assessed the "project" or the "action" level of effectiveness. Reliability of the study results was assessed by determining whether the following tenets of experimental design were included in the study: experimental manipulation, use of controls, and replication. The level of effectiveness assessed by a study was determined by observing the replication level (project, action) and the level at which the observations were made (e.g., individual tortoises, tortoise populations, tortoise habitat). Some documents reported on more than a single measure of effect (e.g., effects of grazing on diet breadth and on population size), and thus the number of documents evaluated was less than the number of studies. Multiple documents could be produced from studies of a single population over time. To avoid inflating the document count, we evaluated only final reports, when available, or the most recent draft reports from long-term studies. Follow-up studies were considered separate studies (for example, studies at grazing exclosures in the Ivanpah Valley that were separated by 10 years were considered two different studies).

3.3. Kinds of information not evaluated

We concentrated on studies related to changes following a recovery action so as not to repeat Boarman's (2002) analysis of threats; thus, reports of tortoise mortalities due to known threats were not evaluated. Furthermore, we did not evaluate popular articles, information circulars, and pamphlets because they were intended as interpretive tools for the general public and therefore did not present new results that would be useful to our efforts. Finally, for logistic reasons, we limited our search of offices to California. Although documents were collected regardless of study location, papers and reports from Nevada, Arizona, and Utah are underrepresented in our sample.

4. Results

4.1. Kinds of information available

Of the 395 documents obtained in our search of biologists' files and published literature, 151 were directly relevant to recovery actions. Of these, 45 were reports of designed studies and 104 were other kinds of relevant information (*Table 4*), such as permit compliance reports, letters, memos, and other materials that dealt with implementation of recovery actions. Several of these 45 documents addressed more than one treatment or more than one measure of effectiveness, such that we assessed 54 measures of the effectiveness of recovery actions (*Table 5*). Although not designed as an exhaustive enumeration of the individual study materials found, collected data indicate little information on implementation of recovery actions arising from designed scientific studies. This impression was further reinforced by interview data that showed that many agency biologists knew that recovery action implementation was occurring without any follow-up monitoring.

On the basis of Boarman (2002), we selected several significant issues related to desert tortoise recovery. These are listed in sections 4.2 through 4.9 below, along with (1) a description of the related management actions; (2) an assessment of the strength of the evidence that the actions are effective in reducing threats; and (3) a discussion of the limits to our current knowledge on the subject.

Table 4. Numbers of documents found in biologists' files pertaining to recovery actions that were either designed studies, or other forms of information.
[See Table 5 for list of documents of designed studies]

Topic	Other documents	Designed study	Total
Construction compliance	30	4	34
Grazing	15	5	20
Guzzlers	1		1
Habitat change	1		1
Habitat restoration	7	2	9
Headstarting		1	1
OHV closure	14	3	17
OHV route marking	8	14	22
Perimeter fence	8	1	9
Predator control	1	1	2
Reserve establishment		3	3
Road closure	1		1
Shooting	1		1
Tortoise fencing	2	5	7
Translocation	15	6	21
Total Result	104	45	149

Table 5. Characteristics of assessed documents.
[Explanations of terms are in text. OHV = off-highway vehicles, Observ. = Observation, Exper. = Experimental]

Author	Action	Measure	Finding	Study type	Replication	Replication level	Control
Avery 1998, Avery and Neibergs 1997	Exclude grazing	Habitat	Positive	Exper.	Replicated	Project	Yes
	Exclude grazing	Tortoises	Positive	Exper.	Replicated	Project	Yes
Baxter 1986	Translocation	Homing	Negative	Exper.	Replicated	Project	No
Berry et al. 1999	Fencing reserve	Population	Positive	Observ.	Replicated	Project	Yes
Boarman and Sazaki 1996	Tortoise fencing	Tortoises	Positive	Exper.	Replicated	Project	Yes
	Tortoise fencing	Population	Positive	Exper.	Replicated	Project	Yes
Bowser et al. 1997	Restore habitat	Habitat	Positive	Exper.	Unreplicated		No
Brooks 1995	Fencing reserve	Habitat	Positive	Exper.	Replicated	Project	Yes
Burge 1986	Post routes	Habitat	Negative	Observ.	Replicated	Project	Yes
Bury and Luckenbach 2002	OHV	Habitat	Positive	Observ.	Replicated	Project	Yes
	OHV	Tortoises	Positive	Observ.	Replicated	Project	Yes
Campbell 1981, 1985	Fencing reserve	OHV use	Positive	Observ.	Replicated	Project	Yes
	Fencing reserve	Shooting	Positive	Observ.	Replicated	Project	Yes
	Fencing reserve	Hunting	Positive	Observ.	Replicated	Project	Yes
Circle Mountain Biological Consultants 1994	Post routes	Tortoises	Positive	Observ.	Replicated	Project	No
	Post routes	Burrows	Positive	Observ.	Replicated	Project	No
	Post routes	Habitat	Positive	Observ.	Replicated	Project	No
EnviroPlus Consulting 1995	Tortoise fencing	Tortoises	Positive	Exper.	Replicated	Action	Yes
Everett et al. 2001	Predator control	Capture rate	Negative	Exper.	Replicated	Project	No
Field et al. 2002	Translocation	Survival	Positive	Exper.	Replicated	Action	Yes
	Translocation	Tortoises	Uncertain	Exper.	Replicated	Project	Internal
Fusari et al.1981	Tortoise fencing	Tortoises	Positive	Exper.	Replicated	Action	No
Goodlett and Goodlett 1993	Post routes	OHV use	No effect	Observ.	Replicated	Project	Yes
Guyot and Clobert 1997	Tortoise fencing	Tortoises	Positive	Exper.	Replicated	Project	No
	Translocation	Tortoises	Positive	Exper.	Replicated	Project	No
Kazmaier et al. 2001	Exclude grazing	Population	No effect	Exper.	Replicated	Action	Yes
	Exclude grazing	Tortoises	No effect	Exper.	Replicated	Action	Yes
Kutiel 1999	OHV	Habitat	Positive	Observ.	Replicated	Project	Yes

Table 5. Characteristics of assessed documents–Continued.
[Explanations of terms are in text. OHV = off-highway vehicles, Observ. = Observation, Exper. = Experimental]

Author	Action	Measure	Finding	Study type	Replication	Replication level	Control
Larsen et al. 1997	Exclude grazing	Habitat	Uncertain	Exper.	Replicated	Project	Yes
LaRue and Dougherty 1999	Construction	Tortoises	Positive	Observ.	Replicated	Meta analysis	No
Medica 1994a	Post routes	Habitat	Negative	Observ.	Replicated	Project	Yes
Medica 1994b	Post routes	Habitat	Negative	Observ.	Replicated	Project	Yes
Medica et al. 1982, Turner et al. 1981	Exclude grazing	Habitat	Uncertain	Exper.	Replicated	Project	Yes
	Exclude grazing	Tortoises	Positive	Exper.	Replicated	Project	Yes
Miller-Allert 2000	Post routes	Habitat	Mixed	Observ.	Replicated	Project	No
Miller-Allert 2001	Post routes	Habitat	Mixed	Observ.	Replicated	Project	No
Morafka et al. 1997	Protect hatchlings	Hatchling survival	Positive	Exper.	Replicated	Project	Yes
Mullen and Ross 1996	Translocation	Tortoises	Positive	Exper.	Replicated	Project	Yes
Musser 1983	Post routes	Habitat	Positive	Exper.	Replicated	Project	No
Nicholson and Humphreys 1981	Exclude grazing	Habitat	Negative	Observ.	Unreplicated		Yes
Olson 1996	Construction	Tortoises	Uncertain	Observ.	Unreplicated		No
Olson et al. 1992	Construction	Survival	Mixed	Observ.	Replicated	Project	No
Ruby et al. 1994	Tortoise fencing	Tortoises	Positive	Exper.	Replicated	Action	Internal
Sazaki et al. 1995	Tortoise fencing	Tortoises	Positive	Observ.	Replicated	Project	No
Stewart 1993	Translocation	Weight change	Positive	Exper.	Replicated	Project	Yes
	Translocation	Survival	Positive	Exper.	Replicated	Project	Yes
Stewart and Baxter 1987	Translocation	Survival	Positive	Exper.	Replicated	Project	No
BLM 1984	Post routes	Habitat	Mixed	Observ.	Replicated	Project	No
Walker and Mastin 1999	Post routes	Habitat	Positive	Observ.	Replicated	Project	Internal
BLM 2000a	Post routes	Habitat	Mixed	Observ.	Replicated	Project	No
BLM 2001b	Post routes	Habitat	Mixed	Observ.	Replicated	Project	No
BLM 2002	Post routes	Habitat	Mixed	Observ.	Replicated	Project	No
Woodman 1986	Post routes	Habitat	Negative	Observ.	Replicated	Project	No
	Post routes	Tortoises	Positive	Observ.	Replicated	Project	No

4.2. Reserves

4.2.a. Actions

Dedicated reserves are areas in which public access is controlled or eliminated, and in which management is directed solely to protection of the desert tortoise. Establishment of dedicated reserves provides increased protection for tortoise populations against multiple threats (e.g., OHVs, mining, military operations, agriculture, etc.; *Table 1*). The 1994 USFWS Desert Tortoise Recovery Plan emphasized effectively protecting large areas containing healthy tortoise populations as a significant recovery action. Protecting habitat is perhaps the least controversial action from an ecological perspective, in the sense that a species' dependence on suitable habitat for persistence is true by definition. However, design of a reserve is a complex issue, requiring a great deal of basic information on life history, ecology, and population genetics of the species. A great deal of research effort has been expended to build the necessary knowledge base for successful reserve design; reviewing this information was beyond the scope of this report. Landscape-scale planning is proceeding (Tracy et al. 2004), but the effectiveness of an entire reserve network ultimately is judged by the recovery of a species. At a finer scale, the effectiveness of a reserve network depends on the effectiveness of its components at maintaining populations, and at this scale, data on effectiveness are available.

Before completion of the recovery plan, the DTNA (established in 1980) was the only dedicated reserve for desert tortoises and has been the focus of intensive study. Much is known about the tortoise population, habitat, and behavior there (Berry 1997, Brooks 2000). Reserve fencing and patrolling of the DTNA perimeter has reduced human use of the area, and thus reduced threats such as shooting and unauthorized OHV travel within its boundaries (Campbell 1981). Fencing of the reserve has also reduced unauthorized livestock grazing and improved tortoise habitat characteristics (Brooks 2000). In addition, it has increased (1) annual and perennial plant biomass, cover, and diversity of natives, (2) soil seed biomass, (3) nocturnal rodent density and diversity, (4) breeding bird abundance and species richness, and (5) lizard abundance and species richness (Brooks 1992, 1995, 1999a, 1999b). Fencing also has decreased (1) biomass of alien annual plants, and (2) an abundance of black-tailed hares (*Lepus californicus*). The DTNA perimeter fence is not tortoise-proof, so individuals that move outside of the reserve are still subject to impacts.

The DTNA illustrates two vexing points about measuring the effectiveness of recovery. First, it is impossible to assess the relative effects on tortoises of each of the several changes that occurred in the DTNA as a result of establishing it as a reserve. A change in population size could be attributed to the "treatment effect" of fencing, but the relative contribution of factors such as reduced grazing versus reduced OHV use could not be determined without additional studies that isolate these effects. Second, although there are no known detrimental effects of establishing reserves, the tortoise population in the DTNA has, in fact, declined (Berry et al. 1999). Uncontrolled threats, such as disease, drought, and predation, may explain this paradoxical outcome (Berry 1997). Similarly, following establishment of the Red Cliffs Desert Reserve within the Upper Virgin River Recovery Unit, Utah, in 1996, tortoise populations were stable for several years (McLuckie et al. 2002). However, after a drought year in 2002, tortoise populations declined by 40%. This population has also been subject to URTD infection, which may have contributed to the decline in numbers (K. Berry, pers. comm.). These two well-studied cases demonstrate the complexities of studying population responses to multiple factors. These declines in the tortoise population have made it difficult for researchers to use the DTNA as evidence of the general importance of establishing reserves.

4.2.b. Limits to our knowledge

Of all of the recovery actions taken, establishing reserves is the one most likely to receive unanimous agreement among biologists as an appropriate measure to undertake. Experiences at the DTNA and Red Cliffs have shown that even the best-supported practices can fail to produce the expected result if other threats are not controlled. Reserves theoretically have the advantage of simultaneously reducing multiple threats, but inferences about the importance of particular threats and the effects of implemented actions to address these threats can be difficult. Furthermore, whether desert tortoise reserves protect isolated populations and/or function as part of a network of interacting populations is not currently known.

Table 6. Possible threats to desert tortoises (from Boarman 2002), strength of the supporting evidence, and best-supported possible impacts.
[OHV, off-highway vehicle; NA, not available]

Individual threats	Strength of evidence	Best supported possible impact
Agriculture	Weak	Habitat loss
Collecting	Weak	Direct mortality[1]
Construction	Strong	Habitat loss, burrow damage, direct mortality
Disease	Weak	Direct mortality
Drought	Weak[2]	Dehydration, predation[3]
Energy and mineral developments	Strong	Habitat loss, direct mortality during construction
Fire	Strong	Habitat loss, habitat degradation, direct mortality
Garbage and litter	Weak	Direct mortality
Handling and deliberate manipulation	Weak	Water loss
Invasive plants	Strong	Habitat degradation[4]
Landfills	Strong	Direct mortality[5]
Livestock grazing	Strong	Direct mortality[6], burrow damage[7], habitat degradation[8], food competition
Military operations	Strong	Habitat loss, direct mortality
OHV	Strong	Reduced tortoise density, habitat degradation, direct mortality, soil compaction, soil erosion
Predation/raven predation/subsidized predators	Strong[5]	Direct mortality
Non-OHV recreation[9]	NA	NA
Roads, highways, and railroads	Strong	Habitat loss, habitat degradation, direct mortality, population fragmentation
Utility corridors	Strong	Habitat loss, direct mortality, increased predation risk[10]
Vandalism	Strong[11]	Direct mortality
Wild horses and burros	Unstudied	

[1]Removal of animals from the population (functional mortality, if not actual mortality).
[2]Tortoises are expected to be adapted to drought, but it may make them more susceptible to other stressors.
[3]Coyotes may increase predation on tortoises as preferred prey become less common.
[4]That grasses are less nutritious than forbs is well established, but the effects of introduced grasses on tortoise habitat quality and population size is less well studied.
[5]Increased raven numbers and increased risk of raven predation are well-established. Consequences of raven predation to tortoise population size are less well-studied.
[6]Few mortalities observed, but damage to styrofoam tortoise models indicates rates can be high.
[7]Rates of burrow damage depended on tortoise size, with juvenile and immature burrows more susceptible to damage than adult burrows.
[8]Changes in soils and in vegetation structure and composition.
[9]Largely unstudied as a group, though several possible activities (such as target shooting) are included in other categories.
[10]Transmission towers may facilitate raven population growth in areas previously lacking nesting substrates.
[11]That tortoises are killed is well supported, but the population-level consequences are not known.

4.3. OHV use

4.3.a. Actions

Boarman (2002) identified several studies that measured impacts of OHVs on desert habitat; he cited the study by Bury and Luckenbach (1986) as the best evidence of the impacts of OHVs on tortoise density. This work has now been published (Bury and Luckenbach 2002). Although both habitat damage and direct mortality may occur, habitat damage is the most strongly established effect (Boarman 2002). Evidence that OHVs are a threat to desert tortoises is therefore considered strong because of well-documented alterations to tortoise habitat (*Table 6*). The relative importance of direct mortality and habitat alteration is not well understood, however, and cannot be inferred from Bury and Luckenbach (2002). Studies of response by desert tortoise populations following the exclusion of OHV use from an area were not found.

If habitat damage is the primary cause of reduced densities of tortoises in these referenced instances, then the slow recovery of desert plant diversity (Lovich and Bainbridge 2003) may make such studies impractical. Habitat restoration may be applied in damaged areas, however. Recent applied restoration strategies are showing promise in accelerating desert vegetation recovery, such that post-restoration tortoise responses may be observed in experimentally tractable time periods (T. Egan, pers. comm.).

Although we did not find studies of the before and after effects of OHV closures on tortoises, several studies were found that examined the relative effectiveness of Federal agency permitting and relevant resource management plan (RMP) requirements, such as vehicle route designation, for minimizing impacts of competitive races on tortoise habitat (Musser 1983; Woodman 1986; Burge 1986; U.S. Bureau of Land Management 1984, 2000a, 2001a; Goodlett and Goodlett 1993; Circle Mountain Biological Consultants (CMBC) 1994; Medica 1994a,b; Walker and Mastin 1999; Miller-Allert 2000, 2001; Sullivan 2002). These studies are only indirectly related to the effects of OHV "free-play" areas, but they provide examples of a before/after design that yielded detailed information about impacts of OHVs on these areas. Although only Woodman (1986) and Circle Mountain Biological Consultants (1994) stated that they searched for dead desert tortoises, all the referenced studies were conducted in a way that such mortalities could have been detected (i.e., either pre- and post-event surveys were done, or monitors were present on race day). Although the experience of personnel monitoring tortoise habitat for these studies varied considerably, no injured or dead tortoises were detected. All the studies assessed habitat damage, in the form of either route widening, new OHV track formation, or damage to vegetation adjacent to established routes.

Although some form of damage was observed in all studies, the actual amount reported differed substantially. For example, Federal agency monitoring of the 1983 Barstow to Vegas motorcycle race (U.S. Bureau of Land Management 1984) showed minimal change in vegetation occurring in 22 plots. In contrast, Medica (1994a) found approximately one damaged shrub per 60 m of race event course in one transect, for an estimated 225 shrubs damaged during one particular event. Course widening and new tracks along posted routes were commonly observed in all reports evaluated. Explanations for race entrants straying from the designated route included (1) poor route marking (particularly at sharp turns or at unauthorized trails connected to the official race event); (2) lack of race monitors; (3) race vehicle passing; and (4) "silt avoidance" by event riders, who moved to more solid, outer portions of a route once its interior became unstable. Several referenced reports cited problems with permit compliance by event spectators (Medica 1994b). Compliance with event-use limitations generally was good when vehicle routes were well-posted and the Federal agency established some form of presence. Problems reported for the most recent events (U.S. Bureau of Land Management 2000a) were similar to those reported for earlier events. Interpretation of damage resulting from race events was completely subjective, based only on authors' personal judgment (that is, they did not refer to a standard for how much damage is acceptable; to our knowledge, no such standard exists).

The effectiveness of route network reductions, area closures and completed route designations as a means of reducing inappropriate OHV traffic has also been studied. One such study, conducted in Israel (Kutiel 1999), involved comparing the development rate of vehicle and pedestrian tracks in protected and unprotected areas over a 50-year period; the comparison was based on air photo interpretation techniques. Reported results indicated that the rate of change in track length per square kilometer was four times greater in the unprotected area than in the protected area. The number of "area cells", or habitat areas between tracks, increased in number geometrically in the unprotected area but increased linearly in the protected area, indicating rapid habitat fragmentation in the unprotected area. Consequently, the number of area cells in the unprotected, non-designated area increased with time as their size decreased. A similar approach was taken by Matchett et al. (2004) in a study of the Dove Springs Open Area in the western Mojave Desert, although comparisons were limited to change over time with no comparison with the closed area. Matchett et al. (2004) reported that track densities continued to increase from the 1960s through the 2000s within this area of unlimited OHV use. This increase was highest between 1965 and 1982 when OHV recreation began to dramatically increase; the increase continued through 2001. The total length of OHV routes increased from 49 to 576 km between 1965 and 2001, and the amount of land exhibiting some form of OHV disturbance increased from 7 to 30%. In addition, heavy OHV use did not stop at the

boundaries of the Open Area, but spread into surrounding public land managed as "limited use," where vehicles were supposed to stay on designated routes. The most concentrated OHV use occurred near large washes and utility rights-of-way.

In another study of route network formation conducted within desert tortoise habitat, Goodlett and Goodlett (1993) found that posted, but unrestored closed areas in Rand Mountain and Fremont Valley, Calif., had similar numbers of new vehicle tracks as the unposted areas closed to vehicle use. In addition, the number of OHV tracks observed increased with proximity to open vehicle-use areas, suggesting that posted vehicle route closures alone were not effective at eliminating all unauthorized OHV use. In contrast, the regularly maintained perimeter fence at the DTNA has been effective at reducing OHV use (Campbell 1985). It should be noted, however, that the relatively longer-term effectiveness along the DTNA fence-line came about only after an initial period when vandalism was high and that maintenance of the fence continued until the vandalism problem subsided. Further, all the above instances were aimed at understanding route network development, and whether the level of the threat or impact could be reduced; the effects of threat reduction on wildlife populations were not assessed.

Restoration of routes may further reduce unauthorized use of closed areas by obscuring the route from view (Egan 2000). A rapid, inexpensive process called "vertical mulching" has been proposed (U.S. Bureau of Land Management 2001b) for closed route restoration in desert tortoise and other special status species' habitats (National Applied Research Science Center 2000). Vertical mulching involves placement of boulders and vegetation (living or dead) across a closed route so that it visually blends in with the surrounding landscape. The *West Mojave Route Designation, Ord Mountain Pilot Unit, Biological Resource Screening Components* (U.S. Bureau of Land Management 1997) identified route closure as a high-priority objective, and the U.S. Fish and Wildlife Service (2001) concurred with the BLM that vehicle route designation and closed route restoration using "vertical mulching" as outlined above would not adversely affect, and might benefit, the federally listed desert tortoise and the Ord-Rodman Critical Habitat Unit. Egan (2000) reports that the BLM has demonstrated that this technique can be economically implemented, although tests of its effectiveness were not cited.

4.3.b. Limits to our knowledge

Although it is logical to conclude that excluding or restricting OHV use will reduce damage to tortoise habitat and that higher-quality habitat will promote healthier populations, we did not find any studies that removed only OHV use before measuring responses of a desert tortoise population. Several of the studies we identified may be prime candidates for further research by removing OHVs then measuring tortoise responses, particularly since a number of years have passed since actions were initiated in these areas such as the actions at the Ord Mountain Project (U.S. Bureau of Land Management 2000b, 2001b).

There is correlative evidence that OHV use and dirt road densities promote exotic plant invasions (Brooks 1999b, Brooks and Esque 2002, Brooks and Berry accepted), but whether excluding OHVs prevents invasions in impacted areas has not been studied. Studies comparing the rates of exotic plant invasion in open areas, in impacted areas that have been closed, and in areas that have not been impacted by OHV use would be valuable.

We also did not find any studies that tested whether measures reducing OHV use, short of complete area closures, are effective at recovering desert tortoise populations. It is relatively well-established (Boarman 2002) that unrestrained OHV use over time reduces tortoise densities; however, no studies were found that test how much habitat loss to OHV use can be sustained by the species, or whether limited vehicle use is less destructive than unrestricted use to desert tortoise habitat. Lacking such studies, it is difficult to extrapolate what is currently known to a population level. For example, monitoring requirements for race events have produced a relative wealth of information about the effectiveness of vehicle route marking for protecting tortoises and habitat. However, although some degree of habitat damage was observed in all cases, different investigators reached different conclusions about the extent and acceptability of the damage. Population-level studies would be needed to determine how much damage a tortoise population could withstand if objective criteria for acceptable damage are to be devised.

4.4. Grazing

4.4.a. Actions

Boarman (2002) identified several ways in which cattle grazing impacts tortoise habitat, particularly near water sources (*Table 6*). Sheep grazing, on the other hand, has hardly been studied (Nicholson and Humphreys 1981). Direct impacts of livestock grazing to tortoises have not been well-documented, and little research has been conducted on the effectiveness of grazing restrictions on tortoise populations. We found only one case (in the Ivanpah Valley of California) in which researchers removed cattle and then tracked changes in tortoise populations (Turner et al. 1981, 1985; Avery and Neibergs 1997). Turner et al. (1981, 1985) found no differences in plant species composition within and outside an exclosure in the 2 years following cattle removal. Plant biomass was greater in grazed areas than in ungrazed areas. No differences in home range size or number of clutches between tortoises in grazed and ungrazed areas were found in this instance, suggesting that cattle grazing has no effect on tortoises or tortoise habitat. However, there are three reasons to be cautious about this literal reading of Turner

et al.'s results. First, this study utilized only one exclosure and one comparison plot, which makes comparisons at the level of the action tenuous. Second, the above study was conducted over the 2-year period following exclosure, and although they did concentrate on measurements that would be expected to respond quickly to removal of cattle, such as cover of annuals and tortoise reproductive output, the study duration may have been too short for a slowly recovering vegetation type and a slowly growing population of tortoises. Third, this study reported that grazing intensity declined substantially as the exclosure was being established, so that the grazed plot was not heavily grazed at any time during the study. It is thus questionable as to whether their findings can be applied to real-life allotments where grazing levels may be consistently high for extended periods.

Between 1991 and 1993 Avery and Neibergs (1997) and Avery (1998) studied the same cattle exclosure established 10 years earlier by Turner et al. (1981, 1985). This more recent study found greater cover of *Hilaria rigida*, a palatable perennial grass, where cattle were excluded, as well as increased desert dandelion (*Malacothrix glabrata*), whereas grazed areas had more compacted soils. In addition, 50% of actively-used burrow entrances were damaged by grazing cattle, which contributed to a 2.5-fold increase in tortoises remaining above ground overnight. Although predation rates were not measured, burrows are thought to provide tortoises protection from predators, and predation risk may have been greater in grazed areas as a consequence. Dead or dormant *Ambrosia dumosa* were more common in grazed plots. Unpalatable shrubs, such as *Hymenoclea salsola* and *Larrea tridentata* were favored by grazing; *L. tridentata* had greater canopy areas, aboveground volumes, and estimated biomass, and *H. salsola* was also more abundant in grazed areas. Furthermore, diet composition overlapped between tortoises and cattle in the late spring when forage dried out, suggesting that these two herbivorous species may compete for food at these times. Conclusions drawn in Avery and Neibergs' study are similarly restricted because of a lack of replication at the action level. Although the study did extend the timeframe for recovery from 2 to 12 years, they still were not certain that enough time had passed for plant or animal population recovery to be detected.

Larsen et al. (1997) studied exclosures that had been established for long periods. Two exclosures were located at an abandoned gunnery range (time of closure not reported); a third exclosure had been closed since the early 1940s. Livestock grazing outside of the exclosures was reported to be "light" to "moderate," though the moderate livestock-use sites had been recently rested for 2 to 6 years. Changes in vegetation were small and idiosyncratic, with no clear, consistent effect of livestock grazing apparent. No differences in soil compaction or abundance of tortoises or tortoise sign were observed. Although the study included replicate sites, grazing intensity was not quantified, and site-specific differences dominated the results. Additionally, these results were preliminary, and the authors considered definitive conclusions to be unwarranted.

Studies at the DTNA provide some insight into the effects of sheep grazing. Although fenced exclusions of livestock also excluded OHV use of the area, the observed increases in annual plant biomass (Brooks 1995, 1999b) and soil seedbank densities (Brooks 1995) inside of the DTNA were likely due to protection from forage utilization by livestock.

Livestock activity and their effects are often concentrated around watering sites. In a study of nine watering sites at the Pilot Knob Grazing Allotment in the central Mojave Desert, Brooks et al. (accepted) documented patterns of vegetation responses that are useful in developing management plans for watering sites. These authors found that absolute and proportional cover of alien annual plants increased with proximity to watering sites, whereas cover and species richness of native annual plants decreased. Not all alien species responded the same: the alien forb Erodium cicutarium and the alien grass Schismus spp. increased with proximity to watering sites, whereas the alien annual grass Bromus madritensis ssp. rubens decreased. Perennial plant cover and species richness also declined with proximity to watering sites, as did the structural diversity of perennial plant cover classes. Significant effects of livestock activity were focused within 200 m of the watering sites, suggesting that efforts to control alien annual plants and restore native plants should optimally be focused within the central part of the disturbance gradient.

4.4.b. Limits to our knowledge

Livestock grazing-related impacts to desert tortoise habitat are well-established, but whether there is a threshold stocking level below which tortoise populations are unaffected is not known. Larsen et al. (1997) did not find grazing effects at three sites with light to moderate cattle grazing, but without more careful quantification of the grazing level this result should be considered suggestive rather than confirmatory. The question –whether there is a threshold stocking level–is complicated by the fact that impacts of livestock presumably vary annually with changes in precipitation and primary productivity (Avery 1998). When tortoise populations are low and forage is abundant, livestock grazing may have little or no effect on tortoises. But, when forage is less abundant, livestock and tortoises may be forced to compete. Additional research is needed to establish whether limited livestock grazing can be done without detrimental effects on desert tortoises. Studies of other species may be of limited use for desert tortoise management. Kazmaier et al. (2001) studied the effects of grazing on the Texas tortoise and found no effects of grazing on growth or survival of this species. However, they expressed reservations about extrapolating the results of their study to desert tortoises and the more arid, low-productivity environments of the Mojave Desert. A recent synthesis of the grazing literature by The Nature Conservancy reached similar conclusions (The Nature Conservancy 2005) about the lack of information needed to set environmentally safe grazing regulations in the Sonoran Desert, and recommended more research into the efficacy of ephemeral allotments, based on seasonal patterns of rainfall and plant growth.

4.5. Road mortality and barrier fencing

4.5.a. Actions

Tortoise mortality along unfenced roads has been well-documented (Boarman 2002). Reduced densities of tortoises along roads suggest that road mortality is sufficient to affect population sizes (von Seckendorff Hoff and Marlow 2002). The size classes of tortoises killed by traffic include larger, reproductive individuals (Boarman et al. in prep.) which are most important for population viability in this species (Doak et al. 1994). Support for considering roads a threat to desert tortoises, therefore, is strong at the individual and population levels (*Table 6*).

Boarman and Sazaki (1996) compared fenced and unfenced sections of Highway 58 and found that fencing with tortoise-proof materials reduced the number of road-killed tortoises by 93% (Boarman and Sazaki 1996). Radio-transmittered tortoises making long-distance movements were not able to cross the fence (Sazaki et al. 1995), supporting the interpretation that reduced road kill was due to the reduction in tortoises crossing the road, rather than to a difference in population density between fenced and unfenced areas. A similar reduction in the incidence of road kill was observed in a study of the Hermann's tortoise in southern France (Guyot and Clobert 1997), which further supports the overall effectiveness of fencing for reducing tortoise mortality.

The major criticisms of fencing are that it fragments populations into smaller units that are more prone to local extinction, and it genetically isolates tortoise populations. Isolation is a risk to long-term viability as it may reduce the genetic diversity within the species. As a solution to this problem, culverts have been used in combination with fencing to allow tortoises to disperse safely (*Table 1*). Fusari et al. (1981) and Fusari (1985) found that tortoises use culverts made of corrugated steel or panelboard in combination with barrier fences under experimental conditions. Boarman et al. (1998) found that desert tortoises use existing culverts running under Highway 58 that are associated with fenced sections of highway. It is unlikely that tortoises preferentially use culverts in the absence of barrier fencing, but in concert with fencing projects they may prove effective at allowing some degree of movement across roads without excessive risk of mortality.

Effectiveness of different kinds of fencing materials has been studied under controlled experimental conditions (Fusari 1985, Spotila et al. 1993, Ruby et al. 1994, EnviroPlus Consulting 1995). These studies generally support the use of 1-cm hardware cloth as fencing material (EnviroPlus Consulting 1995 recommended 1×2 inch welded wire). Tortoises were less likely to fight against this material than materials with larger mesh sizes because they were able to see that the hardware cloth formed a barrier. Solid barriers also prevented tortoises from struggling against the fence, but discouraged them from moving along the barrier to find openings. Hardware cloth appeared to balance the need to provide a visual stimulus to encourage searching for passage through the fence, and the need to prevent tortoises from wasting time trying to breach, and possibly becoming ensnared in, the barrier.

4.5.b. Limits to our knowledge

Fencing reduces the incidence of tortoise road kills, but it is not known whether this protection is sufficient to recover the population. Analysis of distances of marked tortoises from a fenced section of Highway 58 (Boarman, unpubl. data) reveals that tortoise numbers near the road increased slightly between 1991 and 1997, but then declined again in 1998. Whether this was the beginning of a full recovery is not known, as insufficient time had elapsed to draw such a conclusion. Also, interpretation of results is complicated by other possible effects of roads that are not controlled by fencing, such as increased predation risk and exotic plant invasion. Future studies should attempt to quantify these effects to properly account for them in judging the success of individual recovery efforts. Furthermore, fencing is expected to isolate populations compared with unfenced, roadless areas, but it is not known whether fences increase isolation of tortoise populations compared with unfenced sections of road. Roads, particularly heavily traveled ones, are already a barrier to movements, so this is an empirical, not a theoretical, question. Mortality is logically expected to increase with traffic volume and vehicle speeds, but this has not been tested with tortoises. The thresholds for which roads become safe for tortoise populations are not known.

The culverts that are put in place to alleviate the isolating effects of fences and roads may carry their own element of risk to tortoises. Culverts are used not only by tortoises, but by a variety of species, including those that are potential threats to tortoises (e.g., dogs, coyotes, people; Boarman unpubl. data). Additional research is necessary to determine whether the risk of predation is elevated at culverts, as well as to quantify the population-genetic benefits of culverts so as to determine if any such benefits are outweighed by risk of mortality. At this time, no studies of population-level effects of culvert use have been conducted that would help select roads needing culverts and the culvert densities required.

Roads can also have direct local, indirect local, and dispersed landscape effects on ecosystems (Brooks and Lair 2005). Most studies of the effects of roads on desert tortoises have focused on their direct effects (e.g., mortality), whereas most management decisions related to roads (aside from fencing) are focused on determining acceptable densities per unit area as it related to habitat fragmentation. Future research on the ecological effects of roads needs to focus on their dispersed landscape effects to best match the needs of land managers.

4.6. Mortality from construction activities

4.6.a. Actions

Construction activities have a variety of effects on individual tortoises, tortoise habitat, and tortoise populations (Boarman 2002; *Table 6*). Direct habitat loss, mortality, burrow damage, and fugitive dust have all been identified as possible problems (Boarman 2002). As part of their compliance with the Federal ESA, agencies and entities that are undertaking construction projects where desert tortoises are likely to be killed operate under the provisions of section 7(a)(2) consultations or section 10(a)(1)(B) permits; in both cases, project proponents are required to report any tortoises that are killed during construction operations. These reporting requirements have generated information about both the impacts of construction and the effectiveness of terms and conditions.

Actions designed to minimize the impacts of construction activities are specified in biological opinions (BOs), along with required compliance reporting. Measures imposed are a heterogeneous mix and include fencing of construction areas and roads, physically moving tortoises out of harm's way, conducting on-site biological monitoring, implementing reduced vehicle speed limits at construction sites, and others. These measures are primarily aimed at preventing tortoise mortality during construction (*Table 1*). Biological opinions and incidental take permits attempt to anticipate the number of desert tortoises that may be killed during implementation of the project, and the number of animals killed during construction is reported by the permittee. LaRue and Dougherty (1999) analyzed 171 BOs that had been implemented in California or Nevada, and found a small fraction of the number of tortoises that could have legally been killed (1,096 anticipated) were actually killed (59, or 5.4% of allowable take). LaRue and Dougherty (1999) concluded that the terms and conditions attached to construction permits by BOs were effective at protecting desert tortoises because the actual take was well below anticipated take. Although not a formal meta-analysis, this study addressed effectiveness at an action level across many independent projects, and is a positive step in the direction of effectiveness evaluation. Confidence in the study would increase to the extent that BO compliance reporting could be shown to be a reliable method of data collection. Additionally, the conclusion that tortoises were adequately protected was based on the assumption that anticipated take numbers specified in BOs are harmless to tortoise populations, an assumption that, to our knowledge, has not been tested.

Linear construction projects, such as pipelines, fiber optic cable lines, and transmission lines, have the potential to impact large numbers of tortoises, as they stretch across many hundreds of miles of tortoise habitat and may intersect many different tortoise populations (Olson et al. 1992, Olson 1996). The effectiveness of tortoise protection measures during construction was assessed by comparing the number of tortoises killed (29 on the 646 mile-long Kern River pipeline, and 9 on the 384 mile-long Mojave pipeline) with the total number that were moved out of harm's way (401 on the Kern River pipeline, 158 on the Mojave pipeline), under the assumption that some large, but unknown, fraction of the tortoises would have been killed if they had been left in the construction zone. Gas pipelines have a wider construction impact zone than fiber optic lines, such that gas pipelines are expected to have greater impacts. Conclusions about the reduction in impact are difficult to evaluate because the number of tortoises that would have been killed is not known (that is, the study lacks a control). Additionally, the fate of the tortoises moved is not known, and whether they later died or impacted other tortoises was not studied, though these problems have not been found in translocation studies (see section 4.9, "Translocation").

Not all linear construction projects impact tortoise populations in the same way. Comparisons among project types show that gas pipelines kill more tortoises than fiber optic lines or transmission lines, a fact attributed to differences in construction practices among the project types (Olson et al. 1992). As in the example above, the number of tortoises that would have been killed if none were moved is unknown; although increased mortality is a reasonable assumption, the amount of increased mortality cannot be measured.

4.6.b. Limits to our knowledge

Available studies demonstrate that direct mortality to individual tortoises is reduced by adherence to permitting requirements. Although comparing mortality with allowable take is straightforward, setting allowable take numbers is not. It is generally best to consider allowable take to be a hypothesis, rather than a definitive statement, about the amount of mortality that a population can withstand. Because this hypothesis has always been assumed and not tested, no studies on the effectiveness of measures for protecting tortoise populations from construction activities have been performed.

Linear construction projects may also be a source of habitat fragmentation. Although the footprint of the construction may persist for long periods, it is not known whether populations are subdivided as a result. Whether such projects have long-term effects on the genetic structure of a population or the probability of extinction is not known.

4.7. Habitat restoration

4.7.a. Actions

A recent review of natural recovery and habitat restoration in southern California deserts is available from Lovich and Bainbridge (2003). They found that revegetation efforts have

been attempted at small spatial scales, but that most efforts have had limited success and are labor-intensive and expensive. Some natural recovery has been observed in protected areas (Brooks 2000) in which grazing and OHVs have been removed. In contrast, unrestored tank tracks from military maneuvers have persisted for more than 55 years (Belnap and Warren 2002). The need for revegetation thus depends on the severity of impact. Natural recovery of severely degraded habitat is expected to occur over centuries, not decades (Belnap and Warren 2002). Restoration may be facilitated by placement of vertical structure (National Applied Research Science Center 2000), even in severe situations, which may help prevent additional degradation. It is not known whether this type of restoration leads to re-formation of soil crusts and recovery of natural nitrogen cycling.

4.7.b. Limits to our knowledge

Successful revegetation has been demonstrated in the Mojave Desert over the years in a wide variety of studies, resource notes, and pipeline/transmission line project reclamation plans (Clary 1983, University of California Davis Agronomy and Range Science Department 1977, 1978, University of California Davis Cooperative Extension 1990). Some restoration approaches are unlikely to be practical at large spatial scales, because of the cost or logistical difficulties involved (Lovich and Bainbridge 2003). It is also not known whether revegetated areas provide high-quality habitat for desert tortoises, or what degree of restoration is necessary to achieve success.

4.8. Translocation

4.8.a. Actions

We did not find any published studies that used translocation to re-introduce tortoise populations, although ongoing studies by Field et al. (e.g., Field et al. 2000, 2002) are investigating whether pet tortoises can be repatriated to the wild to augment existing populations. For example, Field et al. (2002) compared survivorship between released tortoises that were formerly pets to tortoises that were wild caught and found no difference in survival. Nussear et al. (2002) found no difference in survival or reproduction between resident and translocated tortoises in Nevada. Rainfall increased survival and reproduction in both groups. Stewart (1993) also reported no substantial differences in survival between wild and translocated tortoises, although differences were not statistically tested. Field et al. (2000) found that removal of *ad-libitum* water prior to release also had no effect on survival, but that males given supplemental water prior to release moved more than twice as far in their first season post-release. Translocated tortoises had more variable movements in their first year post-release, but not their second (Nussear et al. 2002). Thus, the initial experiments indicate that translocations and repatriations can be done without negative impacts to wild populations (Tracy et al. 2004).

Several studies followed tortoises that had been moved out of construction zones to assess their survival and movements. For example, Mullen and Ross (1996) reported that relocated individuals (guests) had similar condition index values (a measure of mass corrected for differences in length) to individuals that had not been moved. Furthermore, “residents” that did not have tortoises introduced to their area and “hosts” that did have tortoises released in their area had similar condition index values, suggesting that translocating tortoises did not negatively impact hosts. Irrigation increased the condition index for tortoises during the driest period of the 3 years of the study. High mortality rates in translocated tortoises were attributed to a lower initial pre-release condition index (mortality rate was not reported). This study, which focused on an index of health of individual tortoises, supported the contention that tortoises can survive translocation without impacting tortoises already present at the release point.

4.8.b. Limits to our knowledge

Studies by Field et al. (2000), Nussear et al. (2002), and Mullen and Ross (1996) have shown that tortoise translocation can work and that resident tortoises are not negatively impacted by the practice in the short term. Moving tortoises out of harm’s way at construction sites generally involves shorter displacements that may not even remove tortoises from their home ranges; whether this practice has the same effects as longer-range translocations is not known. Whether releasing tortoises augments long-term population size also is not known, but may depend on characteristics of the site (e.g., habitat quality, tortoise population density, etc.). Releasing pet tortoises and handling tortoises is considered a risk factor because of the potential for disease transmission (Berry 1997). Translocation efforts, therefore, would need to observe rigorous protocols to avoid harming target populations (for example, testing for an immune response to *Mycoplasma agassizii* prior to release to avoid release of infected but asymptomatic individuals; Tracy et al. 2004). It is not known how many individuals would need to be released to establish new populations or to have a positive effect on extant populations. Population-level effects would be expected to be greatest for releases of sexually mature individuals, given that population growth is most sensitive to changes in this age class (Doak et al. 1994). Headstarting programs show promise for protecting hatchlings (Morafka et al. 1997), but would probably have a smaller positive impact on tortoise population growth.

4.9. Predator control

4.9.a. Actions

Both native predators, such as common ravens, coyotes, and mountain lions (P. Medica, unpubl. data), and exotic predators, like feral or domestic dogs, have been implicated as threats to desert tortoises (Boarman 2002). Predator control is controversial and has not been attempted on a large scale. Raven control is notoriously difficult because they are believed to learn quickly to avoid most lethal control methods. Breeding pairs and large aggregations of non-breeding ravens at landfills and other resource sites are threats to tortoises (Kristan and Boarman 2003). Changes in landfill management can reduce raven abundance at the landfill site (Boarman et al., in prep.), but effects on breeding pairs and regional population size are not known. Targeting breeding pairs can be problematic because removing one individual alerts the other, and shooting generally is effective at removing only one member of a breeding pair (Boarman, unpubl. data). In Iceland, 9 years of removing ravens has not reduced population abundance (Skarphédinsson et al. 1990). Local reductions in predation risk, however, may be achievable (Boarman 2003).

Pilot efforts to live-trap feral dogs have had limited success, with only a single individual trapped during a pilot program at the Marine Air Ground Task Force Training Command,Twentynine Palms, Calif. (Everett et al. 2001). During the 158 six-hour trapping periods conducted, 1 coyote and 6 kit foxes were also captured, raising concerns about non-target species impacts. Shooting was offered as an alternative, humane removal method, but without supporting data.

4.9.b. Limits of our knowledge

Both the extent and importance of raven predation on juvenile tortoises is not fully understood. Raven predation on juvenile desert tortoises alone may have little effect on the population levels of tortoises compared with other sources of mortality (Ray et al. 1993, Doak et al. 1994). However, in declining populations, reducing juvenile mortality may be very important in promoting recovery (Congdon et al. 1993, Boarman 2002).

Raven populations are not uniformly distributed across the desert tortoise's range, thus predation risk is mixed (Kristan and Boarman 2003). Where ravens are abundant, the risk of predation approaches 100%, but areas of great raven abundance are restricted to sites of human resource subsidies where groups of primarily non-breeding individuals aggregate. Breeding ravens are also a threat, and though they distribute more evenly over open desert, they still aggregate near human developments (Kristan and Boarman, in prep.). The regional effects of ravens on population levels of desert tortoises is not fully understood, and thus it is not yet known whether raven control should be expected to be an effective recovery action. The most effective methods for raven population control have not been well-studied. Predators of adult tortoises, such as feral dogs and coyotes, are expected to have a larger impact on population levels than that of ravens, but no data are available to test this hypothesis. Effects of canid removal on tortoise populations were not found.

4.10. Other threats

Boarman (2002) found that some commonly accepted threats to tortoises have not been studied sufficiently to establish them as such, and we found that the effectiveness of actions to control these unproven threats also has not been studied. For example, competition for forage between tortoises and wild horses and burros may occur, but its impact on tortoises is unknown. Several threats treated as separate categories by Boarman (2002) all led to habitat loss or degradation (e.g., military maneuvers, agricultural development, construction). Habitat loss is clearly a threat to desert tortoises, but there are many practices that fall short of causing complete habitat destruction. It is likely that their effects on tortoises vary depending on their intensity, but we did not find any studies that undertook an assessment of how varying degrees of habitat degradation affect tortoises. Finally, several possible or demonstrated threats to tortoises, such as disease and invasive exotic plants, are not currently under direct control of resource managers (although this may change with future research) and so are not addressed here. Indirect effects and synergistic effects of threats on tortoise populations were also not specifically addressed by Boarman (2002), but are interesting and important areas for further research. For example, as one reviewer of this current report (P. Medica) suggested, predation on tortoises may depend on an abundance of alternative prey, such as rodents and rabbits, which in turn are strongly affected by drought. Drought conditions may thus increase the intensity of threats to tortoises, thus impacting them in both direct and indirect ways. Although drought is not under the control of managers, managing threats so that tortoises can withstand drought conditions may be necessary and will require additional research.

4.11. Summaries of interviews with desert managers

As part of the search for documents at field offices of desert tortoise managers, Ed LaRue interviewed key personnel (listed in *Table 3*) who had firsthand knowledge of management activities in their resource areas. Although these interviews have to be treated as anecdotal, they indicate that many recovery actions are currently being implemented and that unpublished monitoring data exists that may be useful in assessing the effectiveness of these actions at reducing tortoise threats.

One example of a recovery action is livestock fences, which were reported to be in use by most of the units we visited (BLM, U.S. Navy, U.S. Marine Corps, U.S. Army, and U.S. Air Force). Many of these fences also serve as boundary fences, meant to exclude trespassing by OHVs and livestock. Monitoring levels at Ridgecrest, a BLM site, varied from routine maintenance of fences to periodic vegetation monitoring and photograph documentation. Fencing generally is viewed as effective at keeping livestock out of sensitive areas, provided that the fences are in good repair and gates are kept closed. Smooth wire fence, used at the BLM Needles site because of concerns about harm to native ungulates, is less effective than barbed wire, as cattle are reported to cross over and under it (K. Allison, pers. comm.). Two-strand barbed wire fencing is reported to be less effective than four-strand wire fencing at keeping sheep off of Edwards Air Force Base (M. Hagan, pers. comm.). However, no cattle have entered Fort Irwin National Training Center from the Cronese Lakes Allotment since a two-strand wire fence was completed (M. Quillman, pers. comm.). An 11 mile, three-strand wire fence has been effective at keeping livestock and burros from entering China Lake Naval Air Weapons Station from the Grass Valley area (T. Campbell, pers. comm.).

Another action that has been recommended by managers for implementation across the desert is emergency closures of OHV-use areas, enforced and not, as well as a variety of projects on restoration of closed routes. Managers reported that area closures are difficult to maintain, although livestock fencing can help to discourage OHV use (A. Chavez, pers. comm.). Areas closed to OHV use with only simple barbed-wire fencing often are subject to vandalism. Cut fences have allowed initial trespass access by OHV users into closed areas, followed by unrelated subsequent vehicle trespass, as evidenced at Red Rock Canyon State Park (M. Faull, pers. comm.). Similarly, the perimeter fence at EAFB, in proximity to the El Mirage OHV Use Area, has been breached in several spots and trespassing by OHV users occurs often there (M. Hagan, pers. comm.). In contrast, solid barrier fencing along roads, construction sites, or other hazards has been used frequently, and appears to work well in these applications. For example, at EAFB, tortoises were occasionally found in mine shafts before fencing, but not after (M. Hagan, pers. comm.). Along U.S. Highway 395, areas lacking "K-rail" tortoise barriers during 1990s highway expansion work resulted in the take of desert tortoise on at least one occasion, whereas areas with barriers placed between potentially-occupied tortoise habitat and work activity did not (T. Egan, pers. comm.).

The frequently-recommended management action of vehicle route rehabilitation appears to have had mixed results. For example, vehicle route rehabilitation in the Kingston Range, the Shadow Valley area of the east Mojave Desert, has apparently had positive results, though quantitative data have not been collected (L. Smith, pers. comm.). At Red Rock Canyon State Park, rehabilitation with one particular technique has resulted in minimal natural recruitment of shrubs along closed routes (M. Faull, pers. comm.). Vehicle routes in the Kramer Hills of the west Mojave Desert also have been rehabilitated, but no follow-up data are available (C. Burns, pers. comm.). However, the rate of native plant establishment and closed vehicle route compliance garnered just 4 years after the technique of "vertical mulching" was first applied in the Ord Mountain (National Applied Research Science Center 2000) is promising (T. Egan, pers. comm.). Many of these formerly used vehicle routes are no longer visible, and contain native plant communities. Similar success has been observed by National Park Service route restoration efforts in Death Valley and Joshua Tree National Parks.

5. Conclusions

5.1. Few studies have been designed specifically to evaluate the effectiveness of recovery actions

Given that the early emphasis in desert tortoise research has been on characterizing threats, filling gaps in knowledge of desert tortoise ecology and life history, and estimating the population status and trends, it is not surprising that relatively few studies have been conducted to evaluate the effectiveness of recovery actions. Studies of threats are useful for directing recovery efforts, but they may not be helpful for selecting the best recovery action to implement. For example, knowing that road mortality is a threat to desert tortoises does not provide information to managers about how to alleviate the problem. Once fencing is selected as a preferred method, it is still necessary to decide how much road must be fenced, the kind and spacing of culverts needed to allow passage across the road, and how much maintenance is needed to preserve the fence's effectiveness. Additionally, although it may be possible to isolate the single effects of threats through careful experimental design, recovery actions usually have multiple effects and may be exposed to multiple confounding variables that prevent tortoise population response. Because of these complicating factors, studies of threats may not provide much guidance to managers seeking the best way to recover tortoise populations.

5.2. Recovery actions are necessary, but may not be sufficient

Recovery actions must be done in the face of uncertainty about which threat, or threats, are limiting. Although removal of a single known threat does not guarantee recovery, it is most conservative to assume that a population cannot recover until all known threats are removed. Short of removing all threats, as many known threats as possible should be eliminated. In this sense, removal of each known threat is supported as a necessary condition for recovery, although removing single threats may prove to be insufficient. Theoretically, one of the most comprehensive recovery actions is to set aside a dedicated reserve, but as the DTNA has demonstrated, the tortoise population can still decline if threats remain after a reserve is established. Consequently, lack of recovery because of disease, drought, or predators does not prove that excluding OHVs and livestock was unnecessary. If this level of certainty is desired, studies of these individual effects must be conducted.

5.3. Strengths and weaknesses of available information

This report compares desert tortoise research with an experimental ideal. It would be difficult to find an ecological field study in any publication that met all the criteria of an ideal study. For example, lack of random allocation of subjects to treatment and control groups is extremely common, and replication becomes difficult as the spatial scale of the study increases. Because we did not expect to find ideal studies, we identified the assumptions necessary to apply the results from a variety of studies to populations of wild tortoises (*Table 2*). This approach is meant to encourage prudent interpretation of studies, rather than to dismiss those that failed to match the ideal.

The rows in *Table 2* are arranged in ascending order of reliability, with each successive row adding additional observations that more strongly suggest the effectiveness of an action. For example, removing wild horses or burros from desert tortoise habitat without any follow-up monitoring would fall into the first row because competition with wild horses and burros has not been established as a threat to tortoises (although it is a logical extension of related work on cattle), and if no information was collected about the effects of the removal, there is little to support a conclusion that this was a successful recovery effort. If the threat has been well-established, such as the threat of mortality along an unfenced road, then observations of a reduction of the threat is an indication of success. The latter does not, however, imply that the action is sufficient to recover the population. Most of the studies we reviewed were those in which an assessment was conducted following implementation of a management action taken to reduce a threat. We did not find many examples of assessment of population-level responses to recovery actions, probably because a reduction in threat often can be assessed immediately following implementation of an action, whereas population responses can be assessed only over longer time periods. There may be no easy solution to this problem because the final test of effectiveness of recovery actions is whether these actions result in an increase in population size, which is a slow process for this long-lived species.

Most of the previous studies of effectiveness took place in concert with construction activities or recreational vehicle racing events or after area fencing of tortoise habitat. Because of this, most of these studies were a form of field experiment, the most reliable type of scientific evidence. However, these studies were aimed at measuring the effect of a single project, so they were not replicated at the level of the recovery action. Generalizing results becomes difficult under these circumstances, and such studies would be difficult to publish in peer-reviewed outlets. One approach to this problem is to analyze results from a number of project-oriented studies to evaluate action-level effectiveness. When done using formal, rigorous statistical procedures, this is called “meta-analysis” (Pullin and Knight 2001). LaRue and Dougherty (1999) attempted an informal, non-statistical version of this type of analysis, but formal attempts to integrate results across studies have not been reported.

In addition, most of the studies that we examined also lacked formal peer review or were not widely available to the managers who would benefit from their findings. Publishing studies in peer-reviewed outlets not only encourages high-quality work, it increases the availability of the work. The large amount of information found in biologists’ files that is unpublished, and thus not widely available, suggests that opportunities to improve implementation of recovery actions are being missed.

5.4. The absence of proof of effectiveness is not proof of ineffectiveness

Pullin and Knight’s (2001) analogy between studies of the effectiveness of conservation efforts and medical treatments for humans suggests that the effectiveness of the methods used will improve if an effectiveness evaluation is approached with a critical eye, using scientifically rigorous methods. However, given that such a system is not currently in place, it is important to bear in mind that the current practice of making decisions based on established conservation principals is much better than using no scientific input whatsoever. By analogy, the fact that medical treatment of humans has improved by quantitatively testing effectiveness is encouraging, but it does not show that medical treatments were ineffective before the program was implemented. We assert that the same is true of desert tortoise recovery actions: they are based on logical applications of principles of ecology and population biology, and, although we have concluded that recovery actions can improve with better information, current practices should not be considered baseless.

6. Recommendations

6.1. Implement more scientifically-based monitoring of actions

Actions that lack effectiveness monitoring will be difficult to defend, particularly if they cannot be assumed 100% effective. Scientific monitoring allows the effectiveness of particular actions to be demonstrated quantitatively at the project level, and repeated, consistent demonstration of effectiveness at the project level can collectively establish effectiveness at the action level. Additionally, greater emphasis on population-level responses will ultimately yield the most definitive answers, although these studies are the most difficult, require the greatest commitment of time and money, and have the greatest chance of failure. The need for ongoing effectiveness monitoring may decline as certainty of an action's effectiveness increases.

6.2. Coordinate monitoring activities among projects to facilitate meta-analysis of effectiveness

Follow-up monitoring of recovery actions should be a routine part of implementation. Monitoring efforts are generally site-specific and unreplicated at the level of the action, and thus are difficult to publish. To make maximal use of the information, it should be collected using standardized methods, and then submitted to a central location where it can be incorporated into formal statistical analysis using meta-analysis methods. The recently established Desert Tortoise Recovery Office (Tracy et al. 2004) could coordinate data collection from follow-up monitoring.

6.3. Pursue peer-reviewed publication of effectiveness studies

Studies that have relevance to effectiveness of recovery action should be published in peer-reviewed outlets. Peer review is important to increase reader confidence in the work, and publication increases accessibility of the results. Electronic indexing and document availability has had the positive effect of making papers published even in regional journals with small readerships available, but it may also decrease the likelihood that unpublished work will be found.

6.4. Commission studies to assess tortoise population responses to recovery actions

Recommendation 6.1 in this report is intended to improve our ability to learn from our collective experience with desert tortoise management. However, this recommendation would not eliminate the need for carefully designed studies of effectiveness, given that projects often produce complex "treatment effects" that can be confounded by uncontrolled variables like drought, disease, and predation. The desert tortoise research community has appropriately concentrated on establishing the status and trend of the species and on identifying threats to its persistence. However, a study of threats does not necessarily provide managers with guidance about how best to recover populations. Studies should be commissioned that specifically address the effectiveness of protective measures in recovering the desert tortoise population in question. The DTRPAC report (Tracy et al. 2004) includes detailed recommendations for data needs along these lines.

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Threats to Desert Tortoise Populations: A Critical Review of the Literature

Prepared for:

West Mojave Planning Team,
Bureau of Land Management

U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY
WESTERN ECOLOGICAL RESEARCH CENTER

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U.S. GEOLOGICAL SURVEY
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INTRODUCTION

Decisions in resource management are generally based on a combination of sociopolitical, economic, and environmental factors, and may be biased by personal values. These three components often contradict each other resulting in controversy. Controversies can usually be reduced when solid scientific evidence is used to support or refute a decision. However, it is important to recognize that data often do little to alter antagonists' positions when differences in values are the basis of the dispute. But, supporting data can make the decision more defensible, both legally and ethically, especially if the data supporting all opposing viewpoints are included in the decision-making process.

Resource management decisions must be made using the best scientific information currently available. However, scientific data vary in two important measures of quality: reliability and validity. The reliability of the data is a measure of the degree to which the observations or conclusions can be repeated. Validity of the data is a measure of the degree to which the observation or conclusion reflects what actually occurs in nature. How the data are collected strongly affects the reliability and validity of ecological conclusions that can be made. Research data potentially relevant to management come from different sources, and the source often provides clues to the reliability and, to a certain extent, validity of data. Understanding the quality of data being used to make management decisions helps to separate the philosophical or value-based aspects of arguments from the objective ones, thus helping to clarify the decisions and judgements that need to be made.

The West Mojave Plan is a multispecies, bioregional plan for the management of natural resources within a 9.4 million-acre area of the Mojave Desert in California. The plan addresses the legal requirements for the recovery of the desert tortoise (*Gopherus agassizii*), a threatened species, but also covers an additional approximately 80 species of plants and animals assigned special status by the Bureau of Land Management, U. S. Fish and Wildlife Service, and California Department of Fish and Game. Within the planning area, 28 separate jurisdictions (counties, cities, towns, military installations, etc.) seek programmatic prescriptions that will facilitate stream-lined environmental review, result in expedited authorization for development projects, and protect listed and unlisted species into the foreseeable future to avoid or minimize conflicts between proposed development and species' conservation and recovery. All of the scientific data available concerning the biology and management of these approximately 80 species and their habitats must be evaluated to develop a scientifically credible plan.

This document provides an overview and evaluation of the knowledge of the major threats to the persistence and recovery of desert tortoise populations. I was specifically asked to evaluate the scientific veracity of the data and reports available. I summarize the data presently available with particular focus on the West Mojave Desert, evaluate the scientific integrity of those data, and identify major gaps in the available knowledge. I do not attempt to provide in-depth details on each study or threat; for more details I encourage the reader to consult the individual papers or reports cited throughout this report (many of which are available at most university libraries and at the West

Mojave Plan office in Riverside, California). I also do not attempt to characterize or evaluate the past or present management actions, except where they have direct bearing on evaluation of threats, nor do I attempt, for the most part, to acquire, generate, or evaluate new or existing, but uninterpreted data.

Two Important Caveats

Lack of scientific evidence supporting a purported impact should not be confused with automatically supporting the alternative, that there is no impact, and vice versa. Or as it is sometimes said: "absence of evidence is not evidence of absence." It may just mean that credible or definitive studies testing the hypothesized effects have either not been conducted or not been reported adequately.

Additionally, when I critique a particular study I am neither criticizing the scientist's ability or intent. Often, studies have inherent weaknesses that are completely or largely out of the control of the researcher. For example, as discussed below, it is often very difficult to have a proper control for a study in nature and it is often too expensive or impossible to adequately replicate a natural study. Rather than abandoning the questions altogether, scientists forge ahead with the study in spite of its limitations and collect data that hopefully are useful for managers. I point out the weaknesses here so managers will understand the limitations of such data, not to criticize the researchers not to render the studies useless. Virtually all studies have some inherent value, but their utility falls at different points on the continuum of risk to managers depending in part on how they were conducted and reported.

USE OF DATA TO MAKE MANAGEMENT DECISIONS

Scientific investigations follow an orderly, repeatable process. Many such investigations begin with anecdotes from ranchers, recreationists, or casual observers of nature. These might include issues of concern to managers, such as "I'm seeing fewer tortoises these days" or "tortoises and cattle can coexist." Anecdotes are useful for pointing out to researchers what critical problems may need to be solved through scientific investigation. Most scientific research follows up anecdotes that seem plausible with more craftily constructed hypotheses and direct observation by experienced observers. If such observations warrant further investigation, scientifically based observational studies are initiated. Most studies pertaining to desert tortoises fall into this category. However, observational studies may have problems, such as lack of adequate controls, insufficient sample sizes, or researcher bias in study design or interpretation. In a few cases, experiments are used to objectively test hypotheses that were developed from anecdotal or observational data. Experiments or carefully designed observational studies may lead to development of conceptual or mathematical theories that can then be

used to predict responses of valued resources to management actions. Theory can then be tested with further experimentation or well-designed observations. Very little theory has been applied to problems related to land-management practices in the Mojave Desert.

Types of Data

The quality of data depends on how the questions were formulated and how the data were collected. Research questions in tortoise biology and management rarely employ a standard scientific method called "strong inference" (Platt 1964). For strong inference, progress is generally made by devising clear, falsifiable alternative hypotheses and conducting experiments designed to test competing predictions of these hypotheses. The strongest support for one alternative comes from experimental results that exclude other alternatives. Studies that test only one hypothesis are weak because they fail to show that the same results cannot be explained by other hypotheses. In tortoise research we generally see studies that are designed to support a pre-determined "ruling theory" or "working hypothesis" (Chamberlin 1965) or to simply describe nature. Such studies do little to explicate the phenomenon and to truly advance the management objectives supported by the research.

There are several types of studies that vary by how the data were collected. These categories are listed below in descending order from those generally providing the strongest, most valid conclusions to those providing the weakest, least reliable information. Value specifically refers to the level of risk a manager is taking when making a decision based on the data. The lower the value, the higher the risk. The actual conclusion may be right on target, but if it is from a risky type of data collection, the manager runs a higher risk of making an unsound decision.

Experiment

The strongest scientific data, those demonstrating cause and effect relationships, are generated via well-controlled and replicated experiments (Hairston 1989, Lubchenco and Real 1991). Such experiments involve manipulating one variable (treatment, such as presence of cattle) while holding all other variables constant (such as tortoise density or soil type). Such a design must have a control (or reference site) wherein ideally the only difference is the lack of the treatment. Any resultant change in the treatment area is likely to be caused by the particular treatment. However, one of many uncontrollable factors may occur that could result in a change independent of the treatment. These uncontrollable features, called random error, can fatally compromise the results. To reduce the effects of random errors (or chance), a properly designed study must have replicates - two or more sites that serve as control and two or more sites that serve as the treatment sites (Hurlbert 1984). The more replicates there are, the lower the chance that differences observed between treatment or control sites can be caused by random error. Another source of error that is mitigated by replication is uncontrollable (or unrecognized) differences among study sites (e.g., soil type, grazing history, and slope).

Any experiment that fails to have an adequate number of replicate treatment and control sites fails to satisfy an essential requisite for strong inference. Admittedly, it is often difficult or even impossible in natural settings to establish true control sites where the only difference is the lack of a treatment, not to mention have multiple replicates of the treatment and control. But having a proper control is an important feature and conclusions drawn from studies that lack a control suffer as a result.

Furthermore, the strength of any experiment, its ability to be broadly applicable, is bolstered by sample size. However, when comparing a given treatment with a given control, the sample size is the number of replicate study sites, not the number of measurements taken within each site. It is all too common for studies, particularly non-peer reviewed ones, to artificially inflate their sample sizes thus often reporting a significant effect (i.e., difference between treatment and control caused by the treatment factor) when in fact one did not occur or when the study was inadequately designed or carried out to discern a difference if one indeed existed. For example, when studying the effect of a factor like off-road vehicle (ORV) activity on desert habitat, it is common to measure number of plants and plant species within an ORV area versus outside of the area. If the researcher measured number of plants and plant species along ten transects within a single plot inside and ten transects within a single plot outside, the sample size is not 10 (nor 20) rather it is 1, because there is only one pair of plots being compared. Any differences observed may actually be caused by other factors such as different elevation or vegetation type. To avoid the random error of non-replication, multiple plots should be studied and these should be inside and outside of several ORV areas.

Correlation

Many studies in natural environments measure how a given factor (e.g., animal density) varies at different levels of some treatment (e.g., intensity of cattle grazing). This type of experiment can only show a correlation between the two factors. It provides no evidence that one factor causes a change in the other. Any correlation may just as well be from some unmeasured feature of the environment that affects both factors measured or it may be caused by chance. A cause and effect relationship can only be demonstrated if it can be shown that varying one factor (the independent variable) causes a predictable and consistent change in the other factor (dependent variable). Unfortunately, this is often the only means we have to study phenomena in the natural environment.

Description/Observation

Many studies simply describe a particular physical state or phenomenon (e.g. amount of trash or number of tortoises in a study area). The description can be simply qualitative (e.g., “a lot” or “many”) or may be quantitative involving complex statistics (e.g., means, standard deviations, confidence intervals). Such studies may provide excellent descriptions, but cannot test for cause and effect relationships.

Anecdote

Generally, a non-quantitative description limited in scope (usually a single observation of the given phenomenon) and depth of detail is considered an anecdote. An example of an anecdote is: “in 1978 I saw a tortoise eat a balloon.” Anecdotes usually lack any formal documentation and are most often made by untrained, casual observers, but professionals often report anecdotal observations. Sample sizes are extremely limited. Anecdotes are highly risky for basing management decisions because of their lack of rigor, repeatability, and objectivity.

Anecdotes need to be properly evaluated using sound scientific methodology. They can often form the basis for more formal observations, hypothesis development, or experimentation. Occasionally, there are attempts to legitimize anecdotes by compiling many into a single report and attempting a quantified or statistical treatment. These are misguided attempts because the extreme weakness and subjectivity of the basic data limit entire analyses: the anecdote. An appropriate expression is “the plural of anecdote is not data” (Green 1995).

Speculation

People will often make guesses about possibilities for which there are no hard data. When those guesses are based on clearly stated and well-founded assumptions, the guesses are called hypotheses and can help to direct future conceptual and experimental pursuits (Resnik 1991). When assumptions are weak or unstated the guesses are speculations. An example of a speculation is that fallout from nuclear tests in Nevada in the 1950s is responsible for the prevalence of disease in tortoises today. There is no evidence that fallout from nuclear testing can cause the diseases harming tortoises and no reports detailing the amount of fallout that occurred in tortoise habitat. There are no attempts to correlate probable fallout amounts with incidence of disease. The assertion is strictly a speculation because, on the face of it, it makes some sense.

Speculations may be seductive; often they present a series of progressively dependent statements that have an internal logic of their own. The logic may appear compelling and is often bolstered by attempts to provide "proof" through analogies. Such argumentation often collapses when primary assumptions are nullified or when they are tested against real data, but too often the test is never made. Although they may sometimes form the basis for hypotheses and experiments, speculations are risky to base management decisions on because there is essentially no way to evaluate them and their predictive value is low.

Source of Data

Data sources fall into several categories with varying probabilities of adequate reliability and validity. The source of data provides some indication of its quality. However, it is possible that a particular conclusion based on data from a less reliable

source is more true or accurate than one from a more reliable source, but the likelihood of this being the case is low. Thus it is less risky to base judgements on data obtained from more reliable sources. The basic sources of data follow, in order of increasing risk to management (i.e., decreasing reliability):

Peer Reviewed Open Literature

Open literature refers to articles readily available in university and public libraries and published in professional, publicly available outlets. Easy availability allows anyone to obtain and evaluate the data on which decisions are made.

Peer review is a cornerstone of the scientific process. Rigorous peer review has two essential components: 1) thorough review by two or more scientists (generally anonymous) knowledgeable on the topic and 2) the possibility of rejection if the report does not meet generally accepted scientific standards. The latter component is an important feature that is lacking in less reliable data sources. The review process helps to ensure (but does not guarantee) that: 1) only reliable data with valid conclusions are published because the reviewers make certain that data are presented in sufficient detail to allow adequate evaluation of the conclusions; 2) the collection and analysis methods followed modern scientific standards and were appropriate for making the tests reported, 3) were reported in sufficient detail to allow someone to adequately evaluate and repeat the study; 4) the conclusions follow logically from the data; and 5) relevant related data (e.g., peer-reviewed publications), whether supporting or contradicting the study's conclusions, are cited. Most professional scientific journals (e.g., Ecology, Range Management, Journal of Wildlife Management, Herpetologica, Bulletin of the Wildlife Society) are peer reviewed. The Desert Tortoise Council is now implementing an external review process for its annual symposium proceedings.

Technical Books, Theses, and Dissertations

Most technical books are peer reviewed, but often without the true possibility of rejection. They are often reviewed by an in house editor or panel of editors who may or may not be experts in the particular field. Opinions differ on whether master's theses and doctoral dissertations should be considered peer reviewed. They do not undergo the same blind review that papers in scientific journals do, but they probably receive a much higher level of scrutiny than most papers. Furthermore, there is much more at risk if the thesis or dissertation fails review: the student is not awarded the Masters or Ph.D. In this report, they are treated as technical books being reviewed by a panel (i.e., the student's graduate committee).

Non-peer Reviewed Open Literature

Articles from this source are often used to support decisions or recommendations probably because there are many of them available, the sources are widely available, and

the fact that they have been published adds a perception of respectability. However, there are often risks of using this type of data source. The authors and editors may not be specialists in the field they are writing about or are not scientists. Additionally, there is often no attempt at a logical, unbiased, rationally supported presentation. Occasionally, special interest groups that are pushing a specific interest and land ethic (e.g., Audubon Society, Rangelands, Desert Tortoise Council) publish outlets cited.

By definition, non-peer reviewed sources do not follow the established methods of peer review: there is usually no independent, objective evaluation of the data presentation and no guarantee that articles will be rejected if they fail to meet accepted scientific standards. Often missing is information necessary to allow the reader to evaluate the reliability of data collection and analysis. Statements such as "many tortoises were killed by vehicles" or "tortoises depend on cow dung for nutritional needs" are made without details about how the author determined if a vehicle killed a tortoise, how often tortoises actually eat cow pies, or what are the nutritional needs of tortoises.

Most proceedings of meetings (e.g., past issues of the Proceedings of the Desert Tortoise Council Symposium -) as well as abstracts from meetings are incompletely or not peer reviewed, and contents are usually printed verbatim with little or no editing and no possibility of rejection. Proceedings papers and abstracts often contain preliminary analyses of data and conclusions may change following the final complete analysis and rigorous peer review. The same criticisms holds for many official bulletins and newsletters of professional societies (e.g., Bulletin of the Ecological Society of America, Rangelands).

Technical Reports

Technical reports are generally written by agency and contract scientists and biologists and sometimes individuals untrained in the practices of science and biology. Technical reports are probably the most commonly used source of data for basing management decisions. Many agency biologists do not have the time, opportunity, encouragement, need, or training to publish their data. Sometimes reports are generated for the purpose of providing a quick analysis for management decisions that cannot wait for the one to two years often necessary to become published in a peer reviewed outlet. Such reports may not be subjected to review by competent scientists and are rarely rejected. "Draft" reports may never be finalized and become widely used even though they may be incomplete or fatally flawed. Because they do not appear in the open literature, refutations or critiques of the reports are rarely available. Finally, they may be difficult to locate, which prevents independent evaluation of their findings.

Reports by government biologists and biological consultants are variable in quality. Many are well designed, researched, and written and draw adequately on the existing body of scientific knowledge. Others demonstrate a lack of knowledge of tortoise biology and common management practices; fail to properly cite previous studies, particularly when contrary to the conclusions or recommendations being made in the report; make recommendations that are untested or unwarranted; and have not been

peer reviewed. Such reports form the basis of many management decisions that have or are being made and may result in implementation of non-standard mitigation measures and speculative conclusions that were not tested for their efficacy.

Unpublished Data

There are many data sets (e.g., raw data, tables of compiled data, GIS maps, etc.) that are cited and used even though they may not have been checked for errors, analyzed, or adequately documented (e.g., data collection methods may be unknown). Reliance on such data for making decisions is risky particularly when there is no documentation (e.g., metadata) of how the data were collected and limitations of the data are not discussed.

Professional Judgement

When the proper research has not been conducted or completed, or time or expertise is not readily available, managers often rely on the professional judgement of staff biologists or other scientists. Reliance on professional judgement requires managers to use data that are unreliable if only because they cannot necessarily be independently evaluated or examined. The judgement may involve unsupported speculation, data that have been improperly or incompletely analyzed, or may involve faulty recall of the facts. On the other hand, professional judgements may be very sound, reliable, and based on an objective evaluation of the information available. The manager may not be able to separate good from poor judgements because there is generally too little information to evaluate. Judgements solicited from several competent professionals is advisable when possible. Also, the professionals chosen to provide input should provide citations and critical analyses of the data they are using to make the judgement. They should clearly state where the strengths and weaknesses in their judgements lie. Following steps like these can help to ensure the value of professional judgement.

Science Lore

Science lore, best defined as being the collective knowledge of the scientific, resource professional, or layperson community, is often based more on observation, assumption, and speculation than on scientifically-collected and analyzed data. Facts entrenched in science lore are not necessarily incorrect. They are unreliable because the connection between the hard data and the interpretation may be unknown. Common sources of Science Lore include Television programs, hobbyist journals, newsgroups, and casual conversations with professionals and laypersons.

A common example of Science Lore is the statement that “tortoises live to be 100 years old or more.” This may be true, but in fact the oldest tortoises for which any documentation exists were two captive animals; one was at least 67 years old and maybe in its mid seventies and the other was probably at least 74 and maybe older (the former was adult-sized when first captured 52 years earlier, Jennings 1981; and the later was

adult-sized when captured and grew little in the 59 years before it died, Glenn 1986). No one has followed marked animals in the field long enough to know the average or maximum longevity. In the pair of studies usually cited as evidence for long life, six marked tortoises, recorded as adults by Woodbury and Hardy (1948) in the early 1940's, were refound still living in the 1960's (Hardy 1976). They may have been over 100 or perhaps as young as 30 - 50 years when refound. Since they were of unknown (or unreported) age at the time of capture, we do not know their true age. Using scute annuli (age rings), Germano (1992) estimated that most desert tortoises live 25-35 years, but some live more than 40 years. The cohort of tortoises reported on in Turner et al. (1987a) is still being followed; these known-aged animals are now 40-41 years old (Medica pers. comm.).

The onus is on the scientific community to identify statements that fall into this category. Researches should then investigate the underlying assumptions, find or collect supporting or refuting data and publish the results. Then, fact-based science lore can be elevated to known facts, and unsound lore can be modified or dropped from our lexicon of apparent facts.

This report identifies the quality of the data available on the major threats confronting desert tortoise populations in the hope that the scientific-based components of the final decisions can be clearly separated from the value-based components.

Two Final Caveats

The citation of draft reports or completed but unpublished ones is not normal scientific practice. Because this is a critique of all data that may be relevant to decision making for the West Mojave Plan, draft and incomplete reports are cited. This was done because such documents are often relied upon heavily for making management decisions.

Second, this report includes some papers and observations that are highly speculative or made by laymen, sometimes only in casual conversation. These were included here because they are often pervasive parts of the lore of the tortoise or desert communities and deserve some evaluation even if they were not made in scientific literature.

DESERT TORTOISE BIOLOGY

Knowledge of many characteristics of the basic biology of an organism is essential for making informed decisions concerning the management of that organism. Many aspects of tortoise biology are well known. The reader is referred to the following papers for general summaries of what is known: Berry (1978), Hohman and Ohmart (1980), Bury (1982), Bury and Germano (1994), USFWS (1994), Ernst et al. (1994), Grover and DeFalco (1995), and Boarman (2002). No comprehensive critical summary

of tortoise biology exists and is sorely needed. A recent summary of anthropogenic impacts to desert habitat is Lovich and Bainbridge (1999).

SPECIFIC THREATS TO TORTOISE POPULATIONS

Threats occur under two major categories, direct and indirect, although they are not necessarily mutually exclusive. Direct threats are those that affect the survival or reproduction of tortoises (e.g., road mortality, illegal collecting, disease, predation). Indirect threats affect tortoise populations through their effect on other factors, primarily habitat (e.g., drought, habitat alterations from livestock grazing, recreational activities, global warming, etc.). Direct threats are usually more easily measured and therefore more easily evaluated than indirect effects.

To determine the impact of a specific threat on tortoise populations, it is insufficient to measure the threat solely (e.g., number of cars or density of mines in an area.) One must determine the effect the threat has on some aspect of tortoise reproduction or survival. Many parameters of tortoise biology can be measured when attempting to determine impacts of threats. Sometimes, the easiest and most intuitive response is mortality. It is difficult to deny that a motorized vehicle killed a fresh, smashed tortoise found on a paved highway. When tortoises die they leave behind a shell that can last for four years or more (Woodman and Berry 1984). Often that shell bears evidence of the cause of death (e.g., tooth marks, conchoidal fractures, fracture from blunt trauma, etc.). However, interpreting these signs is subjective and little scientific work that can aid interpretation has been conducted (but see, Berry 1985, 1986a) and most assumptions made in interpreting the evidence are not reported. Reproduction is more problematical, but at least clutch size and frequency can be measured with x-rays or sonograms or by locating nests and monitoring hatching success (Gibbons and Greene 1979; Turner et al. 1986, 1987b; Rostal et al. 1994). Survival of the young is an essential component to understanding the effect of threats on tortoise populations, but is very difficult to measure (e.g., Turner et al 1987b, Morafka 1994). Growth (Medica et al. 1975, Germano 1988, Turner et al. 1981, Patterson and Brattstrom 1972), behavior (Ruby and Niblick 1994, Ruby et al. 1994), and physiology (Nagy and Medica 1986, O'Connor et al. 1994a, Christopher et al. 1994) vary with environmental conditions and may be useful parameters for measuring the effect of impacts, but their efficacy at doing so has yet to be demonstrated. Modeling population demography (i.e., age-specific survival and reproduction), when using accurate measures from the population, can be an excellent way of evaluating the effects of threats and management actions on population growth (Congdon et al. 1993, Heppell 1998).

Relative Importance of Threats

The rating of relative importance of different threat factors is a challenging undertaking for several reasons. First, it is very hard to determine the cause of death of animals and it is even harder to determine how much decline is really attributable to the various indirect causes of mortality (e.g., habitat alteration). Educated guesses can be made about causes of death (Berry 1984, 1985, 1986a, 1990 as amended), but most of the methods used have not been described or subjected to experimentation, independent evaluation, or peer review. Second, not enough is known about several potential threats to evaluate their absolute or relative impact. For example, it has been suggested that toxic chemicals may be responsible for a disease of the shell affecting some populations. However, it is not known if chemicals are the causative agent, which chemicals are the problem, or the source of chemicals. Also, little is known about neither the epidemiology of the disease nor how much mortality is actually caused by it. Third, which mortality factors are functioning is very site specific. Highway mortality is an important factor for populations along highways; it may drain populations two miles or more away (von Seckendorff Hoff and Marlow 1997). On the other hand, for populations away from highways, this may be a very low or non-existent threat. Regional differences occur, also. Urbanization and development are major factors in portions of the west Mojave, but are probably relatively unimportant in much of the east Mojave (outside of the Las Vegas and St. George areas). Finally, as discussed above, factors that caused the declines (e.g., disease) may not be the same factors that are preventing recovery (e.g., genetic or demographic consequences of small populations, fragmentation, and raven predation). For all of these reasons the controversial and subjective task of ranking impacts was avoided here.

Specific threats are easy to discuss and identify, but more pervasive problems often exist when multiple threats interact to make for larger environmental problems. The three largest of these broader impacts affecting tortoise populations are habitat loss, degradation, and fragmentation; urbanization and development; and access by humans to tortoise habitat. I will first focus on specific threats then discuss three broader, more cumulative types of threats. There are virtually no published studies looking specifically at the effect of these general factors on tortoise populations.

Agriculture

Probably the greatest affect agriculture has on tortoise populations is through loss of habitat: when tortoise habitat is converted for agricultural use it becomes mostly unusable by tortoises for foraging or burrowing. Indirect impacts could include facilitation of increases in raven population, drawdown of water table, production of fugitive dust, possible introduction of toxic chemicals, and introduction of invasive plants along corridors and when the fields go fallow.

I found no substantiated references in the literature indicating that desert tortoises use agricultural fields, although alfalfa, with its high nitrogen content, could be a healthy source of food for tortoises (Bailey, 1928, provides an anecdotal account from untrained

observers of "tortoises eagerly eating alfalfa."). Berry and Nicholson (1984a) cited one anecdotal report from an individual with unreported credentials as evidence that "tortoises are known to enter...alfalfa fields" (p. 3-21). Disking, plowing, mowing, and baling would destroy burrows and kill tortoises (as they do the marginated tortoise, *T. marginata*, in the Mediterranean region; Stubbs 1989). There are no reports of desert tortoise burrows in agricultural fields.

The Common Raven, a predator on juvenile desert tortoises, makes considerable use of agricultural fields in the west Mojave Desert (Knight et al. 1993, 1999, Knowles et al. 1989). Agricultural fields probably are important sources of food (i.e., insects, rodents, and seeds) and water for ravens during times of the year when those resources are generally in low abundance elsewhere, thus resulting in more ravens surviving the summers and winters (Boarman 1993, unpubl. data). See "Predation," below, for more discussion.

Pumping of ground water for irrigation can result in a major change in vegetation or habitat type. Koehler (1977) reported that the drawing of water for irrigation from Koehn Dry Lake, near Cantil in the Western Mojave, lowered the water table by 240 ft between 1958 and 1976. Berry and Nicholson (1984a) state that this lowering of the water table has approached the Desert Tortoise Natural Area (DTNA) and imply that it may affect tortoise habitat, although no data were presented to support the implication. Closer inspection of the maps provided in Koehler (1977) show that the water-level decline is lower (30 - 180 ft) near tortoise habitat south and southeast of Koehn Dry Lake. There are no data to indicate what effect this lowering of the water table has on mesquite, other vegetation, or tortoise habitat in the area, but there are data on the effect water table lowering has on mesquite in other arid regions (Nilsen et al. 1984).

Agricultural fields cause dust storms, called fugitive dust (Wilshire 1980). Fugitive dust coats plants, which in turn may reduce photosynthesis and water-use efficiency (Sharifi et al. 1997). The end result is lower productivity of forage plants. Their study did not specifically look at agricultural dust, but the results are probably generalizable.

The finding of "hundreds of...tortoise shells" (with no indication of how long the tortoises had been dead) was reported anecdotally and second hand by Berry and Nicholson (1984a) and was correlated with application of an unspecified pesticide to kill jackrabbits in a nearby (distance unspecified) alfalfa field. Aside from this single unsupported speculation, there are no references to possible toxic effects on tortoises of pesticides, herbicides, and other chemicals used in agriculture. Pesticide use, particularly aerial applications apparently are now very limited in the desert.

Collecting by Humans

Humans collect turtles and tortoises for several reasons, and these activities are responsible for population declines in several of the threatened and endangered species throughout the world (Stubbs 1991). Collecting desert tortoises for pets was probably a

major activity in the recent past (Berry and Nicholson 1984a), although most evidence is anecdotal in nature. Since 1961, it has been illegal under State law to collect tortoises in California and since 1989 collecting has been a Federal offense (USFWS 1994). The Desert Tortoise Recovery Plan (USFWS 1994) cites several documented instances of illegal collecting more recent than those in Berry and Nicholson (1984a), including the unauthorized removal of marked study animals from known study areas. It must be cautioned that some of the examples cited in the Recovery Plan are circumstantial or speculative. For instance, Stewart (1993) reported one strongly supported (tortoise found in a car in Idaho) and one speculative (transmitter and human footprints found on ground and tortoise was missing) example of poaching. Berry (1990 as amended) gives purely speculative and circumstantial evidence for poaching (namely, marked drop in estimated density on a study plot over a 5-year period with relatively few carcasses being found coupled with observations of possibly human-excavated burrows nearby and other evidence for poaching several miles away). The available evidence suggests that collecting for pets is still occurring, but perhaps at a level lower than previously, although this statement is speculative at present. Evaluating the extent of the problem is very difficult because of the cryptic nature of the activity.

A newly documented problem is the collection of wild tortoises by recent immigrants for cultural observances (USFWS 1994, Berry et al. 1996). Berry et al. (1996) reported that 7.7% of tortoise burrows found showed evidence of being excavated by humans and that the number of such burrows is greater near versus far from dirt roads. Their study suggests that poaching tends to occur near roads, even lightly maintained ones, thus the presence of roads may help to facilitate poaching. However, there was no statistically significant difference in distance from roads for disturbed versus undisturbed burrows and the method for determining if a burrow was excavated was circumstantial and subjective.

The bottom line is that there is little evidence to suggest that illegal collecting is currently a widespread problem, but there is also little evidence to the contrary.

Construction Activities

Construction activities here refer specifically to the generally short-term effects of actual construction (clearing land, movement of heavy equipment, presence of construction crews, etc.). The lasting effects of the constructed facility, once in place, are discussed in “Urbanization and Development,” “Energy and Mineral Development,” “Utility Corridors,” and “Habitat Loss, Degradation, and Fragmentation” sections below. In many ways, most construction projects have similar impacts on tortoises and their habitat, regardless of what is being constructed. Those impacts may include: loss of habitat by the project footprint; incidental destruction of habitat in a buffer area around the footprint; damage to soil and cryptogams on the periphery; incidental death of unseen tortoises along roads, beneath crushed vegetation, or in undetected burrows; destruction of burrows; handling of tortoises; entrapment of tortoises in pits or trenches dug for transmission or fiber optic lines, water, and gas pipelines and other utilities; attraction of ravens and facilitation of their survival by augmenting food or water; and fugitive dust

(Olson et al. 1992, EG&G 1993, Olson 1996). There are little data on the extent of these potential impacts. But, Olson (1996) reported that a construction of a natural gas pipeline had the greatest impact on tortoises and habitat, construction of a transmission line had intermediate impacts, and a fiber optic line was the most benign. The differences are largely related to the scale of the project, ability of crews to avoid disturbing burrows, and timing of construction to avoid peak activity periods of tortoises (e.g., spring). In an analysis of 171 Biological Opinions issued by the USFWS in California and Nevada, Circle Mountain Biological Consultants (1996, see also LaRue and Dougherty 1999) found that the majority of tortoise mortality occurred along linear construction projects (e.g., pipeline, fiber optic, and transmission lines) with the extensive Mojave-Kern Pipeline causing the greater number of deaths (38). Tortoise mortality also occurred on mining, landfill, and military projects. The total number of deaths reported on the projects was well below the level authorized by the USFWS (59/1096 = 5.4%). This study was strictly an evaluation of known tortoise mortalities occurring during projects authorized by the USFWS under Section 7 of the Endangered Species Act. It therefore likely underestimates actual tortoise mortality (e.g., tortoises buried during construction or otherwise not found, accidentally killed but not reported, etc.) that occurred.

Disease

Disease in general is a normal and natural phenomenon within wild animal populations. Diseases can weaken individuals, reduce reproductive output, and cause mortality. Epidemic outbreaks of some diseases can become catastrophic, particularly in small or declining populations (Dobson and Meagher 1996, Biggins et al. 1997, Daszek et al. 2000). Sometimes disease can be controlled by wildlife managers by attacking the pathogen; isolating diseased from non-diseased individuals, populations, or species; immunizing healthy individuals; or facilitating habitat conditions that increase individual's immune systems. Other times there may simply be nothing a manager can do. It is important to understand disease etiology and epidemiology before effective management actions, if any, can be determined.

Two diseases have been identified as possibly affecting the stability of some desert tortoise populations: Upper Respiratory Tract Disease (URTD; Jacobson et al. 1991) and cutaneous dyskeratosis affecting the shell (Jacobson et al. 1994). A third disease, a herpesvirus, was recently identified and may have population-level consequences, but very little is known about it (Berry et al. 2002, Origgi et al. 2002). URTD has been found in several populations that have experienced high mortality rates, including some in the west Mojave (Jacobson et al. 1996, Berry 1997). Much is published in peer reviewed journals about the etiology of this disease, which has been found in captive turtles of this and several other species (Jacobson et al. 1991) and in wild populations of the gopher tortoise (*Gopherus polyphemus*; Jacobson 1994). Brown et al. (1994a) showed definitively that URTD can be caused by a bacterium, *Mycoplasma agassizii*. It is likely transmitted by contact with a diseased individual or through aerosols infected with *M. agassizii*. The organism attacks the upper respiratory tract causing lesions in the nasal cavity, excessive nasal discharge, swollen eyelids, sunken

eyes, and in its advanced stage, lethargy and probably death (Jacobson et al. 1991, Schumacher et al. 1997, Homer et al. 1998, Berry and Christopher 2001). It must be noted, however, that some of these clinical signs may also be characteristic of other health condition such as dehydration, allergy, or infection with herpesvirus or the bacteria *Chlamydia* or *Pasteurella* (e.g., Pettan-Brewer et al. 1996, Schumacher et al. 1997).

Malnutrition is known to result in immunosuppression in humans and turtles (Borysenko and Lewis 1979) and is associated with many disease breakouts. It is possible that nutritional deficiency in tortoises caused by human-mediated habitat change and degradation may be partly responsible for the apparent spread of URTD and its perceived impact on tortoise populations (Jacobson et al. 1991, Brown et al. 1994a). Short-term droughts may temporarily reduce immune reactions and increase susceptibility to URTD (Jacobson et al. 1991), although this is speculative. Whereas animals may become debilitated by chronic immune stimulation, no biochemical indicators of stress have been identified in diseased compared to non-diseased turtles (Borysenko 1975, Grumbles 1993, Christopher et al 1993, 1997).

Although evidence indicates a correlation between high rates of mortality and incidence of URTD within populations (Berry 1997), there is little direct evidence that URTD is the cause of the high rates of loss. In two preliminary analyses (Avery and Berry 1993, Weinstein 1993), animals exhibiting clinical signs of (both studies) or testing positively for (latter study) URTD were no more likely to die over a one year period in the west Mojave than were those not exhibiting signs or testing positive. This may be because factors other than disease caused much of the mortality or many animals not showing clinical signs of disease in the field were still infected. A serological test for presence of antibodies against *M. agassizii* has been developed and is now being used to document presence and spread of the disease (Schumacher et al. 1993). But, the test, an enzyme-linked immunosorbent assay (ELISA) does not indicate present infection, only a probability of past exposure. A polymerase chain reaction (PCR) test, which has been developed for *M. agassizii* is more effective for determining active infection (Brown et al. 1995). Lance et al. (1996) reported that infected tortoises had significantly lower testosterone and estradiol levels and that diseased females tended to lay eggs less often. Finally, there is some evidence that animals at the DTNA, where URTD breakout has been particularly intense, may recover from infection (Brown et al. 1994a, b). Interestingly, Berry (2002) reported that none of 119 wild tortoises tested at 9 locations throughout the California deserts in 2000 and 2001 tested positive for URTD. No discussion of this result was provided. A thorough epidemiological study is badly needed to identify the factors involved in the incidence, spread, and virility of the disease in wild populations (D. Brown pers. comm.).

A shell disease, cutaneous dyskeratosis (CD), has been identified in desert tortoise populations (Jacobson et al. 1994). CD consists of lesions along scute sutures of the plastron and to a lesser extent on the carapace. Over time, the lesions spread out onto the scutes. This disease may be caused by the toxic effect of chemicals in the environment, but evidence is lacking to test this hypothesis. Naturally-occurring or human-introduced toxins such as selenium, chlorinated hydrocarbons, organophosphates, nitrogenous compounds, and alkaloids have all been implicated (Homer et al. 1998), but there are no

data showing a direct link. The disease may also be caused by a nutritional deficiency (Jacobson et al. 1994). It is not known whether or not CD is caused by an infectious pathogen or if secondary pathogens act to enhance the lesions (Homer et al. 1998, Homer pers. comm.). It is unclear if the disease is actually lethal or responsible for declines in infected tortoise populations (Homer et al. 1998). Only one documented case of CD from the West Mojave Desert was found in the literature (Homer et al. 1998).

If the shell diseases are toxicoses, toxic responses to environmental toxins (e.g., heavy metals, chlorinated hydrocarbons, organophosphates, and selenium), then there may be a direct link between these diseases and human activities unless the toxin is a natural component of the physical environment. Chaffee et al. (1999) found no significant correlation between elevated levels of metals in organs of ill tortoises and in the soil where the tortoises came from. If there is a link to human activities, then we can consider solutions that would reduce levels of input of the toxic chemical. However, this link is currently highly speculative.

There is some recent, albeit weak, preliminary evidence linking heavy metals to disease in tortoises. In necropsies of 31 mostly ill tortoises, Homer et al. (1994, 1996) found elevated levels of potentially toxic metals and minerals in the liver or kidney of one or more of the animals. Since most of the animals were ill to begin with, an association was made between the presence of the toxicants and presence of the disease. However, that study is strictly correlative, and fails to demonstrate a cause and effect relationship. Berry (1997) claims that "the salvaged tortoises with cutaneous dyskeratosis had elevated concentrations of toxicants in the liver, kidney, or plasma...and/or nutritional deficiencies." However, closer examination of the data presented in Homer et al. (1994, 1996) and cited in Berry (1997) reveals a remarkably low association with only 1 out of 12 tortoises with CD having at least one toxicant concentration greater than two standard deviations above the mean. Four other animals also had unusually high levels of at least one toxicant, but did not suffer from CD. Furthermore, Homer et al. (1994, 1996) identified abnormally high levels as being those concentrations that are greater than two standard deviations from the average concentration found in the 31 tortoises. In a normally distributed set of 20 randomly selected values, 1 will, by definition, fall outside of 2 standard deviations from the mean, because 2 standard deviations is defined as including only 95% of the samples. So if 100 comparisons are made, then 5 levels will be considered abnormally high or low just by chance. In the study, 689 values would be reported, thus 34 (or 95%) would be expected to be greater than twice the standard deviation from the mean just by chance. In fact, 32 were identified as falling outside this range of two standard deviations. These data are in need of a thorough statistical analysis. Homer (pers. comm.) has found significantly higher levels of iron (in liver) and cadmium (in kidneys and liver) of tortoises with URTD compared to those in a control group. It is not known if the levels identified by Homer et al. (1994, 1996, pers. comm.) as being abnormally high are biologically significant. Homer (pers. comm.) has found significantly reduced levels of calcium in the livers of tortoises with CD, which suggests a nutritional deficiency may be involved in the disease.

Several other diseases and infections have been identified in desert tortoises (Homer et al. 1998). These include a poorly known shell necrosis, which can result in sloughing of entire scutes; bacterial and fungal infections; and urolithiasis, a solid ball-like deposition of urate crystals in the bladder (i.e., bladder stones; Homer et al. 1998). There is no evidence to suggest that any of these diseases are at this time widespread, threatening population stability, or hindering population recovery.

Beyond taking precautions to avoid spreading the disease when handling many animals (Rosskopf 1991, Berry and Christopher 2001), educate the public against releasing potentially-diseased captive animals (Berry 1997), include only healthy individuals in translocation efforts (Brown 1994a), the practical management implications of the disease data are unclear. Tully (1998) states, without explanation, that URTD infections are not likely to be controlled by immunizations. Improving habitat conditions may help reduce stress-induced immunosuppression (Brown 1994a), but the link between stress from poor habitat quality and susceptibility to URTD is only speculative.

Drought

A drought is an extended period of abnormally low precipitation. Unlike kangaroo rats and some other desert vertebrates, tortoises acquire much of their water, and maintain and overall positive energy balance, from standing sources (Peterson 1996). O'Connor et al. (1994a) showed that water deprivation in a group of semi-wild tortoises caused higher levels of physiological stress (using several blood assay profiles) compared to a group of semi-wild tortoises with water supplements and a group of free-ranging tortoises. Peterson (1994a) recorded abnormally high levels of mortality in two tortoise populations (west and east Mojave) during a three-year period of an extended drought. The deaths in one population (Ivanpah Valley) were attributed to drought-induced starvation and dehydration and occurred in the third year of study. Ken Nagy (pers. comm.) has stated that tortoises can probably survive 1-2 years without drinking water but will start dying of dehydration after that. The primary source of mortality, which occurred throughout the three-year study, at the DTNA was coyote predation. The coyotes may have switched to the less desirable tortoises following hypothesized drought-induced reduction in coyotes' normal prey (black-tailed jackrabbits; see also Jarchow 1989). Alternatively, tortoises may have been in a weakened condition due to URTD, but Peterson (1994a) found little evidence of disease in his study animals. Low rainfall can also reduce reproductive output with tortoises producing fewer eggs or suspending egg-laying altogether in low-rainfall years (Turner et al. 1984, Lovich et al. 1999). Avery et al. (2002) documented higher survival and reproduction among females at higher elevation site that received more rain than a lower one in Ivanpah valley. Tortoises may survive drought periods by eating less nutritious cacti and shrubs (Turner et al. 1984, Avery 1998).

Much of the desert experienced short-term drought conditions in the late 1980s (Corn 1994a, Hereford 2002), a period when rapid declines and high mortality were reported in some tortoise populations (Berry 1990 as amended, Corn 1994a, Peterson

1994a). However, Corn (1994a) reported that, between 1977-1989 there was no correlation between winter precipitation and relative abundance of large (≤ 180 mm median carapace length [MCL]) or small (<180 mm MCL) tortoises, but there was a significant correlation between summer precipitation and relative abundance of small tortoises. Some reports exist of dehydrated and emaciated tortoises being found (Berry 1990 as amended, Peterson 1994a, Homer et al. 1996).

Drought is a normal phenomenon in the Mojave Desert (Peterson 1994a, Hereford 2002). Desert tortoises have lived in the Mojave Desert for over 10,000 years and probably have evolved under similar boom-bust conditions (Peterson 1994 a,b, 1996; Henen 1997; Nagy and Medica 1986). It is possible that drought can cause episodic mortalities punctuated by periods of low mortality during years with more abundant rainfall. It is reasonable to speculate that drought-induced stress in concert with other threats (e.g., disease, predation) resulted in significant mortality (Peterson 1994a), but there are little data to test this hypothesis. An epidemiological study is needed to evaluate the effect drought has on tortoise populations.

Energy and Mineral Developments

Energy and mineral development includes: presence of utility lines, transmission lines, and gas pipelines; development of land for oil and gas leases; geothermal and solar energy generation; and digging exploratory pits for and extraction of minerals. Impacts from energy and mining developments can include habitat destruction and direct mortality from off-road travel to explore and access sites; habitat loss to road and development construction, leachate ponds, tailings, rubbish, etc.; introduction of toxins; fugitive dust and soil erosion; and urban-type developments to support large mining operations. The extent of area directly affected by energy and mining is difficult to assess because the data are not readily available. According to Luke et al. (1991), as of 1984, 41% of high density tortoise habitat rangewide was leased or partially leased for oil or gas and 2% was directly impacted by mining operations or leased for geothermal development. However, no indication was given for how these figures were obtained. Most mining operations are point sources of disturbance with potentially little effect beyond the immediate site of development. The greatest effect may come from the cumulative impact of many relatively small mining-related disturbances combined with facilitation of rural or urban development (e.g., Randsburg) to support the mining operations in a given area. However, large-scale operations that depend on frequent haul trucks to transport excavated minerals may also present vehicle-related impacts such as increased road kills and air pollution.

There are few data on the effects of energy and mineral development on tortoise populations. Mortalities have occurred in association with mining activities (LaRue and Dougherty 1999). Hard rock mining, particularly pit mining and operations in dry lakebeds, can be a major source of fugitive dust (Wilshire 1980). Loss of habitat and soil and vegetation disturbance can be substantial and major, depending on the size of the area. Although illegal, cross-country travel to drill and access test pits, stake claims, and

evaluate mineral potentials still occur (pers. obs.) and needs to be properly documented and evaluated.

Energy development has similar impacts, particularly direct and indirect loss of habitat, fragmentation of habitat and population, and effects of access roads, which are likely to be relatively light once construction has ended (Brum et al. 1983). Construction of transmission lines requires grading of new roads for construction of towers and maintenance of the lines, and clearing or terracing of habitat for tower placement. Not only is habitat lost (0.16 to 0.24 mi^2 per mile of transmission line; Robinette 1973, cited in Luke et al. 1991), but the new road may help to fragment the population and provide access to areas for other human-related impacts (see "Utility Corridors" section, below). The access roads are also an important source of windblown dust and attendant erosion (Wilshire 1980). The presence of new utility lines, necessary to distribute the electricity, may help facilitate nesting by ravens in specific areas they did not nest in before, if those areas did not have adequate nesting substrates before the new towers were erected (Boarman 1993, Knight and Kawashima 1993). For more discussion, see "Utility Corridors" section, below.

Aside from loss of habitat and other consequences associated with access roads and transmission lines, there is little evidence that energy generation negatively impacts tortoise populations. If designed and managed properly, wind generation may be compatible with tortoise populations (Lovich and Daniels 2000). Tortoises made extensive use of wind turbine pads for burrow cover and, by restricting access, the wind park served as a de facto reserve that minimized several other harmful human activities such as ORV travel, vandalism, and illegal collections. The only study found on solar energy impacts showed that here were only very small changes in air temperature, wind speed, and evaporation rates downwind from a solar power plant in the western Mojave Desert (Rundel and Gibson 1996). They did not study impacts to tortoise populations.

Fire

Fire, once considered a rare event in the Mojave Desert (Humphrey 1974), now occurs with ever-increasing frequency causing a greater threat to tortoises and their habitat (USFWS 1994, Brooks 1998). Fire frequency has increased with the proliferation of introduced plants, particularly the grasses, red brome (*Bromus rubens)* and split grass (*Schismus barbatus* and *S. arabicus*), which provide fuel for fires (Brown and Minnich 1986, Brooks 1999b). These plants help to spread fire because they are often common, tend to grow in large relatively dense mats, and fill the intershrub spaces, which are largely devoid of native vegetation (Brown and Minnich 1986, Rundel and Gibson 1996, Brooks 1999b). Fires cause direct mortality when tortoises are burned or inhale lethal amounts of smoke, which can happen both in and out of burrows. Documented cases of tortoises being burned by fires are uncommon, but do occur (e.g., Woodbury and Hardy 1948 - circumstantial, secondhand account of 14; Homer et al. 1998, reports 1; Esque et al. in press, reports 5, which is 4-13% of the study population; Lovich, pers. comm., found 1). Fires are probably most hazardous to tortoises when they occur during the

active season for tortoises (e.g., spring in the West Mojave). Previously rare, frequency of spring fires are now on the increase (Brooks 1998).

There are several possible indirect impacts of fires. Fires remove dry and some living forage plants. They facilitate proliferation of non-native grasses (Brown and Minnich 1986, Brooks and Berry 1999). The effect this has on tortoises is as yet unresolved. There is some evidence that tortoises may selectively avoid exotic grasses (Jennings 1993, Avery 1998), but Esque (1994) showed that tortoises may choose to eat a majority of non-native plants, particularly in drier years. The physiological consequences of foraging on non-native grasses is also not entirely known, but, in a manipulative study with semi-captive tortoises, Nagy et al. (1998) showed that grasses, native and non-native) provided tortoises with much less nitrogen than did forbs and tortoises tended to loose water when eating them. Avery (1998) also showed that tortoises eating only split grass lost weight, assimilated less protein, and were in a negative nitrogen balance, whereas those that were fed a native forb (*Camissonia boothii*) maintained their weight and experienced a positive nitrogen balance. Those tortoises that fed on both plat types maintained their weight but experienced a net loss of protein. By removing vegetation, fires may alter the thermal environment by increasing temperature extremes experienced by seeds, plants, and burrowing tortoises (Esque and Schwalbe 2002). Soil erosion is enhanced by the loss of stabilizing vegetation, roots, and cryptogamic crusts (Ahlgren and Ahlgren 1966). Fires fragment tortoise habitat by creating patches of unusable habitat, at least over the short term. There is some evidence of an increase in availability of nitrogen and other nutrients for a short while following fires (Loftin 1987), but none demonstrating that plant growth is stimulated by this nutrient flush. Overall effects on vegetation are variable, and may depend in large part on the intensity of the fire, characteristics of the plants, and post-fire precipitation (Esque and Schwalbe 2002). Brown and Minnich (1986) found an increase in annual vegetation following a fire during an unusually rainy period. On the other hand, O'Leary and Minnich (1981) found no difference during a drier year.

The structural characteristics of vegetation in years following fires has been studied. Following burns in creosote scrub community in the Colorado Desert, Brown and Minnich (1986) found 23% higher cover by annual forbs, most of which were exotics. Cover by some native forbs, including ones preferred by tortoises, were also higher in burned vs. unburned areas. They also found that perennial plants, particularly creosote bush, were damaged and exhibited low levels of stump sprouting and germination following more intense fires. A change in dominant shrub type resulted, but the study only reported on 3-5 years post-burn; no data were presented on possible long-term successional changes or recovery. Dense cover by annuals, particularly introduced grasses, provides higher fuel loads, which results in more fires that are also hotter (Brown and Minnich 1986, USFWS 1994, Brooks 1999b).

The amount of tortoise habitat burned by recent fires is relatively low, but increasing. For example, between 1980 and 1990, 243,317 acres burned in the Mojave Desert in California, which is an average of 38 mi^2 per year (USFWS 1994). The increase in number of fires per year over the ten-year period was statistically significant. Tracy (1995) reports that fires occur much more frequently near roads and towns, but no data

were presented in this abstract. Duck et al. (1995) reported that tortoises may be killed by fire-fighting activities, including by large fire trucks driving off of roads in tortoise habitat, and recommended training and fire management techniques to reduce the problem.

Through its destructive effect on woody shrubs, fire has been used to manage (i.e., improve for cattle foraging) desert grasslands. In desert grassland of southern Arizona, fire removed 9-90% of targeted shrubs (i.e., mesquite, *Prosopsis juliflora*; burro-weed, *Aplopappus tenuisectus*; prickly pear cactus, *Opuntia occidentalis*; and cholla, *Opuntia* sp.; Reynolds and Bohning 1956). This work was not conducted in tortoise habitat and the efficacy of using fire in similar ways has not been tested in the Mojave Desert nor has its effectiveness at improving habitat for tortoises been tested.

Garbage and Litter

Garbage illegally dumped in the desert is unsightly, may cause local habitat alteration, and may affect individual tortoises. Indeed, in a popular article, Burge (1989) cited an instant of a tortoise losing its leg after getting it caught in the string of a disposed balloon. She also reports finding foil and glass chips in tortoise scat. No details were provided. There are no data to suggest that litter is a widespread or major problem for tortoise populations. The relationship between organic litter and raven predation on tortoises is covered under "Predation," below.

Illegal dumping of hazardous wastes is an increasing problem in the California deserts (John Key, pers. comm.) Toxins are known to cause a myriad of problems for wildlife (Jacobson et al. 1994), and presumably elevated levels (see "Disease" section, above) of certain metals (e.g., cadmium, copper, molybdenum, mercury, lead) have been found in the tissues of desert tortoises (Homer et al. 1994, 1996, 1998). The distribution and limited size of illegal dumps and hazardous spills suggests that this is a minor problem for tortoise populations as a whole, but they may be of concern on a localized basis. Metals and other pollutants may enter the environment from other sources including mining and air pollution, but their effects on tortoise populations remain speculative.

Handling and Deliberate Manipulation of Tortoises

Handling and deliberate manipulation of tortoises includes curious members of the public picking them up and sometimes removing them from the wild, biologists relocating and translocating them to new sites, pet owners releasing captive tortoises into the wild, and researchers manipulating tortoises for scientific experimentation. The effects can be manifold, depend on the type of handling, and remain largely unstudied.

Members of the public will sometimes pick up tortoises when they find them on roads or alongside trails. They do so out of curiosity or to remove the animal from harm's way (Ginn 1990; picking up a tortoise to cause harm is covered in the

"Vandalism" section, below). Any such handling or even disturbance of a tortoise is illegal under the Endangered Species Act, although it is unlikely that USFWS would prosecute a person who moves a tortoise out of harm's way (pers. obs.).

There are several possible effects of this type of well-meaning handling, but most of them fit into the realm of speculation or science lore. First, when tortoises are handled they sometimes void the contents of their bladder, which may represent loss of important fluids and it is thought this loss could be fatal (Averill-Murray 1999). Averill-Murray (1999) provided some evidence that handling-induced voiding may jeopardize survivability, although usually relatively small amounts of fluid are discharged. Smaller animals were more likely to void, but, if the animal was recaptured at a later date, its growth was not inhibited as a result of voiding previously. The statistical significance of his results may be compromised by his decision not to adjust the level of significance to account for making multiple tests (a problem similar to that noted about Homer 1994, 1996, in the "Disease" section above). Nonetheless, the results suggest there may indeed be a trend towards voiding affecting tortoise survival, particularly in drought years, and this should be followed up with more experimentation.

Other problems with handling tortoises can occur. Diseases might be transferred between tortoises if people handle more than one tortoise without sterilizing their hands or using different clean or sterilized gloves for each handling (Rosskopf 1991, Berry and Christopher 2001). It is claimed that turning over a tortoise to look at its underside will harm its internal organs, break eggs, or cause shock (Rosskopf 1991), but there is no evidence to support this contention. It may be detrimental to a handled tortoise if it is released outside of its home range, far from known burrows, or away from shade (e.g., Stewart 1993). This could be particularly hazardous during hot, dry weather or late in the afternoon, but again no data exist to support this likely speculation. Finally, the disruption of behavior by handling or just approaching the tortoise could be harmful if the disruption causes the animal to withdraw into its shell long enough to prevent it from being able to eat, drink, or retreat to a safe cover site (e.g., burrow, pallet, or shrub) for the night, thus leaving it exposed to predators or harsh environmental conditions. The probability of this disruption being hazardous to the tortoise is likely low, unless disruptions occur extremely frequently. Tortoises can go many months without eating or drinking (Peterson 1996), so a few minutes of disruption is not likely to alter their nitrogen, energy, or water balance. All of these claims need further study to substantiate their validity.

Relocation of animals to a new area is frequently recommended, and is occasionally implemented to save tortoises from construction and other ground disturbing activities. Possible problems with translocation efforts include increased risk of mortality, spread of disease, and reduced reproductive success. There have been a few studies of the effectiveness of relocation efforts, and most of the relocations generally have been marginal to unsuccessful. A study summarized in Berry (1986b) found that 22% (13/43) of the animals translated 16 to 88 km from their capture sites stayed at their relocation sites for more than several days, but only five remained for 15 months to 6 years. Few mortalities were observed, but many disappearances from unknown causes occurred; these animals may have died or wandered away. In another relocation effort,

91% (10/11) stayed within the relocation area, which was only about 450 m from where they were moved, for at least 3 months and at least 36% (4/11) were present after 16 months (Stewart and Baxter 1987). In a third effort, 56% (9/16) of relocated tortoises stayed in the area (5.6 km from their original home ranges) for at least 1.5 years (Stewart 1993). At least 25% (4/16) died within about 2.5 years. A fourth relocation effort was conducted in Nevada. Several tortoises were moved to an area immediately adjacent to a development site (Corn, 1994b, 1997). These 13 animals were moved to areas 2 km away, which was still within or very close to their pre-translocation home ranges. There was no difference in survival, but displaced animals had larger home ranges than did the residents. A preliminary analysis of a fifth study showed that mortality was significantly greater among guests (tortoises moved to a pen immediately adjacent to their capture sites) than hosts (resident tortoises; Weinstein 1993). All of these relocation studies covered short time periods and only measured movements and survival. None of them looked at reproductive success or long-term survival, two of the most important measures of success.

An ongoing project translocating tortoises many miles from their capture site apparently is showing success, but no reports or publications (other than abstracts) are available. Apparently, survivorship and reproduction are equivalent between relocated tortoises and resident tortoises (Nussear et al. 2000). Relocated tortoises did move more during their first year in the new site, but after that their movements were not significantly different than those of resident tortoises. Tortoises released in Utah also moved more than did resident tortoises there (Wilson et al. 2000). Both of these studies need further analyses and complete presentations before their results can be adequately evaluated. The success of desert tortoise relocations probably depends on distance of relocations, habitat quality, density of host population, rainfall, and health condition of the relocated and host animals.

Probably tens of thousands of desert tortoises are held in captivity throughout southern California, Nevada, and elsewhere, some were taken from the wild, others were reared in captivity. There are several documented cases of captive tortoises being released into the wild (Howland 1989, Ginn 1990), an activity that is now illegal. Release of captives may be detrimental to both captives and resident tortoises. Released captive tortoises may die (Berry et al. 1990) because they do not know how to fend for themselves in the wild; will not initially know where to find cover sites, good forage, sources of water, or essential minerals; and may not have genetic adaptations necessary to survive in the particular area. However, 25 formerly-captive tortoise were released in Nevada (Field et al. 2000). The animals were equipped with radio transmitters and followed for 14 months. The unpublished results indicate that movements and weights did not differ between released and resident tortoises. No adults died (released or resident) and 2 (out of 8) released juveniles died compared to neither of the two residents studied.

Of greater concern for the stability or recovery of tortoise populations is the possible impact of the released captives on resident (host) tortoises. The greatest likely effect is the introduction of disease to the wild population. URTD, the disease presently believed by many to have detrimental effects on several wild tortoise populations (see

"Disease" section, above), is commonly found in captive tortoises (Berry et al. 2002, Johnson 2002). Releasing into the wild tortoises that are infected with URTD may introduce the disease-causing bacterium, *Mycoplasma agassizii*, to previously uninfected individuals and populations. There is some evidence that the incidence of disease is greater in areas of known releases of captives and around urban areas where release or escape of captives is likely to be relatively frequent (Jacobson 1993, Berry pers. comm.). However, data on the rangewide incidence of disease have not been peer reviewed and are not generally available, so it is not possible to evaluate this hypothesis.

Desert tortoises have been manipulated in many ways as part of scientific studies. They have been probed, stuck with needles, affixed with transmitters, implanted with transponders, weighed, measured, pulled and sometimes dug out of burrows, tom name a few. All manipulative research involving desert tortoises must be permitted by USFWS to ensure that risk of harm to the tortoises is minimized. USFWS closely evaluates methods and qualifications of researchers before issuing a permit. There is very little written on the effects of research manipulation. In a preliminary analysis from one study, Weinstein (1993) reported that significantly fewer animals whose blood was sampled on a regular basis subsequently died compared to those whose blood was not sampled. In an evaluation of the possible effects of one research tool, Boarman et al. (1998) summarized from the literature on possible impacts to turtles of different ways of attaching radio transmitters. They concluded that there is little evidence of negative impacts of transmitters on turtles and particularly tortoises. Their concluded this partly because of paucity of published accounts of problems experienced. There are a few undocumented reports of individual animals dying from excessive bleeding following blood extraction and possible excessive mortality of animals that had blood extracted 3-4 times per year for several years, but none of this is reported in the literature and thus remains anecdotal. Kuchling (1998) hypothesized that X-rays, used to measure reproductive success, are hazardous to turtles. Using empirical data, Hinton et al. (1997) argued that x-rays are safe when extremely low dosages of radiation are employed, which can be accomplished with use of rare earth screens.

Invasive Plants

The introduction and proliferation of invasive plants is a continuing and increasing problem in the desert. The most common invasive plants found in tortoise habitat in the west Mojave Desert are cheatgrass (*Bromus tectorum*), red brome (foxtail chess, *Bromus madritensis rubens*), split grass (*Schismus barbatus*, and *S. arabicus*), redstem filaree (*Erodium cicutarium*), Russian thistle (tumbleweed, *Salsola tragus*), Sahara mustard (*Brassica tournefortii*), and fiddleneck (*Amsinckia tessellata*; Kemp and Brooks 1998). Fiddleneck is a native species to the U. S., but others are natives to Eurasia, Africa, or South America (Kemp and Brooks 1998, Esque et al. in press). By one estimate, alien annuals comprised 9-13% of all annual plant species but 3 species (red brome, split grass, and redstem filaree) comprised 66% of all annual plant biomass in one wet year (Brooks 1998, 2000). Other less common weedy species are listed in USFWS (1994, p. D21) and Kemp and Brooks (1998).

Invasive grass species (e.g., split grass) tend to have thin, filamentous roots that spread quickly and easily through shallow compacted soil where the surface crust has been broken (Adams et al. 1982a, b). The root structure allows plants with filamentous roots to quickly take advantage of small amounts of water in the soil following light rains and may allow them to outcompete native, non-weeds, which often grow slower, have thicker tap roots that are less efficient at pushing through dense, compacted soil (Adams et al. 1982a, b). There is some empirical evidence that split grass and red brome inhibit or prevent the growth of native plants, including fiddleneck (Brooks 2000), indicating that competition may be occurring and that the native plants are less available to foraging tortoises. However, in Nevada, Hunter (1989, cited in USFWS 1994, p. D22) found no correlation between native plant density and density of red brome.

In general, invasive plants tend to proliferate in areas of disturbance (Hobbs 1989), but the effect of disturbance may be weak compared to that of rainfall and soil nutrient levels. Density or biomass of weedy plants in the Mojave Desert may be higher in areas disturbed by ORVs (Davidson and Fox 1974), livestock (Webb and Stielstra 1979, Durfee 1988), paved roads (Frenkel 1970, Johnson et al. 1975), and dirt roads (Brooks 1998, 1999a). In a strictly correlative study, Brooks (1999a) found that the biomass of two annual exotic plants was weakly associated with levels of disturbance (disturbance was from ORVs and sheep grazing). Biomass of the introduced plants was also positively associated with soil nutrient levels and the proportion of total biomass and species richness (number of species in a given area) comprising exotic species was negatively associated with annual rainfall (i.e., relative proportion of exotic annuals was greater in years with low annual rainfall).

An additional factor that may facilitate proliferation of alien plants is increased nitrogen deposition from airborne pollutants (Allen et al 1998). Nitrogen, in the form of nitric acid and nitrate from automobile exhaust, deposits on plants and soil downwind from urban areas (Fenn et al. 1998) and perhaps from roads. Brooks (1998) has shown experimentally that the addition of nitrogen to west Mojave soil increases the biomass of brome and split grass thereby potentially increasing their competitive advantage over native plants (Eliason and Allen 1997). The effect ORV-based exhaust has on desert vegetation has not been established.

It is often stated that non-native plants are of lower nutritional quality than native species preferred as forage by tortoises, but this is not always the case. The difference in nutritional quality may have more to do with the type of plant (e.g., grass versus forb, Nagy et al. 1998) or annual differences in nutritional quality related to precipitation (Oftedal 2001). For example, the non-native split grass, which is often eaten and sometimes preferred by tortoises (Esque 1994), has been shown empirically to deplete tortoises of nitrogen and phosphorus and water and cause weight losses (Avery 1998, Nagy et al. 1998, Hazard et al. 2001), but so does the native Indian rice grass (*Achnatherum hymenoides*, Nagy et al. 1998). Avery (1998) also demonstrated that split grass was lower in overall quality, crude protein, essential amino acids, water, and vitamin concentrations and higher in fiber and heavy metal concentrations than three non-grass species measured (one introduced and two native forbs). The introduced forb, redstem filaree, had higher aluminum and iron concentrations, but was otherwise similar

to native forbs. Where lower-quality weedy grasses can outcompete preferred higher-quality forbs (Brooks 2000), forbs may be less available to tortoises, tortoises would have to eat the lower quality invasives, and they would then suffer from a nitrogen and phosphorus (or other nutrient) deficiencies (Hazard et al. 2001). This speculation requires further testing.

Mechanical injury from invasive grasses has been observed with instances of the sharp awn of *Bromus rubens* being stuck in the nares of tortoises as well as impacting the food in the upper jaws of the tortoises (Medica, pers. comm.). The interactive effect that invasives and fires have on tortoises was discussed in the "Fire" section, above.

Landfills

There are approximately 27 authorized sanitary landfills and an unknown number of unauthorized, regularly used dumpsites in the California deserts. In the West Mojave Desert, there are 11 authorized landfills. The potential impacts landfills have on tortoise populations include: loss of habitat, spread of garbage, introduction of toxic chemicals, increased road kills from vehicles driving to or from the landfill, proliferation of predatory raven populations, and possible facilitation of increases in coyote and feral dog populations. Other than for raven predation, there are virtually no data to evaluate most of these possible threats.

Loss of habitat to landfills is relatively minor except when viewed in the context of habitat degradation and fragmentation caused by the myriad of human developments that are proliferating in the desert. Spread of garbage probably poses a very small problem for tortoise populations (see “Garbage and Litter” section, above), but there are no data available to evaluate this. The possible effect of toxic chemicals in general is treated in the “Disease” section, above, but toxins from sanitary landfills are likely to have very little effect on tortoise populations. Modern sanitary landfills are designed to prevent the seepage of toxic chemicals and present a very low level (or probability) of risk, and any seepage from these or less optimally operated landfills would probably affect a very small proportion of tortoises. Landfills do generate methane gas, but because desert landfills are so dry, the generation of methane is extremely low and not likely to affect tortoises. Fugitive dust is probably a localized problem and generally minimized through frequent sprinkling of the dirt. Increase in road kills is probably proportional to the level of traffic, speed of vehicles, density of tortoises, and length of road. For most landfills, these factors are relatively low, so the impact of road kills on tortoise populations from vehicles going to landfills is probably relatively minor, but they do happen (LaRue and Dougherty 1999). However, several landfills are slated to be closed and converted to transfer or community collection stations. The garbage would be deposited into dumpsters or large compactors at these stations, then transported to a small number of larger regional landfills. This activity could increase the amount of traffic at these fewer landfills thereby increasing the number of road kills.

The greatest potential impact landfills have on tortoise populations is through their probable role in facilitating increased predation by ravens, and perhaps coyotes.

Ravens make heavy use of landfills for food (Engel and Young 1992, Boarman et al. 1995, Kristan and Boarman 2001). The food eaten probably helps ravens to survive the summer and winter, when natural sources of food are in low abundance (Boarman 1993, in prep.). As a result, more ravens are present at the beginning of their breeding season (February - June) to move into tortoise habitat, nest, raise young, and feed on tortoises. Healthier ravens are more likely to raise chicks successfully, who in turn will move to the landfills and experience higher than normal levels of survival, and the cycle continues. Predation by ravens is probably relatively low immediately around landfills where tortoise populations are relatively low, but increase as ravens disperse to distant nest sites (Kristan and Boarman 2001). See the "Predation" section, below, for more details.

Livestock Grazing

Grazing by livestock (cattle and sheep) is hypothesized to have direct and indirect effects on tortoise populations including: mortality from crushing of animals or their burrows, destruction of vegetation, alteration of soil, augmentation of forage (e.g., presence of livestock droppings, and stimulation of vegetative growth or nutritive value of forage plants), and competition for food.

Reduce Tortoise Density

There are very few data available to determine if grazing has caused declines in tortoise populations. The Beaver Dam Slope, Utah, was grazed heavily by sheep until 1950's and cattle are still grazing there today (Oldemeyer 1994). Tortoise populations on the Beaver Dam Slope were estimated at 150 tortoises/mi^2 (Woodbury and Hardy 1948), but, using very different methods, the population apparently dropped to 34-47/mi^2 in 1986 (Coffeen and Welker 1987, cited in Bury et al. 1994). The reductions have been attributed to grazing, but another cause may include the potential spread of disease from captive tortoises released in the area (Luke et al. 1991). High mortalities and population declines in Piute Valley, Nevada, have also been attributed to grazing (Mortimer and Schneider 1983, and Luke et al. 1991), but 1981 was a drought year and a high level of recent mortalities may have occurred. Such was the case in Ivanpah Valley where 18.4% of radio-transmittered tortoises died (Turner et al. 1984). It is interesting to note that there appeared to be more tortoise mortalities in the section of the Piute Valley study area that experienced lower levels of recent cattle grazing (Mortimer and Schneider 1983), but the data are insufficient to make a definitive judgement. No population trends in California have been attributed with hard data to livestock grazing.

An alternative hypothesis, proposed by Bostick (1990), is that tortoise population declines paralleled declines in cattle grazing throughout the West that began in 1934 with the implementation of the Taylor Grazing Act. Unfortunately, there are no reliable data to test this hypothesis. But its underlying assumption, that tortoises depend on cattle dung for protein, has no empirical support (see "Cow Dung as a Food Source" section, below).

Direct Impacts

CRUSHING TORTOISES

Some observations of tortoises being crushed by livestock exist in the literature, but often with little or no data to allow in-depth evaluation. Berry (1978, p. 28) stated that "smaller tortoises can be crushed easily by cattle or sheep," but provided no data to support the statement. Berry (1978, pp. 19-21) also reported that "a small two-to-three-year old tortoise with a hole through its shell was found near a temporary watering trough near the DTNA. It appeared to have been killed by sheep within the last few days; the hole in the shell was about the size and shape of a sheep's hoof." Ravens also peck holes in the shells of young tortoises; insufficient information was provided to know if the hole was inconsistent with raven predation. Ron Marlow (pers. comm., cited in Berry 1978) described the disappearance of a marked juvenile tortoise and its small burrow by the trampling by sheep. Apparently the marked tortoise was never observed again, so Marlow determined the sheep killed it. The tortoise may have been killed when sheep trampled the burrow. However, marked juveniles are often never seen again, so the tortoise either survived or died from one of many causes. Any one of these anecdotes may be a true indicator of the nature of tortoise-cattle interactions, but the information provided is inadequate to allow for rigorous evaluation and are very susceptible to alternative explanations.

Sheep and cattle may not step on tortoises because they are very cautious of stepping on uneven ground (rocks, bushes, etc.) for fear of losing their footing. This view is supported by the paucity of documentation of tortoises being crushed by cattle and sheep. One published paper (Balph and Malecheck 1985) reported a test of a related hypothesis: cattle will avoid stepping on clumps of bunchgrass because the clumps form an uneven surface that may cause the cow to trip. Cattle significantly avoided crested wheatgrass (*Agropyron cristatum*) tussocks, avoidance was independent of cattle density, and taller tussocks were less apt to be trampled than short ones. Out of 288 hoofprints recorded, 15 (5%) were on tussocks. This well designed study lends support to the contention that cattle will try to avoid stepping on tortoises, at least large tortoises, but clearly tortoises are not grass tussocks. However, this speculation can be countered by the equally plausible contention that the study's results only shows that cattle will avoid stepping on food; they have no bearing on the propensity for sheep to step on non-food items (e.g., juvenile tortoises).

Sheep, on the other hand, may step on many juvenile tortoises, but appear to avoid stepping on subadult and adult tortoises. Tracy (1996) provides an analysis of data from an aborted BLM study. Without providing details of methods, Tracy (1996) reported that 20% of the Styrofoam model juvenile tortoises placed in natural habitat were trampled by sheep, 87% of those trampled models were crushed. Sheep damaged only about 3% of the subadult models and about 2% of the adult models.

CRUSHING BURROWS

No one has rigorously evaluated whether livestock crush a significant proportion of tortoise burrows. Few cases in the literature document livestock trampling actual burrows and a small number of studies shows increased number of collapsed burrows following grazing. Nicholson and Humphreys (1981) measured impacts of sheep grazing immediately after a band of 1000 sheep passed through their West Mojave study site for 12 days. Sheep trampled and partly collapsed a burrow with an adult female inside; apparently the tortoise was unharmed. Sheep completely destroyed the burrow of a juvenile tortoise while the animal was inside; the field workers extracted the unharmed tortoise. The burrow of an adult male was damaged probably with no tortoise inside. On re-examination of burrows found prior to grazing, 4.3% (7/164) were totally destroyed and 10% were damaged after sheep grazed in the area. Most damaged burrows (86%) were in moderate to heavily grazed areas and were relatively exposed. Most burrows placed beneath shrubs escaped damage (Nicholson and Humphreys 1981). This was an observational study. Webb and Stielstra (1979) reported observing crushed tortoise burrows on the south slope of the Rand Mountains in the western Mojave, but gave no data or additional details. In a report on grazing near the DTNA, Berry (1978) reported that sheep trampled most shallow burrows and pallets that were in the open (no numbers were given), and they also crushed and caved in those near the edges of or within shrubs. Berry (1978) also reported that "cattle and sheep frequently trample shallow tortoise burrows," but provided no data. She further speculated that damage to burrows might be deadly to a tortoise that reaches it on a hot morning only to find it unusable. This is a reasonable expectation based on tortoise behavior and thermal ecology, but no supporting data are available. Avery (1997) found significantly more damaged burrows outside of a cattle exclosure versus inside and also found that tortoises outside the exclosure spent more nights in the open, presumably because many of their burrows were collapsed. There is one account of a tortoise burrow being collapsed by a cow in Utah (Esque pers. comm.). A tortoise was found crushed inside.

Tracy (1996) provided an analysis of data from 2 unpublished BLM studies on the effects of sheep grazing on tortoise burrows: the Tortoise and Burrow Study (TABS study) and Styrofoam model tortoise study (Goodlett unpubl.). The TABS study (cited in Tracy 1996) evaluated the condition of tortoise burrows before and after grazing inside and outside of areas grazed by domestic sheep in the Mojave Desert. They found that 2.5% (8/315) of the tortoise burrows were completely destroyed, which was significantly more than before grazing and more than were destroyed outside the grazing area. In the Goodlett study (unpubl.; cited in Tracy 1996), 3.7% (36/969) of the artificial burrows dug to look like desert tortoise burrows were destroyed after grazing. Significantly more juvenile and immature burrows were destroyed compared to adult burrows and destruction was greatest in the open spaces between shrubs. The proportion of burrows destroyed in these two studies and Nicholson and Humphreys (1981) were not significantly different (Tracy 1996).

Indirect Effects

A commonly held assertion is that the Mojave desert plant species and communities evolved in the presence of, and are probably adapted to, a rich fauna of Pleistocene herbivores (Edwards 1992a, 1992b). Therefore, the argument continues, livestock grazing is compatible with present day plant assemblages, in part because Mojave plants respond to grazing by producing more vegetative material, thus becoming more vigorous in the presence of grazing. This argument has several flaws. First, most large herbivores that coexisted in the Mojave desert region 10,000-20,000 years ago likely primarily browsed leaves from woody shrubs, they did less grazing of grasses and herbaceous annual vegetation, like cattle, sheep, and tortoises primarily do (Edwards 1992a). Second, the mammals of the Late Pleistocene and Early Holocene Mojave existed under considerably different vegetative and climatic conditions ago (Van Devender et al. 1987). A major climatic and vegetative transition occurred between 11,000 and 8,000 years ago. It was more mesic and the area was not a desert. The present vegetation assembly, dominated by creosote shrub, did not arrive in the Mojave Desert region until approximately 8000-10,000 years ago (Van Devender et al. 1987). Third, no one has any idea what density the Pleistocene grazers existed at, so grazing intensity is completely unknown. Thus, there is little justification for arguing that tortoises evolved in the presence of grazers and their survival is thus dependent on cattle, as a surrogate for their coevolved grazing species.

SOIL COMPACTION

Grazing can affect soils by increasing soil compaction and decreasing infiltration rate, the capacity of the soil to absorb water. A lower infiltration rate means less water will be available for plants and more surface erosion may occur. In a review of studies investigating the hydrologic effect of grazing on rangelands, Gifford and Hawkins (1978) concluded that grazing at any intensity reduces the infiltration rate of the soil. Heavy grazing reduced infiltration rate by 50% and light to moderate intensities reduced infiltration by 25% over ungrazed; the differences are statistically significant. Contrarily, Avery (1998) found significantly greater compaction at a livestock water source, but no difference between protected and grazed areas away from the water source.

Soil compaction affects vegetation by reducing water absorption (thereby availability to plants) and making it more difficult for plants to spread their roots, particularly tap roots (Adams et al. 1982a, b). Growth and perhaps spread of split grass (*Schismus barbatus* and *S. arabicus*) is facilitated by compaction because of root structure. This may lead to a conversion in the vegetation community type and increased fire hazard. Although, fire spreads slowly and discontinuously with split grass compared to *Bromus* grasses (Brooks 1999b).

Empirical evidence shows that infiltration is higher in grazed areas. , Rauzi and Smith (1973) conducted a comparative experiment in the central plains of Colorado. They demonstrated that infiltration rate was significantly reduced by heavy grazing (vs. moderate and light grazing). Infiltration rate was significantly correlated with total plant

material on the surface (standing crop) in two of the three soil types tested. Species composition was different. Experimental water run-off tests showed moderate grazing areas had 7 times the runoff of light grazing areas and heavily grazed areas had 10 times the runoff as lightly grazed areas. In the Mojave Desert of Nevada and Arizona, signs of increased soil compaction were evident in grazed areas compared to ungrazed areas between highway and highway right-of-way fences (Durfee 1988). Avery (1998) measured soil type, bulk density, and infiltration in an exclosure that cattle were excluded from for approximately 12 years and compared them to grazed areas outside the exclosure. He demonstrated that soil in heavily trampled areas near water tanks was coarser, had higher bulk density, greater penetration resistance, and lower infiltration rates (all are measures of compaction) than in the protected area.

Although they did not measure compaction or infiltration, Nicholson and Humphreys (1981) quantified the proportion of soil disturbed after a band of 1000 sheep spent 12 days foraging and bedding within a 1.6 km^2 study plot. They estimated that 80% of the soil in bedding areas was disturbed, 67% in watering areas, 37% in grazing areas, and 5% in areas not used by sheep. Soil was considered disturbed if the surface crust was broken or missing and was independent of cause. This non-replicated observational study had a control, did not document what effect the measured disturbance had on vegetation or soil parameters, but did suggest the extent of surface disturbance caused by the grazing.

In a comparison of soil conditions following sheep grazing in the Western Mojave, Webb and Stielstra (1979) noted disruption of soil crusts in intershrub spaces and on the coppice mounds of creosote bushes. Surface strength (a measure of compaction) was significantly greater in grazed vs. ungrazed areas, particularly in the upper 10-cm of the soil. Bulk density and moisture content did not differ, perhaps because of the high gravel content of the soil or compaction in both areas from grazing activity in previous years.

CHANGES IN SOIL TEMPERATURE

Another potential indirect effect of livestock grazing on tortoise habitat is alteration of soil temperature due to change in vegetation structure or soil compaction. Steiger (1930 cited in Luke et al. 1991) measured a significant increase in soil temperature at depths of 2.5, 7.5, and 15 cm in clipped versus unclipped plots. Browsing of shrubs may also alter soil temperature, but in unexpected ways. Using models that accurately duplicated the thermal profiles of desert tortoises, Hillard and Tracy (1997), a graduate student from University of Nevada, Reno, found that soils were cooler beneath shrubs with sparse and open undercanopies and hotter when the undercanopy was entirely closed. Apparently, the open undercanopy allowed cooling by both shade and wind, whereas closed undercanopies trapped hot air. Hence, if livestock browse, graze or otherwise reduce density of the undergrowth of a shrub while leaving the canopy with intact shading properties, then soil temperatures may be reduced. Alternatively, if grazing also reduces the shrub's canopy, then soil temperatures may increase. It is unknown what effect grazing-induced changes in soil temperature might have on

tortoises. The temperature during incubation (Spotila et al. 1994) determines sex of tortoises: incubation temperatures above 89.3°F result in females, and below result in males. Although this has not been tested in the field, it is possible that significant increases in soil temperature resulting from grazing-induced vegetation changes may significantly skew the sex ratio of the tortoise population in favor of females and vice versa. Also, Spotila et al. (1994) found that hatching success was highest for eggs incubated between 78.8°F and 95.5°F.

CHANGES IN VEGETATION

Grazing by cattle can alter vegetation in several ways: damage from trampling, change in species composition perhaps resulting in type conversion (change in plant community type), and introduction of invasive plants.

TRAMPLING OF VEGETATION AND SEEDS

Livestock may cause direct damage to vegetation when they step on or push into shrubs and herbaceous annuals, and this impact was measured in a few studies. In the west Mojave Desert, none of the perennials on plant transects where sheep grazed were trampled, whereas 17% found in the bedding area were trampled (Nicholson and Humphreys 1981). Webb and Stielstra (1979) reported that sheep trample creosote bush when seeking shade to bed in. Annuals, which are prevalent on coppice mounds beneath creosote, were also trampled or eaten. As noted above, Balph and Malechick (1985) provided empirical evidence that cattle usually avoided stepping on clumps of crested wheatgrass, but still stepped on them 5% of the time.

Trampling by livestock may help to bury seeds and improve germination through their trampling action. In sagebrush scrub of northern Nevada, Eckert et al. (1986) found that light trampling increased germination of perennial grasses, but not perennial forbs, and heavy trampling decreased emergence of perennial grasses while increasing emergence of sagebrush and perennial forbs. Cattle grazing in Chihuahua Desert grassland enhanced revegetation by non-native grasses, but rain may have confounded the results (Winkel and Roundy 1991). Unfortunately, no similar studies from the Mojave Desert are available. However, biomass of seeds in the soil seed bank was significantly higher inside compared to immediately outside the DTNA, a 38 mi^2 fence enclosed preserve, where sheep grazing and ORVs had been excluded for 15 years (Brooks 1995); this in spite of there being more seed-eating rodents inside the DTNA. The biomass of annual vegetation, including the introduced species, was also greater inside the DTNA, but the total biomass of natives was proportionally higher inside than outside. Several other uses occurring outside the DTNA were absent from inside the preserve, thus the differences cannot be attributed solely to grazing. However, the changes noted are the expected effect of removal of surface disturbance from the reserve.

Near the DTNA, sheep trampled and uprooted perennial shrubs, such as burrobush (*Ambrosia dumosa*), goldenhead (*Acamptopappus sphaerocephalus*), and

Anderson thornbush (*Lycium andersoni*). "Even large creosote bushes (*Larrea tridentata*) were uprooted" (Berry 1978, p 512). "In many areas near stock tanks [in Lanfair Valley, California] the ground is devoid of vegetation for hundreds of meters. Trailing is heavy and damage extensive within 4.6 to 6.4 km of the tanks" (Berry 1978, p. 512). These reports are anecdotal; no data or additional details were provided.

PLANT COMMUNITY CHANGES

As early as 1898, range scientists observed that cattle ranges in the southwest were becoming overgrazed and urged that restorative actions were necessary (Bentley 1898). Since then, several studies have documented vegetation changes over the past century by comparing photographs or field notes taken in both centuries (Humphrey 1958, Humphrey 1987). The dominant change was a conversion from grass- to shrub-dominated communities (type conversion). Whereas livestock grazing has been implicated as an important cause for these changes, separation of the effect of grazing from the effects of fire suppression, rodents and other herbivores, competition, and climate changes is difficult (Humphrey 1958, 1987). Several studies compared grazed areas to nearby ungrazed areas particularly in southeast Arizona. They generally show a similar reduction in grass species in the grazed areas. Unfortunately, none of these studies occurred in the Mojave Desert and, because the grass-dominated ecosystem of southeast Arizona is very different from the non-grass deserts of California, there is little value in extrapolating from one to the other.

In 1980, the BLM created a 672-hectare cattle exclosure in Ivanpah Valley, eastern Mojave Desert of California, to determine the effects of cattle grazing on desert tortoises and their habitat. In the study establishing baseline data for a long-term comparison, Turner et al. (1981) found no significant differences between plots in biomass of annuals, weight or length of tortoises, proportion of reproductively active females, and tortoise home range sizes. Sex ratios and size classes of tortoises were comparable between the two plots. The lack of differences could be attributed to: (1) low use by cattle of the non-excluded area in both years of the study; 2) tortoise and vegetation recovery, if they are to happen, are likely to take much longer to be observable; and (3) sample size (n=1) too small to detect differences. Changes in tortoise weight with time, estimated clutch sizes, and concentrations of some nutrients in some plant species differed between plots, indicating that some differences existed between control and treatment at the start of the study. Over so short a time frame, differences are likely due to prior spatial differences in habitat or populations rather than grazing treatment. There was a similar level of differences between control and treatment plots one year later (Medica et al. 1982).

Avery (1998) conducted a follow up study at the Ivanpah study plot in the early 1990's. Avery (1998) compared vegetation inside and outside the exclosure. Compared to the ungrazed exclosure, the grazed area had significantly larger creosote bushes, more dormant or dead burrobush, *Ambrosia dumosa* (a perennial shrub), fewer and smaller, galleta grass, *Pleuraphis [=Hilaria] rigida* (a native, perennial grass) representing less biomass, more of the disturbance-loving shrub, *Hymenoclea salsola*, and lower diversity

of winter annuals. They found significantly more desert dandelions (*Malacothrix glabrata*), a plant preferred by both cattle and tortoises, and a greater increase in basal area but not density of the native perennial galleta grass, *P. rigida*, in the protected area. *P. rigida* did increase in basal area over a 12 year period in the grazed area, indicating that level of grazing (0.31 - 2.60 animal unit months) does not cause mortality in *P. rigida*. Biomass, cover, density, and species richness of annuals did not differ. Recovery of Mojave Desert vegetation following alteration by cattle grazing could be very slow (Oldemeyer 1994), so 12 years of exclusion may be insufficient to detect a more significant effect.

A recent study compared soil characteristics, vegetation, and tortoise density within and around three exclosures in the Mojave Desert, including 2 in the west Mojave (Larsen et al. 1997). They reported finding few differences between "grazed" and "ungrazed" plots in percent canopy cover, and the differences found were relatively minor. Grazing reduced native forb density and increased soil compaction. Numbers of live tortoises, tortoise carcasses, and tortoise burrows were no different between grazed and ungrazed areas. Details provided were insufficient to adequately evaluate the methods or results and virtually no statistical analyses were provided.

Durfee (1988) compared structural features of the plant community between ungrazed areas along fenced highways and grazed areas outside of the right-of-way fences. A greater proportion of introduced plants, more bare ground, fewer perennial grasses, and lower spatial heterogeneity in species composition occurred in the grazed areas (see also Waller and Micucci 1997).

As cited above, Brooks (1995) found significantly higher annual plant and seed biomass in the DTNA, an area protected from sheep grazing, compared to an area outside the preserve. Berry (1978) characterized the qualitative effect of sheep grazing near the DTNA: "sheep removed almost all traces of annual forbs and grasses; the desert floor appeared more devoid of herbaceous growth than in drought years." No further data were provided in the latter report.

In all of these studies, spatial differences obtained in soil, weather, and vegetation may be independent of cattle grazing. Furthermore, the size of exclosures may be insufficient to allow the ecosystem to function independent of grazing activities outside the exclosure (which is probably not a big problem at the DTNA, studied by Brooks 1992). Furthermore, many of the above studies, particularly the older and observational ones, were reporting on the effects of long-term heavy grazing, whereas grazing regimes being implemented today are generally much lighter (Oldemeyer 1994).

Water for cattle is usually provided at specific points, at either springs or troughs. Because they will only wander a certain distance from the water source, affect of cattle on the environment will be greatest immediately around the water source and will decrease with distance (e.g. Avery 1998). Fusco (1993), Fusco et al. (1995), Bleecker (1988), and Soltero et al. (1989) recorded significant increases in biomass and density of grasses and other species with distance from water sources. Changing the location of water sources would have the effect of reducing the intensity of impact around each water

source, but may increase the impacts at other sites. It is unknown if impacts would be below the (unknown) threshold for significant effect on the environment.

The impact of sheep grazing has been studied only once. In an observational study, Nicholson and Humphreys (1981) noted that areas not grazed by sheep had 2.3 times more cover and 1.6 times higher frequency of annual plants than in sheep bedding areas and 1.8 times more cover and 1.3 times higher frequency than grazed areas. Annual plant cover decreased by 70% in a heavy-use area compared to 50% in a light-use and 40% in a non-use area before grazing versus after grazing one month later. They also found a 96-99% reduction in annual plant cover between April and June in areas receiving heavy and light grazing by sheep. None of the perennials on plant transects where sheep did not graze showed damage after sheep left the area; 18% in the grazed area were damaged and 91 to 99% in the bedding areas were damaged. Apparently, trampling caused most of the damage in the bedding areas whereas most in the light-use area was from browsing. However, differences may be caused by other factors such as soil that may have differed between the sites independent of grazing pressure. Rather than using exclosures, the sheep and herder were allowed to select the areas they grazed. Hence, the sheep avoided ungrazed treatments for this study. This may have biased the results since there may be inherent differences in these areas that caused the sheep to avoid them.

An often cited benefit of grazing is "compensatory growth," growth of plant tissue following clipping, removal, or damage to plants resulting in increased growth or vigor (e.g., Bostick 1990, McNaughton 1985, Savory 1989). The concept is controversial, has gained little empirical support in semi-arid grasslands and ranges (Detling 1988, Bartolome 1989, Weltz et al. 1989, Wilms et al. 1990), may only be viable in wet, fertile, monocultural environments (Painter and Belsky 1993), and has not been tested in the Mojave Desert (e.g., Painter and Belsky 1993). What little evidence exists from the Mojave Desert fails to support the compensatory growth hypothesis. Avery (1998) found that *Pleuraphis [=Hilaria] rigida*, a native grass consumed by both cattle and desert tortoises, was significantly smaller in grazed versus ungrazed areas. More *Ambrosia dumosa*, which is sometimes eaten by cattle in drought years (Medica pers. comm.), was found dead or dormant in the grazed compared to ungrazed plots. Creosote (*L. tridentata*) was larger in grazed areas, but is consumed by neither cattle nor tortoises (Avery 1998).

INVASIVE PLANTS

Grazing has been implicated in the proliferation of invasive plants in the Mojave Desert (Mack 1981, Jackson 1985, Brooks 1995). Webb and Stielstra (1979) noted that *Schismus* and *Erodium* densities remained unchanged between a grazed and ungrazed area probably because they have an adaptive tolerance to environmental disruption such as soil compaction thus giving them a competitive edge over many native annuals. Berry (1978) reported that the heavily grazed Lanfair Valley "now contains a high percentage of weedy, invader, perennial species typical of overgrazed desert lands," but provided no data. Bostick (1990) argued that cattle grazing helped tortoise populations by aiding the

spread of cacti. Some evidence from outside the Mojave suggests that grazing does aid in the spread of cacti, but the evidence is equivocal. Also, tortoises do eat cacti, which may be an important source of water and nutrition during drought periods (Turner et al. 1984, Avery 1998). But, the evidence in support of Bostick's hypothesis is weak.

COMPETITION

An important effect livestock grazing may have on tortoise populations is competition for food. Because of the enormous differences in size and energy requirements of the two species, the competition, if it occurs, is likely to be heavily asymmetric, with cattle affecting the tortoise populations, but probably not the converse. Three conditions must be met for asymmetric competition to occur: overlap in use of some resource (e.g., food), the resource must somehow limit or constrain one or both species in question, and use of the resource by one species must negatively affect the other species (Begon et al. 1990). Some data exist to help determine if competition for forage exists between cattle and tortoises, but less exist for sheep.

Many studies provide qualitative insights into forage species of tortoises (Woodbury and Hardy 1948, Burge and Bradley 1976, Hansen et al. 1976, Hohman and Ohmart 1980, Luckenback 1982, Nagy and Medica 1986) and three major studies quantified diet and forage selection in desert tortoises (Jennings 1993, Esque 1994, and Avery 1998). Tortoises primarily eat annual herbs in the spring and switch to grasses, perennial succulents (cacti), and dried annuals later in spring and early summer (Avery 1998). Tortoises are active again in the late spring and early fall as temperatures cool. As a result of localized late summer rains, sporadic green up of the vegetation can occur. At this time annuals germinate and bunch grasses (e.g., *Hilaria rigida*) green up and set seed. Cattle then eat the bunch grasses (Medica et al. 1992). In a drought year, tortoises in Ivanpah Valley consumed little food other than cacti during the latter part of the season (Turner et al. 1984). Thus, cacti may serve as a reserve supply of energy, more importantly as a potential source of water.

Four studies quantified plant foods eaten by cattle in the Mojave Desert (Coombs 1979, Burkhardt and Chamberlain 1982, Avery and Neibergs 1997). Avery and Neibergs (1997) followed cattle on horseback in the eastern Mojave Desert. By recording the species of plant and number of bites taken by the free-ranging cattle they found that foods chosen by cattle varied with season. In winter cattle primarily ate the perennial grass, big galleta grass (*Pleuraphis* [=*Hilaria*] *rigida*) and dried annuals from the previous spring (Medica et al. 1982, documented that cattle and tortoises eat perennial grasses in fall). Contrarily, Burkhardt and Chamberlain (1982) found perennial shrubs to predominate the diet of cattle in winter, annual grasses and green forbs did so in spring. Coombs (1979) found that cattle in the eastern Mojave of Utah particularly ate *Bromus* sp., *Ephedranevadensis*, and *Eurotia lanata* and ate perennial grasses considerably more often than expected based on their relatively uncommon presence. All of these studies illustrated that cattle in the desert eat diverse foods and that the foods eaten vary with season, locality, and availability.

Several studies provided evidence that tortoise and cattle diets overlap (Coombs 1979, Sheppard 1981, Medica et al. 1982, Avery and Neibergs 1997, Avery 1998), three of which did so quantitatively. Coombs (1979) and Sheppard (1981) used fecal samples, which are biased because they overestimate food items that contain large undigestible parts (e.g., silica-containing stems of grasses) and underestimate items that are highly digestible (e.g., moist forbs). Sheppard (1981) showed that plaintain (*Plantago insularis*), filaree, and *Schismus* experienced the highest levels of overlap , but overlap varied considerably between months and years. Coombs (1979) found that overlap existed, but neither study provided a species-by-species comparison or an explanation of how overlap was calculated. *Camassonia boothii*, *Malacothrix glabrata*, *Rafinesquia neomexicana*, *Schismus barbatus*, and *Stephanomeria exigua* were major forage items of both cattle and tortoises in Ivanpah Valley (Avery and Neibergs 1997, Avery 1998). Diet overlap between the two herbivores was greatest in early spring (38% Vs 16% in late spring, Avery and Neibergs 1997, Avery 1998).

Three studies provide data on forage overlap between sheep and tortoises. Webb and Stielstra (1979) reported that in the western Mojave Desert, sheep primarily ate herbaceous vegetation from the coppice mounds around the base of perennial shrubs. By comparing biomass of plants in a grazed area versus a nearby ungrazed area, they determined that three species were primarily removed: *Phacelia tanacetifolia*, *Thelypodium lasiophyllum*, and *Erodium cicutarium*.. Shrubs browsed by the sheep included *Ambrosia dumosa*, *Grayia spinosa*, *Haplopappus cooperi*, and *Acamptopappus sphaerocephalus*. Cover, volume, and biomass of these shrubs were significantly lower in grazed vs. ungrazed areas. However, because measurements were not taken before grazing it is possible that some differences may have existed before grazing commenced. Hansen et al. (1976) estimated that 15% of sheep diet in the western Mojave was composed of grasses and 52% of desert tortoise diets was composed of grasses. Nicholson and Humphreys (1981) reported several species of plants, particularly flowering annuals and burrobush (*Ambrosia dumosa*), that were highly used by sheep, but provided no quantitative data. Several species eaten by sheep were also eaten by tortoises including: split grass (*Schismus arabicus*), checker fiddleneck (*Amsinckia tessellata*), desert dandelion (*Malacothrix glabrata*), filaree (*Erodium cicutarium*), Fremont pincushion (*Chaenactis fremontii*), Parry rock pink (*Stephanomeria parryi*), chickory ((*Rafinesquia neomexicana*), snake's head (*Malacothrix coulteri*), red brome (*Bromus rubens*).

Only two studies directly tested for competition between tortoises and livestock. In an extensive study, Avery (1998) showed that cattle and tortoise diets overlap (38% in early spring, 16% in late spring). He also demonstrated that tortoise foraging was altered in the area where both species co-occurred. In late spring in the absence of cattle, tortoises primarily ate herbaceous perennials (91% of diet), whereas in the grazed areas, tortoises primarily ate annual grasses (59%) followed by herbaceous perennials (21%). The species of herbs also differed: in the exclosure tortoises preferred desert dandelion (*Malacothrix glabrata*), whereas in the grazed areas they ate primarily the exotic grass, splitgrass (*Schismus barbatus*). The availability of desert dandelion was significantly higher in the ungrazed area, which indicates a response to grazing, and of splitgrass was equivalent in the two areas. In one dry year, tortoises spent significantly more time

(approximately three times more) foraging in the grazed than in the protected areas, presumably in search of nutritionally-adequate food to fill up on. Thus, two of the three conditions necessary to confirm that cattle compete with tortoises for food were clearly supported empirically. The final condition, that one species must negatively impact the other, was also demonstrated, but more indirectly. In a separate, independent study, tortoises eating primarily *Schismus barbatus* have been shown to be put in a negative water and nitrogen balance (Nagy et al. 1998), which could increase mortality particularly during periods of extended drought (Peterson 1994a, Avery 1998). Furthermore, Henen (1997) demonstrated that lower nitrogen intake reduces reproductive output in female tortoises. A long-term comparison of differential survival and reproductive success of tortoises within and outside an exclosure would be an excellent empirical test of the effect cattle grazing has on tortoise populations.

Tracy (1996) found that in years of very low annual productivity, tortoises lay fewer eggs. They also found that cattle foraging reduced tortoise forage abundance enough to cause tortoises to lay fewer eggs than normal. The conclusion is that, in low rain years, cattle may remove enough forage to reduce tortoise reproductive output, thus competition occurs in those years. The authors did not track hatchling success to determine if the fewer eggs still resulted in the same number of successful hatchlings.

COW DUNG AS A FOOD SOURCE

Bostick (1990) argued that declines in tortoise populations is caused by a reduction in the availability of cow dung which has declined with the reduction in numbers of cattle grazing in the southwest. He argued that cow dung is an important source of food for tortoises. However, Avery (1998) studied tortoise foraging behavior where tortoises coexisted with cattle. He observed over 30,000 bites of items and observed only 231 bites of cow dung. Esque (1994) also observed over 30,000 bites on food objects. He reported that 107 of them were of feces, but none were from livestock. Furthermore, Allen (1999) evaluated the nutritional quality of cow dung and found it to be deficient for tortoises. In fact, even when cow pies were their only choice of food for one month, most tortoises (71%) refused to eat. Those that did eat, assimilated virtually none of the nitrogen. Thus, whereas Bostick (1990) presented an intriguing alternative hypothesis for tortoise population declines, there is no empirical support for its basic assumptions.

Summary

Surprisingly little information is available on the effects of grazing on the Mojave Desert ecosystem (Oldemeyer 1994, Rundel and Gibson 1996, Lovich and Bainbridge 1999). Differences in rainfall patterns, nutrient cycling, and foraging behavior of herbivores and how these three factors interact make applications of research from other areas of limited value in understanding the range ecology of the Mojave Desert. The paucity of information is surprising given the controversy surrounding grazing in the

Mojave and the importance of scientific information for making resource management decisions affecting grazing. Studies mostly from other arid and semi-arid regions tells us that grazing can alter community structure, compact soil, disturb cryptogamic soils, increase fugitive dust and erosion. Some impacts to tortoises or their habitat have been demonstrated, but the evidence is not overwhelming.

Military Operations

The California deserts were used for military exercises as far back as 1859 when Fort Mojave was first built (Krzysik 1998). The most extensive use was for World War II training when 18400 mi^2 (47105 km^2) in California and Arizona were designated as the Desert Training Center and used extensively for training with tank and armored vehicles. Today, four major, active military installations occur within the West Mojave and comprise a total of 4165 mi^2 (10663 km^2): Naval Air Weapons Station ("China Lake;" 1731 mi^2, 4432 km^2), National Training Center ("Fort Irwin;" 1016 mi^2, 2600 km^2), Air Force Flight Training Center ("Edwards Air Force Base;" 476 mi^2, 1218 km^2), and Marine Corp Air Ground Combat Center ("MCAGCC" or "Twentynine Palms;" 943 mi^2, 2413 km^2).

As outlined in the Recovery Plan (USFWS 1994), impacts to tortoise populations come from four basic types of military activities:

> "(1) construction, operation, and maintenance of bases and support facilities (air strips, roads, etc.); (2) development of local support communities, including urban, industrial, and commercial facilities; (3) field maneuvers; including tank traffic, air to ground bombing, static testing of explosives, littering with unexploded ordinance, shell casings, and ration cans; and (4) distribution of chemicals." (USFWS 1994, p. D14)

A fifth potential impact is above ground nuclear weapons testing, which took place in Nevada in the 1950s and 1960s.

<u>Construction, Operation, and Maintenance of Bases and Support Facilities</u>

All four major military bases in the west Mojave Desert each have facilitated the growth or development of large internal support communities. The development of these communities destroyed tortoise habitat and likely brought with them all of the other impacts generally associated with large human settlements (fragmentation, ORVs, release of disease, facilitation of raven population growth, domestic predators, etc.), each of which are discussed elsewhere in this report. There is some evidence that the tortoise population around China Lake declined within four decades following development of the base at China Lake (Berry and Nicholson 1984a). However likely this conclusion probably is, the data used were based solely on anecdotal observations (Bury and Corn 1995); and the data only show a correlation, not a cause and effect. Removal (translocation) of tortoises from construction sites, runways, and other heavy use areas to

other parts of the desert occurs and may affect the tortoises moved (Berry and Nicholson 1984a; see "Handling and Deliberate Manipulation" section, above). Another impact is the fragmentation of the habitat by the apparent haphazard placement of facilities throughout major portions of habitat (pers. obs.).

Development of Local Support Communities

The four major military bases in the west Mojave Desert have facilitated the growth or development of large external support communities: Ridgecrest, Barstow, Lancaster, Palmdale, and Twentynine Palms, which each have problems for tortoises typical of large suburban areas in the desert (see "Urbanization and Development" section, below).

Field Maneuvers

Tank maneuvers cause some of the most drastic and long-lasting impacts to the Mojave Desert habitats. Extensive tank training operations were conducted in the 1940's and in 1964 over 17,500 mi^2 of desert (Lathrop 1983, Prose and Metzger 1985, Krzysik 1998) and even more intensive maneuvers are currently taking place within an 819 mi^2 area on Fort Irwin (Krzysik 1998) and on MCAGCC (Baxter and Stewart 1990). Direct mortality to tortoises is relatively rare or not often reported, but does occur (Stewart and Baxter 1987, Quillman pers. comm.). Tanks damage vegetation, compact soil, cause fugitive dust, and run over tortoise burrows and tortoises. The results are largely denuded habitat, and altered vegetation composition, abundance, and distribution (Wilshire and Nakata 1976, Lathrop 1983, Baxter and Stewart 1990, Prose et al. 1987, Krzysik 1998). Natural recovery can take a long time; 55 year old tank tracks can still be seen throughout many parts of the desert (Wilshire and Nakata 1976, Krzysik 1998). Krzysik (1998) reported a significant reduction in tortoise densities (62-81% over six years) in active training areas of Fort Irwin and no change or increases in densities in areas with light and no activity. The effect of tank maneuvers was highest in valley bottoms and progressively less in high bajadas, talus slopes, and rugged mountain ranges where training activities were considerably lower.

Bombing and other explosive ordinance cause impacts in some areas, but no documentation was found of their effect on tortoise populations or habitat.

Distribution of Chemicals

It has been suggested that diseases affecting tortoise shells may be caused by residual chemical remains left over from military operations, but the evidence is highly speculative (See "Disease" section, above).

Nuclear Weapons Testing

Between 1951 and early 1963, the U. S. Atomic Energy Commission detonated 100 atomic devices above ground at the Nevada Test Site, Nevada (U. S. Department of Energy 1994). From mid 1960s to early 1990s only underground tests were conducted. Resource Concepts Inc. (1996) argued that radiation released into the atmosphere during these tests might explain tortoise declines. They cited two anecdotal accounts, one of many sheep getting sick near Cedar City, Utah, and another of high Geiger counter levels around the mouth of a cow in the same area. They suggested that nuclear fallout might explain the presence of disease in tortoise populations. Beatley (1967) found only very low levels of radiation at a plant study plot 8 km east of a below-ground test blast and attributed vegetative defoliation to dust from heavy vehicular traffic on a nearby dirt road.

The University of California, Laboratory of Nuclear Medicine and Radiation Biology conducted experimental radioecology research studies in Rock Valley located along the southern boundary of the Nevada Test Site. These irradiation studies involved the chronic exposure of plants and animals from a centrally located 137 cesium source located atop of a 50-ft tower within a 21-ac fenced plot. Rundel and Gibson (1996) provided a brief summary of the results of the Rock Valley irradiation experiment. Beyond direct mortality from the test blasts, there was very little persistent effect of radiation on the surrounding lizard populations. Little long-term effect on the pocket mouse, *Perognathus formosus*, was found (Turner 1975). On the other hand, female lizards at Rock Valley were found to be sterile several years after the experiment began (Turner 1975, Turner and Medica 1977). There were five adult tortoises present throughout most of the study and four still remained in 2001 (Medica pers. comm.).

I could find no data that bear directly on the potential effects of nuclear weapons testing on tortoise populations. The map in Gallagher (1993) suggests that fallout was nearly nonexistent in the west Mojave (which is consistent with predominant wind patterns), where URTD is rampant (Berry 1997). Therefore, if there is an effect from testing, it probably cannot be a universal explanation for rangewide declines nor can it explain the markedly high losses and levels of disease documented in the west Mojave.

Noise and Vibration

The following is largely paraphrased from my contribution to the Desert Tortoise Recovery Plan (USFWS 1994). Anthropogenic noise and vibrations may impact tortoises in several ways including: disruption of communication, and damage to the auditory system. A body of peer reviewed scientific literature exists demonstrating how background noise may mask important vocal signals in insects and amphibians (e.g., Bushcrickets, *Conocephalus brevipennis*, Bailey and Morris, 1986; Green Treefrogs, *Hyla cinerea*, Ehret and Gerhardt, 1980). Hierarchical social interactions, hearing, and vocal communication have all been identified in desert tortoises (Adrian et al. 1938, Campbell and Evans 1967, Patterson 1971, 1976, and Brattstrom 1974, Bowles et al. 1999). Patterson (1976) identified eleven different classes of vocal signals used by desert

tortoises in various of social interactions, but he did not demonstrate that animals who hear the signals react or change their behavior in any way, a necessary component in identifying communication. The signals are relatively low amplitude, have fundamental frequencies 200 Hz or lower, and harmonics that reach as high as 4500 Hz (Patterson, 1976).

The portions in the following excerpt from USFWS (1994) pertaining to desert tortoises is purely speculative with no direct empirical support for desert tortoises:

> " Many anthropogenic noises, such as automobile, jet, and train noises, cover a wide frequency bandwidth. When such sounds propagate through the environment, the high frequencies rapidly attenuate, but the low frequencies may travel great distances (Lyon, 1973). The dominant frequencies that remain after propagation correspond closely to the frequency bandwidth characteristic of desert tortoise vocalizations. Therefore, masking of these signals may significantly alter an animal's ability to effectively communicate or respond in appropriate ways. The same holds true for incidental sounds made by approaching predators; masking of these sounds may reduce a tortoise's ability to avoid capture by the predator. The degree to which masking by noise affects tortoise survival and reproduction depends on the physical characteristics (i.e., frequency, amplitude, and short- and long-term timing) of the noise and the animal signal, propagation characteristics of the sounds in the particular environment, auditory acuities of the tortoises, and importance of the signal in mediating social or predator interactions. There are no studies to test the masking effect of noise on tortoise behavior, but the effect is likely to be relatively low given that vocal communication is probably not extremely important in mediating social interactions and that noises loud enough to mask sounds important to tortoises are generally uncommon and short in duration. The only place the noise would be continuous enough may be alongside heavily traveled roads, where tortoise abundance is generally quite low.
>
> "Loud noises (and associated vibrations) may damage the hearing apparatus of tortoises. Little research has been performed on tortoise ears, but it is clear that tortoises are able to hear, and the relatively complex vocal repertoires demonstrated by tortoises suggests that their hearing acuity is similarly complex. Brattstrom and Bondello (1983) experimentally demonstrated that off-highway vehicle noise can reduce the hearing thresholds of Mojave Fringe-toed Lizards (*Uma scoparia*). Relatively short, single bursts (500 sec) of loud sounds (95 dBA at 5 meters) caused hearing damage to seven test lizards (Brattstrom and Bondello, 1983). Comparable results were obtained when desert iguanas (*Dipsosaurus dorsalis*) were exposed to one to ten hours of motorcycle noise (Bondello, 1976). It is likely that repeated or continuous exposure to damaging noises will cause a greater reduction in auditory response of these lizards. It is not unreasonable to expect loud noises to similarly impact the auditory performance of desert tortoises."

A study conducted by Bowles et al. (1999) showed very little behavioral or physiological effect on tortoises of loud noises that simulated jet over flights and sonic booms. They also demonstrated that tortoise hearing is fairly sensitive (mean = 34 dB SPL) and was most sensitive to sounds between 125 and 750 Hz, well within the range of the fundamental frequency of most of their vocalizations. The authors concluded that tortoises probably could tolerate occasional exposure to sonic boom level sounds (140 dB SPL), but some may suffer permanent hearing loss from repeated long-term exposure to loud sounds such as from ORVs and construction blasts.

ORV Activities

Like most other threats, off road vehicle (ORV) activities may affect tortoise populations in multiple ways: direct mortality by crushing tortoises on the surface or in burrows, or indirect mortality through habitat alteration from soil compaction, vegetation destruction (direct or indirect via dust), or toxins from exhaust. However, different types of ORV activities will likely have different effects on tortoise populations. There are basically four categories of activity that may have very different impacts: free play where vehicles are not restricted to designated routes and cross travel or off-road and off-trail activity probably occurs regularly; non-competitive recreational uses outside of free play areas are limited to designated roads and trails with any driving off of those routes being illegal; competitive events are organized races that are restricted to designated open areas; and unauthorized cross-country travel for recreational or commercial (e.g., mining exploration) purposes. Hence in this report, ORV refers to motorized vehicle travel off of paved and graded dirt roads whether they are on ungraded dirt roads, trails, or cross country driving. ORVs can include dirt bikes, sport utility vehicles, all-terrain vehicles, sand rails, and any other type of motorized vehicle that travels such roads.

Reduce Tortoise Density

A number of reports document ORVs may directly kill tortoises (see below), however the data are insufficient to evaluate the extent of its overall impact on tortoise populations. We must rely more on other measures such as differences in tortoise densities between areas used by ORVs and those free from such activity. For example, Bury and Luckenback (1986) compared tortoise densities inside and outside of an ORV free-play area. They found 3.8 times more tortoises in a control area lacking ORV activity compared to a nearby open area and the animals were significantly heavier ($p<0.01$) in the control area. They also found 2.8 times the number of burrows, more of which were active, in the control area. Most of the burrows in the ORV area were in the section most lightly used by vehicles. The denser vegetation in the control area made searching much slower, hence 3.6 times more effort was spent searching the control area. The differences in number of tortoises are not likely to be a consequence of differences in search time because identical and consistent methods were used to sample each area (Bury and Luckenbach 1977). As this study was unreplicated (only one control, and one treatment area were surveyed), it is conceivable that the differences detected are due to

causes other than ORV activity (e.g., soil or habitat differences or natural patchiness of tortoise populations).

Berry et al. (1986) compared tortoise populations inside of the DTNA and immediately outside where heavy ORV activity occurs. Using methods that are of questionable validity (Corn 1994a), they noted that significant declines occurred over a six-year period among juveniles and immatures in both areas, but that the declines were significantly greater in the adjacent area with more ORV activity.

Berry et al. (1994; for published abstract see Berry et al. 1996), compared evidence of human activity and tortoise sign (i. e., number of tracks, scat, and burrows, which is positively correlated to tortoise density; Turner et al. 1985) along 100 transects conducted in 1977-79 and 150 in 1990. They found that vehicle trails in 1990 were positively associated with areas classified as having low to medium densities of tortoises, but that numbers of vehicle trails and tracks were not directly correlated to actual number of tortoise sign. In one area, ORV activity had been stopped by BLM one year prior to the study, so vehicle tracks had been obliterated or were aged and did not accurately reflect the level of ORV activity the tortoise population had experienced over the past several years. Furthermore, the study lacked an adequate control site, but it is difficult to have good controls in a broad field study like this.

An indirect piece of evidence that ORVs reduce tortoise population density comes from Nicholson (1978). She reports on the findings of sets of transects walked at varying distances from the edges of several paved roads and highways in the Mojave desert. The study was designed to measure the effects of paved roads, not dirt roads or ORV travel on tortoise populations, thus is of little relevance to evaluating ORV impacts. She found that counts of tortoise sign increased with distance from paved roads. However, along Shadow Mountain Road, she found a reduction in tortoise sign 880 meters from the road edge, in an area with "excessive ORV use." She provided no statistical analysis of this observation, nor did she comment on the presence or absence of ORV activity along any of the 39 other transects she walked.

Direct Effects

CRUSHING TORTOISES AND BURROWS

Several accounts occur in the non-scientific literature of tortoises being crushed by ORVs, but most of these are anecdotal or unique incidents. In a popular account of ORV impacts to the desert environment, Luckenbach (1975) states: "I have personally found horned lizards, whiptails, zebra-tails, sand lizards, and tortoises crushed by ORVs;" no documentation or quantification was provided. Similar anecdotal statements were made in Berry and Nicholson (1984a) and Bury and Marlow (1973).

Berry and Nicholson (1984a) observed dead tortoises that were crushed in burrows that were apparently collapsed by ORVs, but no data or details were provided. Bury and Marlow's (1973) popular article about general impacts of ORVs on tortoises also makes the claim that burrows are crushed by ORVs, but provide no data. Fifteen

burrows found in 1976 and 1977 in an ORV-use area were collapsed in 1985, their collapse being "related to ORV activity from trails through the area" (Bury and Luckenback 1986), although they gave no further indication of how they determined the cause of collapse. Woodman (1986) and Burge (1986) found no crushed burrows following the Parker 400 and Frontier 500 races, respectively.

Four studies quantified vehicle-related mortality on study sites with frequent ORV traffic. In her preliminary analysis of 1357 tortoise carcasses found on 14 permanent study plots for studying tortoise populations, Berry (1990 as amended) attributed approximately 57 (4%) to vehicles (some of the data were presented in Berry et al. 1986). It must be noted that 787 (58%) of the shells were not evaluated or were unclassifiable either because they bore no diagnostic characteristics or were too fragmented to analyze. Campbell (1985) found 2 vehicle-killed tortoises, one apparently killed by a 4-wheel vehicle on a dirt road inside the preserve and another killed outside the preserve by a sheep watering truck. In their comparative study of ORV impacts, Bury and Luckenback (1986) indicated that one immature tortoise was found crushed in a motorcycle trail. In a review of tortoise population dynamics, Marlow (1974) states that "nine recently crushed tortoises were observed in an area supposedly closed to ORVs. From tracks surrounding most of the carcasses there was little question as to the cause of their deaths."

It is the correspondence between tortoise and ORV enthusiasts' habitat preference that is likely responsible for some of the conflicts between the two. Jennings (1997) showed that tortoises spent significantly more time in washes, washlets, and on small hills. This is because their preferred food plants occurred in these habitats and they tend to burrow and travel more in washes and washlets than in other habitats. Jennings (1997) claims these habitats are also preferred disproportionately by ORV recreationists, but presented no supporting data.

Indirect Effects

Compaction of Soil

Soil becomes compacted, at least temporarily, when a motorized vehicle passes over it, and that compaction changes with the weight of the vehicle, soil type, and moisture content of the soil (Webb 1983). But, the affect this compaction has on tortoise populations depends on the lasting effect of compaction, its effect on vegetation and burrow digging abilities, how widespread the compaction is, and the respective effects on tortoise survival and reproduction.

Davidson and Fox (1974) investigated the effect a motorcycle dual sport race had on Mojave vegetation and soil. The soil, which was of similar type at both sites, was significantly denser and less porous at a pit area and alongside a trail than at a control site several hundred meters away. Significantly fewer plant species, fewer individuals, and less cover were found in impacted areas compared to the control site. However, the study was unreplicated. An increase in bulk density of the soil was measured in an evaluation of the impacts of the 1974 Barstow to Vegas Race (BLM 1975). However, many of the

measurements were taken one week after a rain, so, because compaction is intensified on wet and moist soil (Webb 1983), the results may be unreliable.

Babcock and Sons (1973) found 10% or more increase in bulk density in disturbed versus undisturbed sites in alluvial wash, alluvial fan, and desert flat areas, but only a 3% increase in compaction in disturbed sand. Similarly, Wilshire and Nakata (1976) found sand dunes to be more resistant to compaction than playas or alluvial fans. Compaction was relatively light in heavily used dry washes and heavy in well used alluvial fans. Dry playas, which dry out fast after rains, resist compaction more than do wet playas (Wilshire and Nakata 1976), which are moist on or near the surface. Compaction on wet playas was measurable down to 15 cm or more.

In their manipulative experiment on the effect of vehicle type, number of passes, soil type, and soil moisture, Adams et al (1982a, b) measured soil compaction with a penetrometer. They found that compaction by a SUV was greater than that of a motorcycle. The SUV compacted wet soil significantly after only one pass on wet soil and after five passes on dry soil. The motorcycle compacted wet soil after 20 passes. Single passes by motorcycles on wet soil and SUVs on dry soils did not differ significant from the controls. The great variability in environmental conditions makes it difficult to make unambiguous generalizations.

Greater temperature extremes occurred in more compacted soils in heavy ORV use areas, probably from removal of vegetation and changes in soil characteristics from compaction (Willis and Raney 1971, Webb et al. 1978). This possible effect on soil temperature not only affects plant germination and growth, but may have interesting, if unexplored, implications for tortoise growth, development, and morphology. A further likely, but untested potential impact of soil compaction may be to make it difficult for tortoises to burrow, which would not only affect tortoises directly but would also reduce tortoises' role in reducing compaction through soil turnover (Prose et al. 1987).

Infiltration rate is a measure of the soil's ability to absorb moisture. More compacted soils have a lower infiltration rates so less water is available for plants (Webb 1983). Babcock and Sons (1973) found much lower infiltration rates on disturbed versus undisturbed desert sites, except in very sandy areas (dunes and washes). Webb (1983) measured 73% lower infiltration rate compared to a control site after 200 vehicle passes over wet sandy loam. The greatest decrease occurred after the first few passes. Infiltration rates of sands and clays are least affected by compaction, whereas loamy sands and gravelly soils are with a mixture of particle sizes are most affected.

DESTRUCTION OF CRYPTOGAMIC SOILS

Cryptogamic soils are important for reducing soil erosion, controlling water infiltration, regulating soil temperatures, fixing (catching and converting) atmospheric nitrogen, and accumulating organic matter (Cline and Rickard 1973, Pauli 1964, Rogers et al. 1966). Cryptogamic soils are collections of mostly symbiotic bacteria, algae, fungi, and lichen that live on or slightly below the soil surface and create a semi-permeable soil

surface. They often occur in the open spaces between desert shrubs and help to facilitate seedling establishment and plant growth (St. Clair et al. 1984, DeFalco 1995).

ORVs, livestock, and other surface disturbances easily damage cryptogamic soils (Belnap 1996). Damage from compaction, even minor, can greatly reduce nitrogen fixation by the crust, an effect that sometimes increases rather than decreases with time since compaction (Belnap 1996). It is not certain how tortoises are affected by damage to cryptogamic soils and a 1980 review of the effects of ORVs on desert soils was inconclusive (Rowlands 1980). DeFalco (1995) found that, in the one season studied, tortoises selectively avoided foraging on plants growing on crusts. Although crusts fix nitrogen and the nitrogen can then be transferred to plants growing in close proximity to the crusts (Maryland and McIntosh 1966), concentration of nitrogen in tortoise forage plants were generally lower on cryptogamic soils (DeFalco 1995). However, many other nutrients are important to tortoises, and it is unknown if their concentrations are augmentated by cryptogams in associated tortoise forage plants. In non-tortoise habitat in southwest Utah, Belnap and Harper (1995) showed that nitrogen, phosphorus, potassium, calcium, magnesium, and iron concentrations were higher in some plant species growing on encrusted soils compared to those growing where there were no crusts. The primary importance of cryptogamic soils to tortoise populations could be in stabilizing the soils against wind and water erosion (Belnap and Gardner 1993, DeFalco 1995), but more research is clearly needed.

CHANGES IN VEGETATION

Several studies measured the effect ORVs have on vegetation; most of them evaluated damage from competitive events. Burge (1986) described how many perennial shrubs were damaged along the edge of the Frontier 500 competitive race. She counted 1170 uprooted or crushed shrubs (no species identified) after the race. Davidson and Fox (1974) measured plant diversity, number of individuals, and amount of cover in a pit area (where vehicles were parked), alongside a dual sport race trail, and “several hundred yards away” (i.e., control area). They found significantly lower values for all three parameters in the pit area, moderate values alongside the trail, and the highest values at the control site. Woodman (1986) recorded the destruction of several creosote and burrobushes around the periphery of the pit area for the 1981 Parker 400 race. A BLM report detailing damage to vegetation caused by the 1974 Barstow to Vegas Motorcycle Race (BLM 1975) showed that 0 to 76% of the plants, particularly seedlings and small shrubs, were damaged in each of 26 sites.

Berry et al. (1990) measured habitat changes over a six-year period inside and outside of the DTNA where ORV non-race activity occurred. They found a 23% increase in habitat loss around a staging/pit area and that ORV trails increased in width by 130% and 157% in area.

Vegetation is clearly degraded by heavy ORV activity. Bury and Luckenback (1986) compared vegetation inside (treatment) and outside (control) an ORV use area south of Barstow. There were 1.7 times the number of live perennials on control, and 2.4

times number of dead ones (mostly *Ambrosia dumosa*) on the treatment area. Plant cover was 3.9% higher in the treatment area. This study suffers from a lack of replication. Comparing aerial photographs taken at the same points 19 to 25 years apart in six different locations in the Mojave and Colorado Deserts, Lathrop (1983) measured an average of 49% reduction in shrub density in ORV areas. Ground-based transects in control and treatment (disturbed) sites yielded 48-97% reductions in perennial plant cover in the ORV use areas. Thirty-four to 46% reductions in density resulted from single race events at two separate locations (Lathrop 1983). Luckenbach (1975) reports, that "in one Hounds-and-Hare race, an estimated 140,000 creosote bushes (*Larrea tridentata*), 64,000 burro-weed *(Franseria dumosa*), and 15,000 Mojave yuccas (*Yucca schidigera*) were destroyed or severely damaged over a stretch of 100 miles." No additional details were provided.

Rowlands et al. (1980) and Adams et al. (1982b) conducted one of the only manipulative experiments on ORV effects on Mojave desert vegetation. They studied the effect that different numbers of passes over the same area by a motorcycle and a 4-wheel drive sports utility vehicle (SUV) had on plant growth. They also looked at the interactive effects of soil moisture and soil type. Plant density, biomass, and cover generally were reduced following any level of disturbance with motorcycles requiring a greater number of passes to equal the reduction caused by the SUV. Grama grass (*Bouteloua barbata*), appeared to respond positively to light disturbance, but less so to heavy disturbance. The introduced weed, split grass (*Schismus barbatus)*, was significantly more abundant within tracks than in control areas, probably because the fibrous nature of their roots allowed them to become better established than more tap-rooted natives in compacted soil.

Vollmer et al. (1976) found annual plant density to be significantly lower within experimentally created tracks from two 4-wheel drive vehicles compared to the hump between the tracks and in an area randomly covered by the same vehicles. No difference in density occurred between the randomly driven area compared to the control site. Shrubs in the regularly driven area (42 passes by vehicles) suffered twice as much damage as those in the randomly driven area. This study lacked replication and proper controls, but data collection and analysis were well executed.

Kuhn (1974, cited in Lathrop 1983) reported a reduction in plant density of 24% and plant cover of 85% in ORV-disturbed plots compared to undisturbed controls in foredunes at Kelso Dunes. Similarly, comparing aerial photographs taken 21 years apart, Lathrop (1983) measured a 50% reduction in shrub density in the same foredunes.

EROSION AND LOSS OF SOIL

ORV activity can increase erosion, which removes soil nutrients and soil that is penetrable to roots (Adams and Endo 1980a, Wilshire 1980). ORVs modify various features that help to stabilize the soil against erosion including surface crusts, coarse particles, desert pavements, and vegetation (Hinckley 1983). They also alter the configuration of the ground surface thus affecting water runoff patterns (Hinckley 1983).

The net loss of soil at specific ORV-use areas has been documented. Wilshire and Nakata (1976) estimated 150 metric tons of dirt were lost to erosion from one 68-meter long western Mojave hillside trail with a 44-58% slope. Total estimated loss for the portion of hill used for an unspecified number of years was 11,000 metric tons. Snyder et al. (1976) estimated that 150-230 mm of soil was lost per year along transects in an ORV use area over two to five years at Dove Canyon. That amount is compared to estimates of natural erosion rates of 1.0 to 4.6 mm per year in arid areas (reported in Hinckley et al. 1983). No control or low-impact reference sites were established in this study. Webb et al. (1978) reported a loss of 0.3 to 3.0 metric tons per m^2 from an ORV trail in arid land at a heavily used ORV park in central California. They further reported that erosion was greatest on sand loam and gravelly sandy loam and least on clay and clay loam.

In artificial rain trials, Iverson (1979) found greater sediment yield (soil runoff) in vehicle-disturbed versus undisturbed slopes from loosening of soil and alteration of flow patterns. The difference was thought to be from increased water flow velocity and more channeling of the flow, not from reduced filtration. Consequently the effect would be more pronounced during intense thunderstorms than during more mild winter frontal-type storms. Also using artificial rain, Eckert et al. (1977) looked at infiltration and sedimentation rates at two Mojave desert sites in Nevada following single and multiple passes of truck and motorcycle. Single passes made no measurable difference. Multiple passes increased rates of infiltration and sedimentation, particularly in interplant spaces versus beneath plants. However, the artificial rainfall rates were similar to rare very heavy thunderstorms; they were unlike the winter cyclonic rainfall that is more typical of the western Mojave desert. Furthermore, Reicosky (1979) suggested that movement of water towards vehicle tracks compensates for decreased infiltration rates. Hinckley et al. (1983) suggested that water erosion would be the least in areas that are relatively flat, experience short, low-intensity storms, and have a coarse (gravelly) surface.

Fugitive dust, dust blown from the ground by wind and vehicle activity, can potentially be a problem for desert tortoises. Fugitive dust is related to vehicle speed, surface texture, surface moisture, and probably vehicle type (with heavy four-wheel drive vehicles causing the most dust followed by light four-wheel drive vehicles followed by motorcycles; Adams and Endo 1980b). The threshold velocity for wind erosion (TV), the lowest wind speed necessary to create dust, is highest for desert pavement and areas with hard surface crusts. Soils with a large proportion of fine particles will be more susceptible to wind erosion. Disturbances that lower the TV will increase the incidence of dust storms. Disturbance of sand dunes and sandy washes does not alter their TV. Areas protected by cryptogamic soils and desert pavement had greatest reduction in TV following disturbance, and more so with siltier versus sandy soils (Adams and Endo 1980b, Gillette and Adams 1983). Winds of 20-30 mph at 6 ft above ground caused fugitive dust in these areas. Erodibility also varies with width of disturbed area up to about five meters (Wilshire pers comm., cited in Adams and Endo 1980a)

Satellite images taken on January 1, 1973, captured dust storms from Santa Ana wind conditions (Bowden et al. 1974, Wilshire 1980). Many of the dust plumes, which were 10 to 30-km long and covered 300 km^2, originated in areas of intensive ORV

activity in the western Mojave. BLM (1975) measured three to five times more suspended particulate density for fugitive dust during the 1974 Barstow to Vegas race site compared to before the race.

The main effect of wind erosion on productivity is removal and redistribution of surface nutrients, not reduction in soil depth. Loss of soil nutrients found in the top 5 to 10 cm of soil significantly reduced perennial cover in a similar arid environment in Australia (Charley and Cowling 1968). Sharifi et al. (1997, 1999) showed that photosynthesis and plant productivity are hampered by dust on the leaves of desert shrubs, but that the effect may be ameliorated by heavy summer rainfall.

LIGHT ORV USE

Most of the foregoing discussion relates specifically to competitive events and heavy use like what now occurs within open use or freeplay areas. They are of limited applicability to understanding the effect of lighter travel in areas where traffic is legally restricted to designated routes (i.e., dirt roads). Indeed, very little data are available to evaluate these impacts primarily because the focus of most research has been on the effects of heavier ORV use. There are a few studies that demonstrated that occasional vehicles riding off of roads (including for parking or camping within 100 ft of roads, which is currently permitted, Bureau of land Management 1980), can damage the soil and vegetation, the amount of damage being less than heavier off road travel. Webb (1983) found that the greatest increase in compaction occurred the first few time a motorcycle crossed an area and compaction increased with more crossings, but at a lower rate. Similarly, Adams and Endo (1980a) discovered that just a few passes by an SUV were sufficient to significantly increase compaction and a single pass did so in some wet soils. Vollmer et al. (1976) found that there was damage to plants in an area subjected to random four-wheel drive activity, but that damage was higher in areas that were repeatedly driven over. Bury and Luckenbach (1977) reported little difference in the number of creosote shrubs in moderate use versus undisturbed plots, but did find that half were broken or damaged in the moderate use area. Likewise, a “sparsely” used ORV area within the Jawbone Canyon Open Area showed 35% less perennial plant cover than an unused control area (Lathrop 1978). Finally, just stepping on cryptogamic crusts can damage and decrease nitrogen fixing activities of the crusts (Belnap 1996).

All of these studies indicate that some damage is likely to occur when vehicles stray off of established roads. Goodlett and Goodlett (1993) demonstrated that ORV enthusiasts will not always obey signs indicating routes are closed, nor do they always stay on designated routes. However, their study was conducted in an area that had recently changed from an open free play area to a limited use one. Although it is likely that number of tracks will be highest in close proximity to roads (e.g., LaRue, pers obs.), no studies have tested for this pattern. Many of the problems associated with light ORV use likely relate to increased human access the roads and trails afford (see "Human Access to Tortoise Habitat" section, below).

Summary

Although each study comparing tortoise densities inside and outside of ORV areas has limitations, they all lend evidence to reductions in tortoise population densities in heavy ORV use areas. The causes for these declines are less certain. Tortoises and their burrows are crushed by ORVs, although it is difficult to evaluate the full impact this activity currently has on tortoise populations, partly because there are probably relatively few tortoises in most open use areas. ORVs damage and destroy vegetation. Density, cover, and biomass are all reduced inside versus outside of ORV use areas, particularly following multiple passes by vehicles. Split grass (*Schismus barbatus)*, a weedy introduced grass, in particular appears to benefit from ORV activity. Very light, basically non-repeated, vehicle use probably has relatively little long-term impact. Soil becomes compacted by vehicles. The compaction increases with moisture content of the soil, weight of vehicle (particularly high weight to tire surface area ratio), and soil type. Cohesionless sand, such as in sand dunes and washes, are largely immune to compaction while moist soils are much more susceptible than dry ones. Compaction, lower infiltration rates, loss of plants and cryptogamic soils all contribute to increased wind and water erosion and fugitive dust, particularly when such areas are several meters in width. More research is needed to understand the effect light ORV use has on tortoise populations and habitat.

Predation/Raven Predation/Subsidized Predators

Desert tortoises have several natural predators including: coyotes, kit foxes, feral dogs, bobcats, skunks, badgers, common ravens, and golden eagles. The dominant predator probably varies temporally, spatially, and with size of the tortoise (Berry 1990 as amended). Few studies have attempted to quantify or estimate the relative proportion of mortality attributable to the various predators at specific sites, and none attempt to characterize it regionally.

One of the earliest publications reporting that ravens are potentially important predators on desert tortoises was Campbell (1983). He found 140 shells of juvenile tortoises (36 to 103 mm MCL) at the base of fence posts along the 30.5 miles of fencing surrounding the DTNA. He attributed 136 to raven predation, but gave no indication why. Berry (1985) evaluated 403 juvenile tortoise shells found on 27 desert tortoise study plots throughout the Mojave Desert. She determined that ravens killed 35%. Her evaluation was based on circumstantial evidence because the reference collection was shells found beneath perch sites that may have been used by other predators or scavengers. Although the patterns of shell damage she used are consistent with the patterns Boarman and Hamilton (in prep.) obtained from 266 shells collected from beneath raven nests. Also, ravens are scavengers as well as predators, so some of the shells attributable to raven predation may actually have been found and eaten after death (Boarman 1993).

During the first 5 to 7 years of life, the tortoise shell is incompletely ossified; it is soft and easy to puncture and rip open. When pecked open by a raven, the soft shell will

bend then dry in place leaving parts of the shell pushed in or pulled out. Carcasses found in this condition were likely pried open when the tortoise was alive or shortly after death. The shell soon dries after death. Once this happens the shell will fracture when pecked open, giving a different appearance. Although based on sound knowledge of the biology of tortoises, this scenario has not been subjected to quantification or controlled experimentation.

Woodman and Juarez (1988) reported finding 250 shells, probably killed over a four year period, dead beneath one raven nest near the Kramer Hills. Some of the carcasses found were of young animals found alive and individually marked by the same researchers several weeks earlier and apparently in healthy condition. This provided the first hard evidence that ravens almost certainly were killing some tortoises, not just scavenging them. Since that time, several observations have been made of ravens carrying away live juvenile tortoises (Boarman 1993). One researcher reported finding a tortoise eviscerated, but still alive, beneath a raven nest (R. Knight pers. comm.). These reports all remain anecdotal, but, because observing the act of predation by a predatory bird is notoriously difficult, it is unlikely we will ever be able to acquire an adequate number of good hard data on the phenomenon. One published account evaluated food of ravens in the Mojave desert by looking at pellets, indigestible portions of food that were coughed up at their nests (Camp et al 1993). They found tortoise remains in only 1.3% of the pellets. However, they did not report the 19 shells they found at several of those nests because they only reported on pellet contents (Camp pers. comm., Boarman pers. obs.); shell fragments usually are not found in pellets. They also did not establish whether all nests studied were in tortoise habitat.

The fact that ravens do kill some tortoises does not alone indicate that the losses are serious enough to warrant management action. We must understand the extent of predation and if it is having an impact on tortoise populations. Evaluating raven predation is perplexing because of the difficulties in finding small carcasses over such a large area of desert and in monitoring small, hard to find young tortoises (Berry and Turner 1986, Shields 1994). The extent of predation can be estimated by evaluating juvenile tortoise carcasses found throughout the desert. Berry (1985) and Boarman and Hamilton (in prep) analyzed the characteristics of 150 and 266, respectively, juvenile tortoise shells found in the deserts of California. Their reports indicate that primarily animals less than 100 mm MCL (less than approximately 5-7 years old) are taken throughout most portions of the desert in California. Beneath 23 transmission towers in Nevada, McCullough Ecological Systems (1995) found the remains of 78 juvenile tortoises, many showing signs consistent with raven predation.

A common argument made against raven predation being of management concern is that we must concentrate on protecting adult female tortoises (Doak et al. 1994). This is partly because adult females are the ones actually reproducing, thus contributing most to the persistence of the population and partly because juvenile animals typically experience high mortality, so losses to ravens are natural and the population can sustain the losses. This is a correct prediction from life history theory for many animal species, but not for long-lived ones that first reproduce later in life (approaching 20 years), like the desert tortoise (Congdon et al. 1993, 2002). Life history theory predicts that stable

populations of such animals can sustain annual mortality of juveniles of 25%. However, when adult populations are declining, juvenile mortality must be reduced to approximately 5% to ensure recruitment of new individuals into the breeding population (Congdon et al. 1993). This finding is based on well developed life history theory. Therefore, in tortoise populations that are experiencing overall declines, additional losses of juveniles to ravens may decrease the stability or at least prevent recovery.

A survey of tortoise remains found beneath raven nests was recently completed (Boarman and Hamilton in prep.). It showed that ravens prey on tortoises throughout the Mojave Desert in California, but probably not all ravens nesting in tortoise habitat ate tortoises. The most shells found at one nest in one year between 1991 and 1997 was 28, which were found beneath each of two nests in the eastern Mojave Desert. The results are preliminary and conservative because they pertain only to remains dropped beneath or near the raven nests. Many shells are found at locations well away from nests. During the raven breeding season, however, most foraging is probably done near the nest (Sherman 1993) and most food is likely brought back to or near the nest, so the results are probably relatively accurate if conservative.

There are little data available to determine the effect other predators might have on desert tortoise populations. For example, finding shells chewed by mammals, probably canids, and tortoise remains in coyote scat, Berry (1990 as amended) reported evidence of canid or felid predation at four out of twelve study plots in California. Proportion of deaths attributable to mammalian predators over all 12 plots was 53.% (ranged = 1.8% to 45.3% among the 4 plots where mammal-related mortality determined). Turner et al. (1997b) determined that most tortoise nests that failed were dug up by coyotes or kit foxes, but no data were presented. In 1998 and 1999, 47% and 12%, respectively, of nests studied at Twentynine Palms (MCAGCC) were dug up, probably by kit foxes (Bjurlin and Bissonette 2001). Bjurlin and Bissonette (2001) also believed that feral dogs cause a significant amount of mortality among adult tortoises in the area, but presented evidence for only one such death. They did report a high incidence of canid-like shell damage to live tortoises and the presence of feral dogs and dog packs within their study site. The effect that feral dog predation has on tortoise populations appears to be an emerging problem that warrants further documentation.

Non-ORV Recreation

Non-ORV recreation in the Mojave Desert includes camping, nature study, rock collecting, sight-seeing, hunting, horseback riding, mountain biking, and target practice. There are no studies concerning their impacts on tortoise populations: hence, there may or may not be impacts. Likely impacts include handling and disturbance of tortoises; loss of habitat to campgrounds, picnic areas, scenic pull outs, vandalism, and other support facilities; increase in road kills; and support of ravens when organic garbage is left behind. There could also be soil compaction and damage of vegetation and cryptogamic crusts from off-trail travel by mountain bikes, horses, and hikers. All of these impacts are related to the problems with increased access to tortoise habitat (discussed in "Human Access to Tortoise Habitat" section, below). Given the increased interest in non-

motorized recreation in the deserts, this is an important area for future research. There are no studies that directly measured the impacts of non-motorized recreation on tortoise populations or their habitats and only one that showed that hiking off of trails can significantly damage cryptogamic crusts (Belnap 1996).

Hunting and target practicing are two additional recreational activities that may impact tortoises. One of the primary anthropogenic causes for wildfire in the desert is from bullets striking rocks (R. Franklin, BLM Fire Management Officer, pers. comm.), which can occur while hunting or target practicing. The California Department of Fish and Game has constructed an array of small- and big–game guzzlers to help facilitate growth of game species populations. Not only can ravens sometimes access water at the big game guzzlers, but tortoises can get caught and die in some types of small game guzzlers. Hoover (1996) found the remains of 26 tortoises in 89 of the upland game watering devices in California. Finally, people target practicing, which is a very different activity than hunting, might also illegally use tortoises as targets (Berry 1986a, see "Vandalism," below).

Roads, Highways, and Railroads

Roads, highways, and railroads have several impacts on desert tortoises and their habitat. Direct impacts may include mortality through road and train kills and destruction of habitat (including burrows). Possible indirect effects include degradation of habitat because they serve as corridors of dispersal for invasive plants, predators, development, recreation, and other anthropogenic sources of impact. Roads, highways, and railroads also serve to fragment the habitat and populations (see "Habitat Degradation, Fragmentation, and Destruction," below).

Many tortoises fall victim to road kills. For instance, Boarman and Sazaki (1996) reported finding 115 tortoise carcasses along 28.8 km of highway in the west Mojave. This represents a conservative estimate of 1 tortoise killed per 3.3 km of road surveyed per year. This source of mortality primarily affects subadults and adults, although the results are partially skewed by the difficulty of finding smaller carcasses and their quicker loss to scavengers and decay. The figures cannot be extrapolated to all roads and highways to estimate total losses to road kills in the desert because mortality rate likely depends on traffic speed and volume, density and demography of surrounding tortoise population, and perhaps width and age of road. The results also cannot be applied to lightly traveled paved or dirt roads because of a four-way relationship between tortoise density, road conditions, traffic volume, and road kill rate. A tortoise depression zone exists along highway edges and extends to 0.4 km or further (Nicholson 1978, Berry and Turner 1987, Berry et al. 1990, LaRue 1993, Boarman and Sazaki 1996, von Seckendorff Hoff and Marlow 1997, cf. Baepler et al. 1994). The cause is probably primarily road kills, but illegal collections, noise, and other factors may also contribute although there are no data to evaluate their likely or relative effects.

A common mitigation for the impacts of roads and highways is a barrier fence, which has been shown to be highly effective at reducing mortality in tortoises and other

vertebrates in the west Mojave (Boarman and Sazaki 1996). However, fences only increase the fragmenting effects of roads. Preliminary results of an eight-year long study indicate that culverts are used by tortoises to cross highways (Boarman et al. 1998), but it is unknown whether their use is sufficient to ameliorate the fragmenting effects of fenced highways (Boarman and Sazaki 1996).

Roads are also major attractants for common ravens, which are predators on juvenile tortoises (Knight and Kawashima 1993, Boarman 1993). Ravens, being partly scavengers, are known for cruising road edges in search of road kills (Boarman and Heinrich 1999), but risk of predation is not increased near roads (Kristan and Boarman 2001).

The flush of vegetation that grows alongside roads (Frenkel 1970, Johnson et al. 1975) as a result of rainwater runoff and collection may benefit tortoises by providing a more consistent source of food over a more extended period of time, even in relatively dry years (Boarman et al. 1997). Alternatively, the abundance of food may bring them into harms way if (1) they wander onto the road, (2) vehicles pull onto the vegetated shoulder of the road, (3) grading or mowing activities occur during times of tortoise activity, (4) herbicides are applied to control growth of weeds along the road shoulder, or (5) they are seen and caught by passers-by. Brooks (1998) found a significant positive correlation between number of alien annual plant species near roads and density of dirt roads., and the species richness and biomass of alien annuals is higher near roads than away from them (Brooks pers. comm.).

Railroads may also impact tortoise populations through train kills and perhaps by tortoises getting caught between the rails (Mount 1986). No published studies were found that looked for train-killed tortoises along extensive sections of railroad tracks. However, Ron Marlow (pers. comm.) found eight carcasses between the rails along approximately 100 km of railroad tracks in the eastern Mojave. Noise or vibration may also affect tortoises that live alongside railroads, but has not been studied (see “Noise and Vibration,” above). Railroads provide a positive benefit: tortoises regularly build burrows in railroad berms that are not covered with gravel. It is not known if train noise negatively affects the behavior, audition, or reproductive success of these tortoises.

Utility Corridors

Corridors formed by utility and energy rights-of-way cause linear impacts to populations and may have levels of impacts well beyond those of many point sources of impacts. In a retrospective evaluation of results of 234 Biological Opinions issued by USFWS in California and Nevada (LaRue and Dougherty 1999), 80% (47/59) of the tortoises reportedly killed in California and Nevada were killed along utility corridors. Most of those were along the Kern-Mojave Pipeline (Olson et al. 1993, Olson 1996). Considerable habitat destruction or alteration occurs when pipelines and transmission lines are constructed and the impacts are repeated as maintenance operations or new pipelines or power lines are placed along existing corridors. Trenches opened for laying or maintaining pipes may serve as traps for tortoises and other animals (Olson et al.

1993). Dirt roads used for maintenance-related access create dust (Wilshire 1980) and provide access to less disturbed habitat (Brum et al. 1983). The habitat conversions during early stages of post-construction succession along pipeline corridors (Vasek et al. 1975) not only may suppress regular use by tortoises, but may function to reduce dispersal across the corridor thus effectively fragmenting a previously intact population (this view is speculative).

The presence of transmission towers in areas otherwise devoid of other raven nesting substrates (e.g., Joshua trees, palo verdes, cliffs), may introduce heavy predation to an area previously immune to such predation (Boarman 1993). Most raven predation on tortoises appears to occur during the raven breeding season (April - May, pers. obs.). By one estimate, ravens probably do most (75%) of their foraging within 400 m of their nest (Sherman 1993) and raven predation pressure is notably intense near their nests (Kristan and Boarman 2001). Therefore, ravens nesting on transmission towers, where no other nesting substrate exists within about 800 m, may significantly reduce juvenile tortoise populations within 400 m of the corridor, but this effect is quite localized. However, recent unpublished data on the distribution of raven depredated juvenile tortoises suggests that not all ravens nesting within tortoise habitat actually eat tortoises (at least they do not bring the shells back to the nest; Boarman and Hamilton in press).

Data collected along paved highways indicate that road kills can substantially reduce tortoise populations within at least 0.4-0.8 km of such roads (see “Roads, Highways, and Railroads” section, above), and their impact is likely lower along newer and more lightly traveled roads (Nicholson 1978). But, there are no data on the impact of lightly traveled dirt roads (e.g., utility maintenance/access roads) on tortoise population densities.

Vandalism

Vandalism is the “purposeful killing or maiming of tortoises” (Luke et al. 1991, p. 4-61). Reports of tortoises being vandalized include shooting, crushing, running over, chopping off heads, and turning them over (Berry and Nicholson 1984a, Berry 1986a, Bury and Marlow 73). Most reports of specific incidents are anecdotal, but sometimes substantial. The most quantitative accounts are for gunshot deaths (Berry 1986a, 1990 as amended), but are mostly based on postmortem forensic analysis. Berry (1986a) found 91 tortoises carcasses (14.3% of those collected at 11 sites) showing evidence of being shot. The proportion of carcasses showing evidence of gunshots was significantly higher from west Mojave sites (20.7%) than from east Mojave (1.5%) and Colorado (2%) desert sites. Eleven of the 58 (19%) tortoise found dead on the Beaver Dam Slope, Utah, showed signs of traumatic injury. This category included individuals exhibiting gunshot wounds. These ranged from pellet wounds through .22 caliber holes to one individual exhibiting a .44 caliber bullet wound.

Wild Horses and Burros

Wild burro and tortoise ranges overlap in some places, but the overlap is quite low in the West Mojave. No published studies were found that investigated the impact burros or horses (neither of which are native to North America) have on tortoise populations. The primary effect is likely to be habitat alteration through soil compaction and vegetation change. Burro populations are probably not extensive enough in most areas to pose a major threat to tortoise populations, but this is speculative.

CUMULATIVE THREATS TO TORTOISE POPULATIONS

Human Access to Tortoise Habitat

Perhaps the most important general threat to tortoise populations relates to actual human presence in tortoise habitat and thus refers primarily to access. Many of the individual threats discussed above relate to the level of access to tortoise habitat afforded to people. For instance, law enforcement officials have documented illegal collecting of tortoises for food or cultural ceremonies on a few occasions (USFWS 1994). One study supported the intuitive impression that poaching occurs close to roads (Berry et al. 1996), but the methods employed were not very precise (counting burrows that appeared to have been dug up with shovels) making the results weak at best. Since roads likely provide access to poachers, a logical conclusion of their study is that a larger proportion of the tortoise population will be under the risk of being poached where more roads intrude on tortoise habitat.

The presence of a road poses potential harm to tortoises and their habitat and the more roads there are the greater is the proportion of the tortoise population that is under the threat of illegal off-road activity. Boarman and Sazaki (1996) demonstrated that tortoises regularly die from collisions with automobiles and Nicholson (1978) showed that the rate of mortality probably increases with traffic volume. So, road kill is probably proportionally lower on lightly traveled dirt roads, but may still exist. However, because tortoise populations are probably less depressed alongside lightly traveled roads (Nicholson 1978) and if tortoises are less inhibited from crossing narrower, dirt-covered roads (for which there are no data), we may speculate that proportionally more tortoises may cross lightly traveled roads. The possibility does exist that ORVs may crush tortoises or their burrows on or off of roads (Marlow 1974, Bury and Luckenbach 1986, Berry 1990 as amended).

Mortality on roads is not the only type of vehicle-related impact; ORVs sometimes drive off of established routes, including within 100 ft to camp and park (Bureau of Land Management 1980). One study has supported the hypothesis that off-road activity is high near dirt roads even in an area that was heavily signed (Goodlett and Goodlett 1993). For example, they counted an average of one track every 31 feet along transects walked perpendicular to authorized routes. As expected, the density of tracks decreased with distance from the road from an average of 2.1 per 20 ft near the road to 0.5 per 20 feet 250 to 300 feet away. No statistical analyses were made. Goodlett and

Goodlett (1993) also demonstrated that ORV recreationists ignored BLM signs indicating trails and roads were closed to vehicles in the Rand Mountains. An average of 11.5 new tracks was counted along 17 trails 6 to 7 days after the trails were raked. An average of 10.0 tracks was found along 20 unmarked routes (again, no statistical analyses were provided), which suggests that the signs were essentially ineffective at preventing people from riding on closed trails. The motorcycle activity occurred over Thanksgiving weekend, 1991.

Furthermore, there is ample evidence that occasional driving off of roads compacts soil and damages vegetation (Vollmer et al. 1976, Webb 1983, Adams et al. 1982a, b, see also "ORV" section, above). The greatest increase in compaction can occur after a single or very few passes by a vehicle over unimpacted soil (Webb 1983), or at least soil strength (a measure of compaction) is significantly increased after a very few passes by an SUV (Adams et al. 1982a, b). Any driving or even walking over cryptogamic crusts damages the crust (Belnap 1996). As discussed in the "ORV Activities" section, above, there are very little data to indicate how these habitat alterations might affect tortoise populations.).

Other potentially harmful activities that likely occur in greater numbers near roads include: mineral exploration, illegal dumping of garbage and toxic wastes, release of ill tortoises, vandalism, anthropogenic fire, handling and harassing of tortoises, and trailing of sheep (Berry and Nicholson 1984a). Invasive plants also proliferate near roads and where road densities are higher (Brooks 1995, 1999a). The threat posed to tortoise populations by all of these factors likely increases with increased access afforded by the proliferation of roads, even very lightly traveled ones. Furthermore, some of these individual threats may be relatively low, but their cumulative impact may be great. Berry (1990 as amended, 1992), presents data that suggests a correlation between tortoise population declines and density of roads, trails, and tracks on tortoise study plots, but the results have not been treated to statistical analysis. This important association between access and tortoise wellbeing needs further study.

Habitat Loss, Degradation, and Fragmentation

One of the most pervasive problems for desert tortoise populations is also among the most difficult to evaluate: habitat loss, degradation, and fragmentation from the myriad activities that take place in the desert. This is the cumulative result of several of the individual threats discussed above.

Habitat loss is generally quite apparent (e.g., loss of useable habitat when paved for a parking lot or plowed for agriculture), but is sometimes less than obvious (e.g., a given area may be rendered unusable by tortoises after soil is heavily compressed and vegetation is destroyed after many vehicles drive over the area). Previously useful habitat may be rendered unusable, but may appear superficially similar to useable habitat.

Habitat degradation consists of human-mediated changes in habitat characteristics that render an area less valuable to, but still potentially usable by, tortoises. The

degradation may be manifested in altered soil structure, increased exotic plants, lower abundance of preferred forage plants, reduced availability of effective cover sites, or a combination of these traits. The degradation may not directly cause increased mortality in tortoise populations, but may reduce reproductive output or cause some animals to leave the area in search of less degraded habitat. Although these responses have been hypothesized, there have been no studies on tortoise habitat choice or preference patterns changing as a result of habitat changes.

Many of the impacts discussed above fit easily into the category of habitat degradation that may significantly reduce habitat quality for tortoises. A single vehicle driving over a section of ground may have little impact by itself (Adams et al. 1980a, b), but when that is added to a pile of trash nearby, compaction from grazing (Avery 1998), and reduced primary productivity of plants because of dust from a nearby dirt road (Sharifi et al. 1997), the cumulative habitat degradation may significantly reduce quantity or quality of forage for tortoises. The cumulative effects of factors leading to habitat loss and habitat degradation have been implicated as causes in the extirpation and drastic reductions in tortoise populations from the Antelope, Searles, and Indian Wells valleys, and in the vicinity of several other communities in the West Mojave (e.g., Barstow, Mojave, and Victorville; Berry and Nicholson 1984a, Feldmeth and Clements 1990, Tierra Madre Consultants 1991, USFWS 1994).

Fragmentation is the process by which solid blocks of habitat and populations depending on the habitat are broken up into smaller subunits with limited dispersal between habitat blocks (Meffe and Carroll 1997). Rivers, mountain ranges, major changes in soil or habitat type all represent natural causes of fragmentation. Highways, railroad tracks, towns, and other developments, isolated and conglomerated, are examples of anthropogenic factors that fragment desert tortoise habitat in the West Mojave Desert. Smaller populations are more susceptible to local extinctions as a result of both genetic and demographic (population) processes. A smaller population has fewer individuals available for interbreeding, which may result in genetic deterioration: inbreeding depression and loss of genetic diversity within the population (Frankham 1995). Genetic deterioration can result in the inability to adapt to short- or long-term environmental changes, which makes the population more vulnerable to extinction. Small populations are also susceptible to extinctions from random fluctuations in birth rate, death rate, age distributions, and sex ratios (Opdam 1988). Small populations suffer from the Allee Effect, the fact that it is harder to find a mate when there are fewer individuals in a population (Allee et al. 1949). Finally, smaller populations are more vulnerable to catastrophic events (e.g., disease epidemics, earthquakes, and floods) and random environmental fluctuations in such things as food resources. These processes (genetic deterioration and demographic consequences of small populations) are theoretical possibilities, but have not been documented empirically in desert tortoises populations (see USFWS 1994 for a theoretical analysis).

An additional problem associated with fragmentation is that the negative effects of habitat edges are increased considerably (Murcia 1995, Meffe and Carroll 1997). Edges, or boundaries, are problems for ecosystems because the microenvironment in the edge is different than in the interior: temperature, humidity, light, chemical inputs, etc.,

may all differ in edge regions. The distribution and persistence of many plant and animal species are often strongly affected by these microenvironmental conditions, so the communities are usually different along edges. Furthermore, edge conditions often facilitate the introduction, establishment, and spread of exotic species that may become predators or competitors with plants or animals in the interior (Janzen 1986, Wilcove et al. 1986). For desert tortoises, the edge effect is a theoretical possibility, but it has not been well documented in tortoise populations. Furthermore, some edge effects may only function over relatively short distances (e.g., tens of yards) or not at all (Ratti and Reese 1988, Murcia 1995).

There are little data that directly test this hypothesized cumulative effect of multiple impacts on tortoise populations. Berry and Nicholson (1984a) do cite anecdotal evidence of the loss of previously-existing populations in now heavily-populated areas of Antelope, Lucerne, and Yucca valleys. Berry et al. (1994) present correlative data showing that declines in tortoise populations in the Rand Mountains and Fremont Valleys correlate with increases in a suite of human impacts. The Desert Tortoise Recovery Plan (USFWS 1994) provides data that show significant declines occurred in populations exhibiting high rates of human-caused mortality.

Urbanization and Development

Whereas construction activity (treated as an individual threat, above) has impacts specific to the activities of building new structures (e.g., temporary compaction of vegetation and soil, fugitive dust, disturbance and possible death of tortoises), these impacts largely cease once construction has been completed (although for some impacts, such as soil compaction, there is a residual effect caused by delayed recovery, Lovich and Bainbridge 1999). The result of the construction activity is the presence of new structures, which are called here "developments," and which have its attendant impacts. These impacts include long-term or permanent loss or alteration of habitat, impacts from maintenance activities, disruption of tortoise behavior, and road kills (Berry and Nicholson 1984a, Luke et al. 1991).

Developments may be relatively isolated from each other, but “Urbanization” refers to cumulative effects of multiple and nearly contiguous developments including construction of permanent residences that cover large areas. Urbanization has several impacts associated with the presence of many people in the area, not, all of which are well documented. Urbanization results in considerable fragmentation, loss of habitat, and habitat alteration to the point of being largely useless to tortoise populations (Berry and Nicholson 1984a, Feldmeth and Clements 1990, Tierra Madre Associates 1991, section titled “Habitat Loss, Degradation, and Fragmentation”). Some recreational activities may emanate directly from urban areas. Wild dogs may be more prevalent (e.g., Bjurlin and Bissonette 2001) and collecting, handling and vandalism of tortoises could increase where there are more people. Captive tortoises, potentially infected URTD (see "Disease" section, above), are more likely to escape and help spread disease to the native population (Jacobson 1993, Berry pers. comm.). Illegal dumping is prevalent (pers. obs.), raven populations are larger (Knight et al. 1993), and exotic plants predominate

(Humphrey 1987, Brooks 1998) around urban developments. Urban areas and associated flood control channels in the desert are often the source of much fugitive dust (Wilshire 1980). Many of these impacts may be relatively minor by themselves, but their cumulative effects on nearby tortoise populations may be great.

There is some evidence that tortoise populations can persist in the presence of light industrial developments. In the 1980s 460 wind turbines and 51 electrical transformers were erected in tortoise habitat at Mesa, California. Approximately 10-20 years later, there were still tortoises living and reproducing in the same area; some burrow beneath and rest upon concrete support pads for the turbines (Lovich and Daniels 2000). Reproductive output is higher than at any other site studied to date (Lovich et al. 1999). However, there are no data available to determine if the population has increased, decreased, or remained stable since construction. Tortoises may persist in this area because of the relatively low level of actual human activity in the wind park and the high productivity in the area, which is in the ecotone between creosote scrub and coastal sage scrub habitat.

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THE APPLICATION OF HABITAT MODELING TO THE DESERT TORTOISE (*GOPHERUS AGASSIZII*)

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ABSTRACT: Habitat modeling offers an approach to understanding some management problems of desert tortoises (*Gopherus agassizii*) and to focusing new research efforts. Modeling can provide (1) a method to organize existing information, (2) a means to identify whether physical habitat or some factor outside the scope of the habitat model is limiting populations, (3) a method to integrate habitat into resource development planning, and (4) a mechanism for focusing research on missing species-habitat information.

Key words: Desert tortoise; *Gopherus agassizii*; Habitat quality; Habitat model; Suitability graphs; Planning; Impact assessment

THE relationship between desert tortoise (*Gopherus agassizii*) abundance and habitat quality is an important factor in making decisions that influence tortoise populations or habitat. A system that discriminates between favorable and inferior tortoise habitats is useful for project planning. For example, when selecting desert areas for human use, it is better to avoid areas of high tortoise abundance or high habitat potential. Occasions also arise when appropriate management could improve habitat quality. In such instances, it is necessary to know which environmental factors are limiting tortoise habitat so that appropriate management measures can be initiated to improve habitat quality.

Another consideration is the California Energy Commission's recommendation to study the feasibility and effectiveness of moving tortoises from power plant sites to other areas. This tactic creates problems, including genetic mixing and possible complications associated with homing behavior by relocated individuals. A related problem is the identification of areas that are underpopulated and capable of supporting additional animals. Tortoise relocation raises several related questions. (1) What factors interact to provide high quality tortoise habitat? (2) Can differences in tortoise habitat quality be identified? (3) What relationships exist between habitats of different quality and tortoise abundance? (4) How will the tortoise respond to changes in specific habitat conditions? (5) Can this information be used in making decisions about where to place facilities?

One method of answering questions of this nature is to use a habitat model. A model uses existing information about critical variables to generate predictions and, using simplifying assumptions, provides testable hypotheses. A good model eliminates extraneous information that could inhibit, rather than contribute to, the development of sound management decisions (Overton, 1977). Model objectives must be established in any modeling exercise. If predictions of animal numbers are desired, a population model rather than habitat model should be developed. There are different kinds of habitat models. One type predicts the presence or absence of a species, whereas other habitat models provide information about habitat suitability over a range of habitat conditions.

Habitat suitability models can be structured in ways based on life requisites, life stages, seasonal habitats, or other criteria. One could develop separate habitat models for (1) habitat for adult tortoises, (2) habitat requirements of reproducing tortoises, or (3) the habitat of immature tortoises. In this paper, we discuss the type of habitat model that is capable of ranking hab-

itat quality of adult desert tortoises over a range of habitat conditions. We define a set of variables that are important in determining habitat quality and provide illustrations to show how habitat quality can be scaled as a function of those variables. This discussion is based on relationships beween habitat features and the distribution, occurrence, and abundance of adult tortoises. We recognize that very young tortoises may have other habitat requirements. The approach is heuristic and is intended to promote thought and help focus research on habitat relationships of desert tortoises.

Relationships between abundance and habitat structure are apt to be clouded by factors that may not be considered as part of the habitat model (Schamberger and O'Neil, in press). For example, in undisturbed areas, one would expect to find an equilibrium between tortoise numbers and the environment. However, the short-term effects of fire, predation, disease, or rainfall could result in short-term changes in abundance that may be unrelated to habitat potential. In addition, grazing, urbanization, road construction, mining, off-road vehicles, trails, and human depredation all have changed the tortoises' habitat and have reduced tortoise density. Thus, habitat models are not intended to be instantaneous predictors of animal abundance, but they attempt to focus on physical environmental factors that may influence habitat quality.

Habitat Suitability Index Models

The concept and use of Habitat Suitability Index (HSI) models have been described and used to model habitat relationships for numerous species (U.S. Fish and Wildlife Service, 1981). For example, the gray squirrel occupies forest communities in the eastern United States. Squirrels consume a variety of plants during the spring and summer, but they subsist almost entirely on nuts during fall and winter. Requirements for cover and reproduction are provided by trees. One underlying assumption in the evaluation of squirrel habitat is that fall and winter food supply always is most limiting. A model by Allen (1982) illustrated how percent canopy closure of trees producing nuts (V_1), tree species diversity (V_2), percent tree canopy closure (V_3), average diameter of overstory trees (V_4), and percent shrub crown cover (V_5) are believed to interact to describe the quality of squirrel habitat. A suitability index was developed for each of these five variables. Two life requisites that represent habitat quality for the squirrel, food and cover, were scored on the basis of the five suitability index values:

$$\text{Winter food} = (V_1 \times V_2)^{1/2}$$

$$\text{Cover and reproduction} = (V_3 \times V_4)^{1/2} \times V_5$$

The geometric mean (parenthetical expressions) is but one of several methods used in computing measures of suitability so that if either of two necessary components is zero the combined variable also is zero. In this example, the HSI for the gray squirrel is taken as the lowest value for the winter food or cover/reproduction components. This prevents a high score for one component from offsetting a deficiency in another limiting environmental requirement.

Elements of an HSI Model for Desert Tortoise Habitat

The ensuing discussion is designed to show how an HSI model might be developed and applied to the evaluation of desert tortoise habitat in California. General thoughts as to how various environmental factors interact to influence tortoise abundance were illustrated by Luckenbach (1982). He based his conclusions on observations along 137 transects (each 6.4 km in length) in southeastern California. Luckenbach discussed qualitative relationships between elevation, soil types, denning potential, vegetation, rainfall, species richness of perennial plants, and productivity of annual plants as related to tortoise habitat quality. Luckenbach's illustration indicated that the most favorable habitats were at elevations ranging from approximately 300–900 m, with sandy loam or light gravel-clay soils (good denning potential), a diversity of peren-

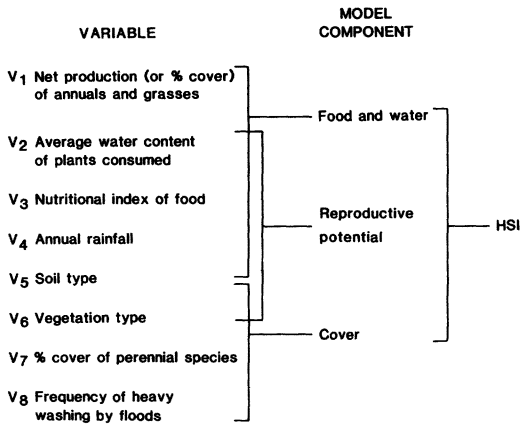

FIG. 1.—Example model structure for desert tortoise habitat.

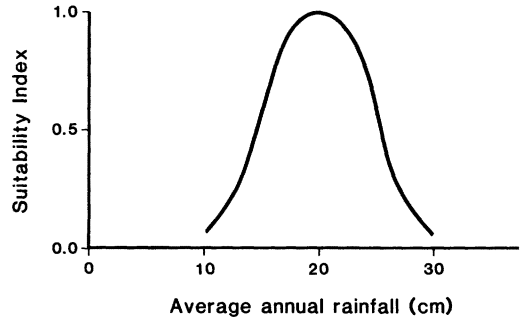

FIG. 2.—Suitability index graph showing the possible relationship between average annual rainfall and habitat quality for the desert tortoise.

nial plants, and a high production of ephemerals. Optimal habitat was dominated by creosote bush scrub (*Larrea tridentata*) in areas having 50–200 mm of annual rainfall. Luckenbach (1982) presented his data in a multi-axis illustration, not as a habitat model. However, some of these data are suitable for use in the HSI model approach.

Data from Luckenbach (1982), Berry (1984), and Turner et al. (1984) were used to structure a draft HSI model based on three model components (Fig. 1). Not all variables are related to tortoise distribution and abundance in the same way. Some are of broad scope and probably control the geographic distribution of the species with little effect on local patterns of occurrence. Others might be expected to exert site-specific influences. The habitat variables discussed below are related to food and water, cover, and reproductive requirements. Water is important to desert species because it provides free water following rainstorms and because the vegetation cycle, and consequently the availability of food and cover, follows precipitation patterns. The variables suggested in this paper are not intended to be a definitive list required to thoroughly describe tortoise habitat. Additional research may identify more useful variables.

Food and Water

Tortoises subsist almost entirely on plant material, which provides energy, minerals, and water. The following variables, some of which are interrelated, describe the food and water value of a site: net production by annual plants and grasses (V_1), water content of plants consumed (V_2), nutrient quality of food (including necessary minerals and caloric content) (V_3), and annual rainfall (V_4). Tortoises in some areas eat dirt, which may be a sign of a mineral deficiency in their diets (Marlow and Tollestrup, 1982). Calcium is an element required by tortoises for shell development and for synthesis of egg shells.

Cover

Tortoises rely both on shrubs and burrows for cover. Important vegetation variables that may be useful in a habitat model include the species of dominant or co-dominant shrubs as indicated by vegetation type (V_6) and total cover by perennials (V_7). In Arizona, tortoises often are found associated with rocky outcrops and may live in holes in or beneath rocks (Burge, 1978). In California, tortoises usually excavate burrows in soil. Hence, as indicated by Luckenbach (1982), soil type (V_5) has an important bearing on the quality of tortoise habitats in California. Frequency and extent of heavy washing by floods (V_8) also may be an important variable.

Reproductive Potential

The energy costs of reproduction are related to the same variables important in determining food value. Requirements for

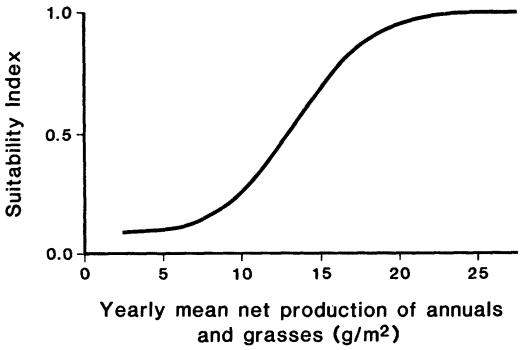

FIG. 3.—Suitability index graph showing the possible relationship between net production of annuals and grasses and habitat quality for the desert tortoise.

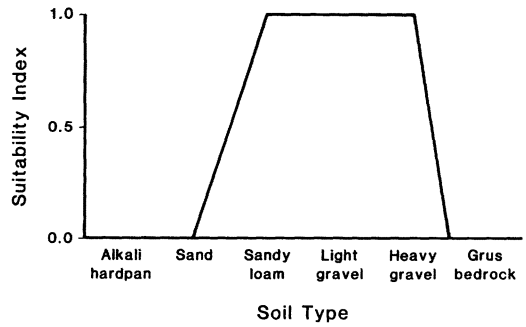

FIG. 4.—Suitability index graph depicting the possible relationship between soil type and habitat quality for the desert tortoise (from Luckenbach, 1982).

nests are the same as those relating to burrows, because tortoises establish nests at the bottom of burrows (Turner et al., 1986). Of lesser importance may be the size and spacing of shrubs, which might have some effect on courtship, if tortoises find each other by visual cues.

Model Variables and Habitat Quality

The foregoing text has identified eight variables believed to be important in describing desert tortoise habitat quality. The relationships between variables and habitat suitability need to be quantitatively defined. The typical HSI model uses mechanistic curves to define ranges of optimum or suboptimum habitat for habitat variables. Figure 2 illustrates how annual rainfall (see Luckenbach, 1982) might be scaled as a conventional HSI variable. The decline in habitat suitability as annual rainfall increases beyond about 20 cm/yr presumably reflects other features such as higher elevation or latitude. Figures 3–5 illustrate possible scalings of three other variables: yearly production of annuals, soil type, and vegetation type. Sometimes such relationships can be found in existing literature. Other times the relationships can only be estimated until more definitive research can be conducted.

Once the variables defining desert tortoise habitat quality are identified and related to habitat suitability, the next step is to determine a method to estimate overall habitat suitability. The simplest approach is to use the lowest value of all variables or the lowest life requisite value as the HSI value for the species. Although numerous methods are available, the method used must accurately represent the habitat relationships between the species and the variables.

DISCUSSION

Habitat models are useful for habitat evaluations, impact assessments, development of management and mitigation plans, and directing research. Actions that would influence one or more of the model variables can be simulated to determine the possible impact on tortoise habitat. For example, if food abundance was determined to be limiting habitat at a site, management options could be developed to increase the abundance of grasses and annual plants, thus increasing the food value of the site and increasing habitat quality.

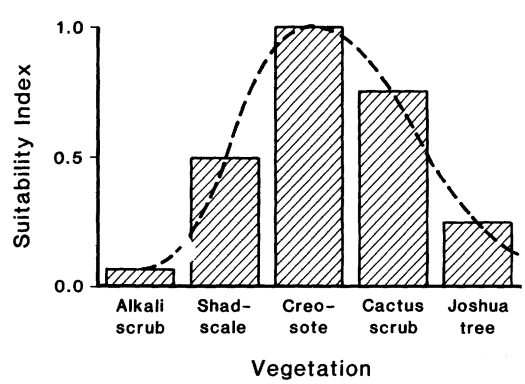

FIG. 5.—Suitability index graph depicting the possible relationship between vegetation type and habitat quality for the desert tortoise (from Luckenbach, 1982).

Research can be focused by use of the habitat modeling approach. The abundance of grasses and annual plants has been reported by Luckenbach (1982) as a factor influencing tortoise habitat quality. Research results could quantitatively relate the abundance of grasses and annual plants to habitat quality. This information would reduce subjectivity of habitat assessments, provide quantitative information that relates habitat to species well-being, and identify criteria for habitat assessment and management.

Previous discussion has emphasized the relationships between single environmental factors and habitat quality. Interactions between variables are more difficult to ascertain and model. How elevation, rainfall, soil type, and vegetation jointly affect tortoise habitat quality is not known. In addition, habitat factors may vary regionally. Earlier discussions by Nagy and Medica (1986) and Turner et al. (1986) showed how rainfall, plant production, and tortoise habitat relationships may vary from area to area; winter rainfall is a dominant influence in the western and northern Mojave Desert, whereas summer rainfall is more important in the eastern Mojave (see also Turner et al., 1984).

Fortunately, habitat suitability models are dynamic and can be modified as new information becomes available. In this paper, we have drawn on information based on counts of tortoises along 137 transects in southeastern California reported by Luckenbach (1982). Between 1976 and 1982, over 1800 additional transects were examined in this area (Berry, 1986). These data are now being used in multivariate analyses designed to clarify further some of the relationships described in this paper.

The habitat model approach provides a mechanism to organize existing habitat information about the desert tortoise, identify data gaps to suggest future research, and provide guidance for decision-making during the planning phase of resource development activities.

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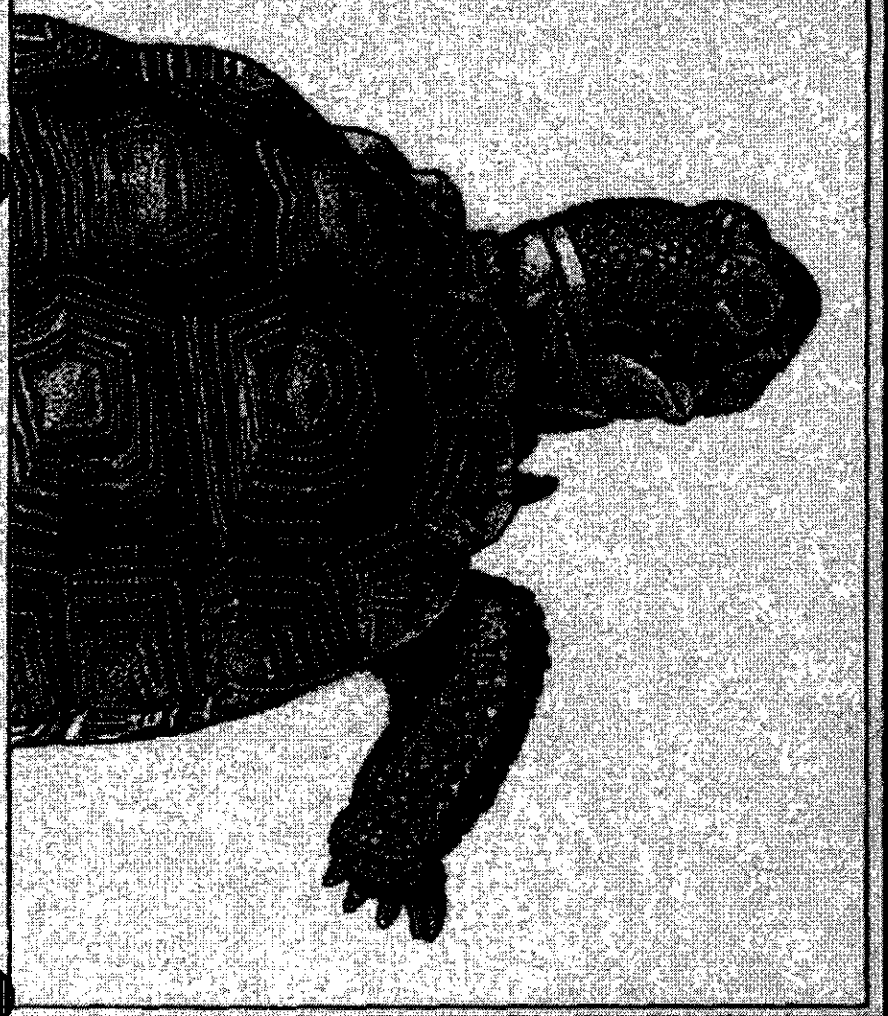
Desert Tortoise

(Mojave Population)



Recovery Plan

As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in island Territories under U.S. administration.

Desert Tortoise

(Mojave Population)

Recovery Plan

June 1994

Prepared for Regions 1, 2, and 6 of the U.S. Fish and Wildlife Service
Region 1 - Lead Region, Portland, Oregon.

DESERT TORTOISE (MOJAVE POPULATION)

RECOVERY PLAN

Prepared by
the Desert Tortoise Recovery Team

For

Regions 1, 2, and 6
U.S. Fish and Wildlife Service
Region 1 - Lead Region, Portland, Oregon

Approved _____
Regional Director, U.S. Fish and Wildlife Service

Concurred _____
Chairman, Desert Tortoise Management Oversight Group

Date Approved June 28, 1994

DISCLAIMER PAGE

Recovery plans delineate reasonable actions which are believed to be required to recover and/or protect listed species. Plans are published by the Fish and Wildlife Service, sometimes prepared with the assistance of recovery teams, contractors, State agencies, and others. Objectives will be attained and any necessary funds made available subject to budgetary and other constraints affecting the parties involved, as well as the need to address other priorities. Recovery plans do not necessarily represent the views, official positions, or approval of any individuals or agencies involved in the plan formulation, other than the Fish and Wildlife Service, and only after they have been signed by the Regional Director or Director as approved. Approved recovery plans are subject to modification as dictated by new findings, changes in special status, and the completion of recovery tasks.

LITERATURE CITATION SHOULD READ AS FOLLOWS:

Fish and Wildlife Service. 1994. Desert tortoise (Mojave population) Recovery Plan. U.S. Fish and Wildlife Service, Portland, Oregon. 73 pages plus appendices.

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EXECUTIVE SUMMARY

Current Status:

The range of the desert tortoise, *Gopherus agassizii*, includes the Mojave and Sonoran deserts in southern California, southern Nevada, Arizona, the southwestern tip of Utah, and Sonora and northern Sinaloa, Mexico. The Mojave population of the desert tortoise (an administrative designation for animals living north and west of the Colorado River) was listed as threatened on April 2, 1990. Critical habitat for the Mojave population was designated on February 8, 1994.

Habitat Requirements and Limiting Factors:

The Mojave population of the desert tortoise occurs primarily on flats and bajadas characterized by scattered shrubs and abundant inter-space for growth of herbaceous plants, with soils ranging from sand to sandy-gravel. Desert tortoises are also found on rocky terrain and slopes, and there is significant geographic variation in the way desert tortoises use available resources.

The Mojave population was listed because desert tortoise numbers are declining precipitously in many areas. These declines are mainly attributed to direct and indirect human-caused mortality coupled with the inadequacy of existing regulatory mechanisms to protect desert tortoises and their habitat. Impacts such as the destruction, degradation, and fragmentation of desert tortoise habitat result from urbanization, agricultural development, livestock grazing, mining, and roads. Human "predation" is also a major factor in the decline of desert tortoise populations. Predation is used here in its broadest sense, meaning the taking of desert tortoises out of their populations either by death (accidental or intentional) or removal from native habitat. An upper respiratory tract disease (URTD) is an additional major cause of desert tortoise mortality and population decline, particularly in the western Mojave Desert.

Recovery Objective:

Delisting through recovery.

Delisting Criteria:

Genetics, morphology, behavior, ecology, and habitat use define six distinct population segments or recovery units[1] within the range of the Mojave population: northern Colorado, eastern Colorado, upper Virgin River, eastern Mojave, northeastern Mojave, and western Mojave. The

[1] For the purpose of this document, the following definitions should be used:

Recovery unit - a geographic area harboring an evolutionarily distinct population of the desert tortoise (Mojave population);
Desert Wildlife Management Area (DWMA) - administrative area within the recovery unit which is managed such that reserve-level protection is afforded desert tortoise populations while maintaining and protecting other sensitive species and ecosystem functions (e.g., watersheds).

population within a recovery unit may be considered for delisting when the following criteria are met:

(1) As determined by a scientifically credible monitoring plan, the population within a recovery unit must exhibit a statistically significant upward trend or remain stationary for at least 25 years (one desert tortoise generation);

(2) enough habitat must be protected within a recovery unit, or the habitat and desert tortoise populations must be managed intensively enough to ensure long-term viability;

(3) provisions must be made for population management within each recovery unit so that discrete population growth rates (lambdas) are maintained at or above 1.0.

(4) regulatory mechanisms or land management commitments must be implemented that provide for long-term protection of desert tortoises and their habitat; and

(5) the population in the recovery unit is unlikely to need protection under the Endangered Species Act in the foreseeable future.

Actions Needed:

This Recovery Plan describes a strategy for recovery and delisting. Key to this strategy is

- the establishment of at least one Desert Wildlife Management Area

- implementation of reserve level protection within each DWMA

so as to maintain at least one viable population at a minimum density of 10 adult tortoises per square mile within each of the six recovery units. Based on genetic and demographic considerations outlined in the Plan it is recommended that each DWMA within a recovery unit be at least 1,000 square miles in extent so as to contain a viable population of desert tortoises that is relatively resistant to extinction processes. To insure population persistence the Plan proposes multiple DWMAs connected by protected functional habitat within recovery units wherever enough extant desert tortoise habitat exists. Multiple, smaller, and more intensively managed DWMAs with a combined area of 1,000 square miles may be necessary in recovery units where individual DWMAs of 1,000 square miles are not possible to contain a viable population. In all, 14 DWMAs are proposed.

The Recovery Plan recommends general areas where DWMAs should be established within recovery units. DWMA selection and boundary delineation, however, should be accomplished by land management agencies in close coordination with the Fish and Wildlife Service and State wildlife agencies, after soliciting input from other interested parties. The design of DWMAs should follow accepted concepts of reserve design. Action Need 1 is recommended to establish the DWMAs:

1. Develop and implement recovery unit management plans. This task includes (a) selection and delineation of DWMAs, (b) securing of habitat in DWMAs, (c) development of management within DWMAs necessary to reduce or eliminate factors which have caused declines in desert tortoise populations, (d) implementation of DWMA management, and (e) monitoring of the recovery effort.

Additional actions needed to accomplish recovery are:

2. Environmental education to inform the public about the status of the desert tortoise and regulations within DWMAs.

3. Research activities necessary to monitor and guide the recovery effort.

Costs:

(in $1,000s) Costs of specific management actions in DWMAs will be determined after recovery unit management plans are developed and are shown as "to be determined" (TBD).

Year	Need 1	Need 2	Need 3	Total
1994	860	950	1760	3570
1995	2055	0	1817	3872
1996	0	0	1750	1750
1997	0	0	1225	1225
1998	1135	0	1205	2340
1999	0	0	325	325
2000	0	0	305	305
2001	1135	0	285	1420
2002	0	0	285	285
2003	0	0	300	300
2004	1135	0	90	1225
2005	0	0	50	50
2006	0	0	70	70
Recovery Costs:	6,320	950	9,432	16,702

Date of Recovery: Delisting could be initiated in year 2019 if recovery criteria have been met.

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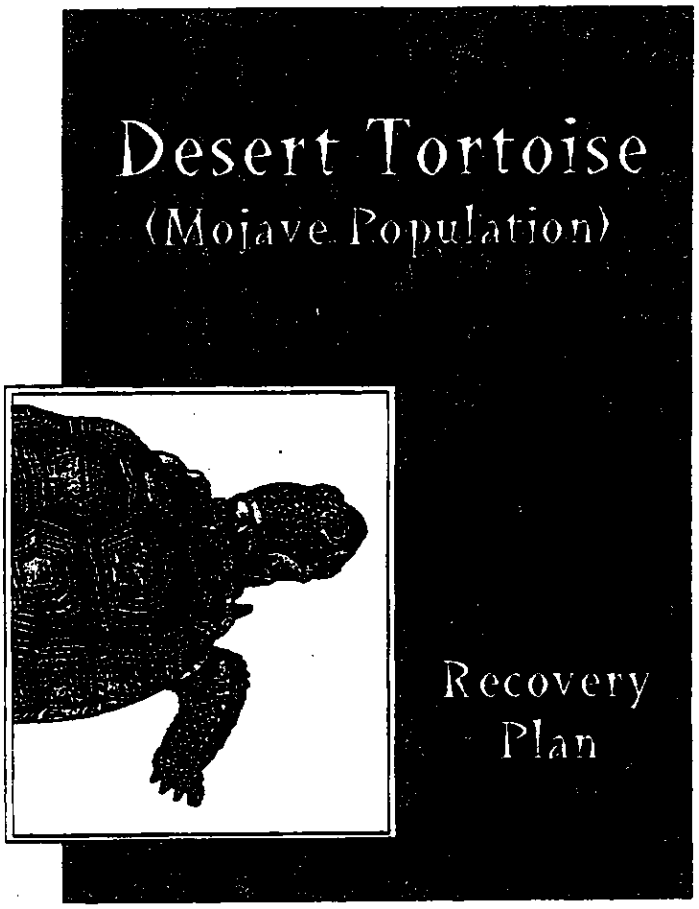
I. Introduction



proposed Desert Wildlife Management Areas; Appendix G proposes a means to analyze the environmental determinants of population size; Appendix H contains designated desert tortoise critical habitat maps which were based upon DWMA boundaries proposed in the Draft Plan; and Appendix I provides a summary of the comments received on the Draft Plan.

A. *Status of the Mojave Population of the Desert Tortoise.*

1. *Listing of the Mojave Population.*

In the early 1970's, biologists began to recognize that desert tortoise populations were declining through much of their range in the United States. In 1980, the Fish and Wildlife Service listed the desert tortoise on the Beaver Dam Slope in Utah as a federally threatened species and designated critical habitat. In 1984, the Defenders of Wildlife, Natural Resources Defense Council, and Environmental Defense Fund petitioned the Fish and Wildlife Service to list the desert tortoise as endangered (Fish and Wildlife Service 1985). In 1985, the Fish and Wildlife Service made a determination that the listing was warranted, but action was precluded because of other pending higher priorities. New information on mortality rates resulted in the emergency listing of desert tortoises north and west of the Colorado River (excluding the Beaver Dam Slope population) as endangered, on August 4, 1989 (Fish and Wildlife Service 1989a). The entire Mojave population* was subsequently listed as threatened on April 2, 1990 (Fish and Wildlife Service 1990a). The primary reasons for listing this population included deterioration and loss of habitat, collection for pets or other purposes, elevated levels of predation, loss of desert tortoises from disease, and the inadequacy of existing regulatory mechanisms to protect desert tortoises and their habitat (Fish and Wildlife Service 1990a).

2. *Critical habitat designation.*

In 1993 several environmental groups sued the Department of the Interior to compel designation of critical habitat for the Mojave population of the desert tortoise, alleging that the Secretary had failed to meet the designation deadline under section 4(b)(6)(C)(ii) of the Endangered Species Act. Final critical habitat designation for the Mojave population was published in the Federal Register in February 1994 (59 FR 5820). Designated critical habitat for the desert tortoise encompasses portions of the Mojave and Colorado deserts that contain the primary constituent elements and focuses on areas that are essential to the species' recovery. The critical habitat

* "Mojave population" as used here is a regulatory designation for those desert tortoises occurring north and west of the Colorado River. Elsewhere in this document "population" adheres to the biological definition: a group of individuals in a given area at a given time (Ehrlich et al. 1974).

unit boundaries were based on proposed DWMAs in the Draft Recovery Plan for the Desert Tortoise (Mojave Population) (Fish and Wildlife Service 1993) (Appendix H). Further discussion of critical habitat and its relevance to recovery of the species can be found in Section II.E.

3. *Current population trends.*

It is estimated that many desert tortoise populations have declined at rates ranging between 3 and 59 % per year (Berry 1990, as amended). These declines have been attributed to direct take by humans (e.g., collection for pets or food, shooting, killing and injuring with motor vehicles); habitat loss, degradation, and fragmentation (e.g., due to roads, agriculture, residential development, military training); diseases; and recent drought (Sievers et al. 1988, Luckenbach 1982, Coombs 1977a and b, Appendix D). Populations in areas with a high incidence of known human-caused mortality exhibit the greatest declines (Figure 1).

B. *Reasons for Decline.*

The following account draws upon a large body of literature detailing the major causes of desert tortoise population decline (Table 1). This information is reviewed in Appendix D and in Jacobson (1994), except where otherwise cited.

The most serious problem facing the remaining desert tortoise populations in the Mojave region (the area occupied by the Mojave population of the desert tortoise) is the cumulative load of human and disease-related mortality accompanied by habitat destruction, degradation, and fragmentation. Virtually every extant desert tortoise population has been affected by one or more of these factors. While the recent drought undoubtedly exacerbated already difficult conditions for desert tortoises, current population declines are not simply the result of drought. Drought is a natural occurrence which desert tortoises have experienced and survived for thousands of years (VanDevender et al. 1987).

As a result of cumulative impacts, desert tortoise populations have been extirpated or almost extirpated from large portions of the western and northern parts of their geographic range in California (e.g., Antelope, Indian Wells, and Searles valleys) (Appendix D). Population declines or extirpations attributable to cumulative impacts have occurred in and near the California communities of Mojave, Boron, Kramer Junction, Barstow, Victorville, Apple Valley, Lucerne Valley, and Twentynine Palms. Similar patterns are evident near Las Vegas, Laughlin, and Mesquite, Nevada; and St. George, Utah. Future extirpations can be expected in the vicinity of all cities, towns, and settlements.

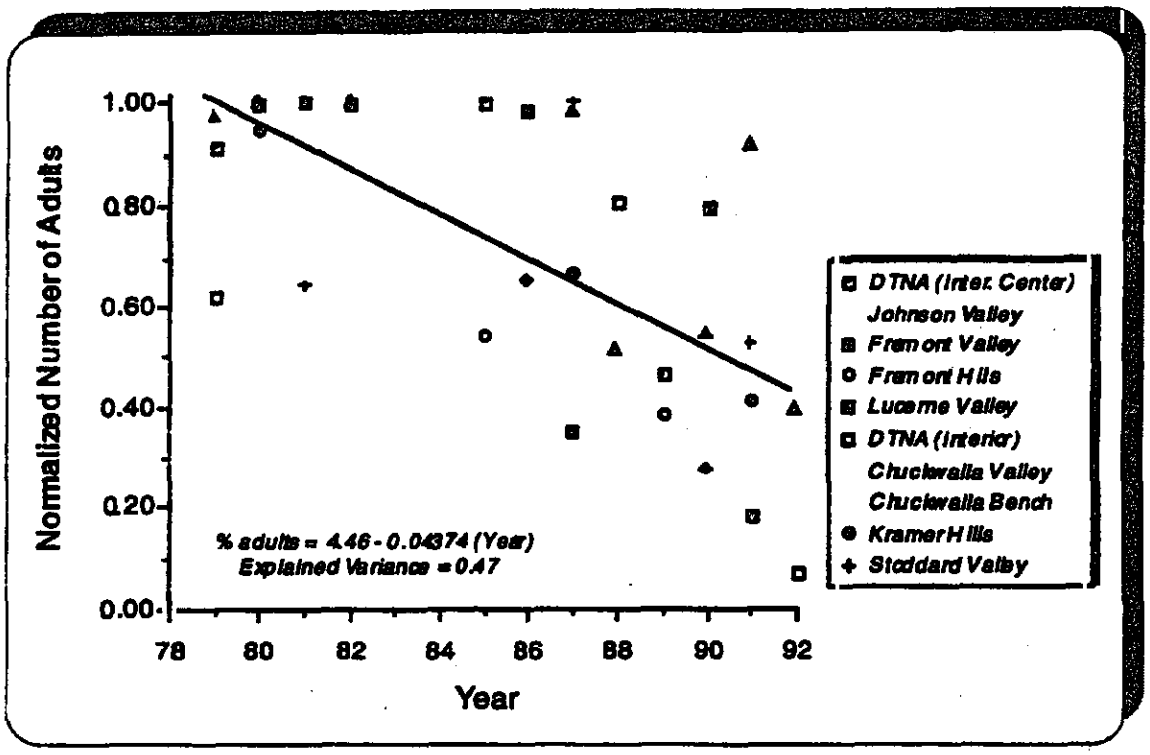


Figure 1. The number of adult desert tortoises found on desert tortoise trend plots located in California (Berry 1990, as amended) The study plots shown occur in areas with a high incidence of known human-caused mortality. All data are normalized to the highest population size recorded within the years populations were monitored. The downward trend in population density is highly significant ($F_{1,14} = 28.4$, $p < 0.0001$).

Table 1. Partial summary of references relating the effects (direct and indirect) of human activities, off highway vehicles (OHVs), and grazing of domestic cattle and sheep on desert tortoise habitat and on the desert tortoise (*Gopherus agassizii*).

HUMAN ACTIVITIES

Effects of Human Population Growth and Urbanization
- Biosystems 1992
- Berry 1984b
- Berry and Burge 1984
- Berry and Nicholson 1984b
- Klemens 1989
- Lamb 1991
- Swingland and Klemens 1989
- Tierra Madre 1991

Effects of Freeways, Highways, Paved and Dirt Roads, and Railroads
- Berry et al. 1986a
- Berry and Turner 1984
- Boarman et al. 1992
- Dames and Moore 1991
- Goodlett and Goodlett 1991, 1992
- Marlow and Hoff 1992
- Mount 1986
- Nicholson 1978a, 1978b
- U.S. Ecology 1989

Effects of Military Operations
- Berry and Nicholson 1984b
- Krzysik 1985
- Krzysik and Woodman 1991
- Prose 1985, 1986
- Prose and Metzger 1985
- Prose et al. 1987

Effects of Energy (transmission and pipelines), and Mineral Development
- Berry 1984b
- Berry and Nicholson 1984b
- Biosystems 1992
- Brum et al. 1983
- Riedy 1989
- Robinette 1973
- Woodman et al. 1983

Human Vandalism
- Berry 1984b, 1986a, 1990, as amended
- Berry and Nicholson 1984b
- Berry et al. 1986a
- Bury and Marlow 1973
- Campbell 1981
- Ginn 1990
- Jaeger 1950
- Jennings 1991

Human Predation for Food
- Ditzler 1991
- Swingland and Klemens 1989
- Schneider and Everson 1989

Collection and Commercial Trade
- Berry 1990, as amended
- Berry and Burge 1984
- Berry and Nicholson 1984b
- Ginn 1990
- Howland 1989
- Jennings 1991
- St. Amant 1984
- Stewart 1991

USE OF OHVs

Immediate Effects

Loss of Soil
- Wilshire 1977a, 1977b, 1979
- Wilshire et al. 1977

Loss of Annual Plants, Grasses
- BLM 1975
- Wilshire et al. 1977

Loss of Perennial Plants
- Wilshire 1979
- Wilshire et al. 1977

Loss of Desert Tortoise Burrows
- Burge 1983
- Bury 1978
- Bury and Luckenbach 1986
- Bury and Marlow 1973

Crushing Desert Tortoises
- Bury and Luckenbach 1986
- Luckenbach 1975

Delayed and Cumulative Effects

Loss of Soil
- Baldwin and Stoddard 1973
- Gilette and Adams 1983
- Hinckley et al. 1983
- Nakata 1983
- Sheridan 1979
- Stull et al. 1979
- Wilshire 1980
- Wilshire et al. 1977

Soil Compaction
- Adams et al. 1982a
- Bodman and Constantin 1965
- Dickey et al. 1973
- Webb 1983
- Webb et al. 1978
- Wilshire 1977a, b
- Wilshire and Nakata 1976
- Wilshire et al. 1977

Effect on Annual Plants
- Adams et al. 1982a, 1982b
- Rowlands et al. 1980

Effect on Perennial Plants
- Biosystems 1992
- Bury and Luckenbach 1983, 1986
- Bury et al. 1977
- Davidson and Fox 1974
- Keefe and Berry 1973
- Lathrop 1983a, b
- Vollmer et al. 1976

Effects on Live Desert Tortoises
- Bury 1987
- Bury and Luckenbach 1986
- Bury et al. 1977

Effects on Other Vertebrates
- Berry 1973
- Bondello 1976
- Brattstrom and Bondello 1983
- Bury and Luckenbach 1983
- Bury et al. 1977
- Busack and Bury 1974
- U.S. BLM 1975

GRAZING OF DOMESTIC SHEEP AND CATTLE

Changes in Habitat

Soil
- Arndt 1966
- Avery et al. 1992
- Ellison 1960
- Gifford and Hawkins 1978
- Klemmedson 1956
- Sharp et al. 1964

Vegetation
- Bentley 1898
- Clements 1934
- Coombs 1977a, b
- Corbett 1952
- Ellison 1960
- Frenkel 1970
- Gardner 1951
- Hardy 1945
- Humphrey 1958, 1987
- Janzen 1986
- Kay et al. 1988
- Mack 1981
- Nicholson and Humphreys 1981
- Orians 1984
- Reynolds 1958
- Rowlands et al. 1980
- BLM 1980a
- Webb and Stielstra 1979
- Wester 1981

Competition Between Tortoises and Livestock
- Berry 1978
- Biosystems 1992
- Coombs 1979
- Medica et al. 1982
- Nicholson and Humphreys 1981
- Sheppard 1981

Trampling
- Berry 1978
- Berry and Shields et al. 1986
- Knowles 1987
- Marlow 1974
- Nicholson and Humphreys 1981
- Rauzi and Smith 1973
- Webb and Wilshire 1980

Consequences of Altered Habitat
- Coe et al. 1976, 1979
- Congdon and Gibbons 1985
- Gibbons and Patterson 1982
- Gibbons et al. 1983
- Jarchow and May 1989
- Jones 1987
- Mitchell 1985
- Swingland and Coe 1979
- Tracy 1992
- Turner et al. 1984, 1987
- Wingfield 1983

Population Declines in the Tortoise and Other Native Herbivores
- Busack and Bury 1974
- Karl 1980, 1982
- Medin and Cleary 1989
- Phillips 1936
- Turner et al. 1981

1. *Human contact and direct mortality.*

Human "predation" is a major factor in the decline of the desert tortoise. Here predation is used in its broadest sense, meaning the taking of desert tortoises out of their natural populations either by death (accidental or intentional) or by removal. People illegally collect desert tortoises for pets, food, and commercial trade. Some new immigrants to the United States collect desert tortoises for medicinal or other cultural purposes (Section 4.1 of Appendix D). Stewart (1991) reported that from 12.5 to 43.7% of desert tortoises with radio transmitters were poached or suspected of being poached from his research site in the western Mojave Desert between 1987 and 1991. Berry (1990, as amended) presented similar evidence of illegal collections at a study plot near Stewart's site during the 1980's. Even in remote areas, desert tortoises on permanent study plots have been collected and later have appeared in cities or towns dozens of miles away from the plots.

Desert tortoises are often struck and killed by vehicles on roads and highways, and mortality of desert tortoises due to gunshot and off-highway vehicles is common in parts of the Mojave region, particularly near cities and towns where people and desert tortoises most frequently come in contact. For example, between 1981 and 1987, 40% of the desert tortoises found dead on a study plot in the Fremont Valley, California, were killed by gunshot or vehicles traveling cross-country or on trails (Berry 1990, as amended). Berry (1986a) reported that nearly 15% of 635 desert tortoise carcasses that were examined from several California study sites showed signs of gunshot.

2. *Predation.*

Desert tortoises, particularly hatchlings and juveniles, are preyed upon by several native species of mammals, reptiles, and birds. Domestic and feral dogs are a new, and probably significant, source of mortality (Causey and Cude 1978, Berry 1979). Predation by the common raven (*Corvus corax*) is intense on younger age classes of the desert tortoise, and the Fish and Wildlife Service's Breeding Bird Survey Program provided data to show a 15-fold increase in raven populations in the Mojave Desert and a 4.7-fold increase in raven populations in the Colorado and Sonoran deserts from 1968 and 1988 (Bureau of Land Management et al. 1989, Table 1). Raven population increases seem to be due to increased food supplies, (e.g., roadkills, landfills, trash, garbage dumps, agricultural developments), as well as new sites for perches and nests (e.g., fence posts, power poles and towers, signs, buildings, bridges, and freeway access-ramps).

The contribution of mammalian or avian predation to overall desert tortoise mortality is not well understood. The best-documented predator is the raven. Berry (1990, as amended) believes that

predation pressure from ravens probably has resulted in such high losses of juveniles in some portions of the Mojave region that recruitment of immature desert tortoises into the adult population has been halted. Increased mortality of young desert tortoises combined with drastically lowered survivorship of adults is likely responsible for observed catastrophic population declines (Berry 1990, as amended).

3. *Disease.*

Disease has contributed to high mortality rates in the western Mojave Desert in the last four years (Berry 1990, as amended, Avery and Berry 1990, Jacobson 1994). Disease is also suspected of contributing to declines in desert tortoise populations in the Chuckwalla Bench area of the eastern Colorado Desert and at some sites on the Beaver Dam Slope in the northeastern Mojave Desert (Berry 1992, Jacobson et al. 1994).

An upper respiratory tract disease (URTD) is prevalent in captive desert tortoises and has been identified in wild desert tortoises in many localities in the Mojave region. The disease is currently a major cause of mortality in the western Mojave Desert and perhaps elsewhere. Recent studies have demonstrated *Mycoplasma agassizii* sp. nov. as the causative agent of URTD. A serological test has been developed to determine exposure status of desert tortoises to URTD (Schumacher et al. 1993). Predisposing factors such as habitat degradation, poor nutrition, and drought are also likely involved (Jacobson et al. 1991). Drought and concomitant poor nutrition have the potential to compromise desert tortoises immunologically and, therefore, make them more susceptible to URTD. However, in recent experimental studies, URTD was induced in apparently healthy desert tortoises when challenged with an isolate of *M. agassizii* obtained from an ill desert tortoise (M.B. Brown, University of Florida, pers. comm. 1993). Under certain conditions, even healthy desert tortoises may become infected with the causative organism and develop signs of URTD. Controlling human-related spread of URTD (Jacobson 1994), improving habitat conditions, and monitoring health status of desert tortoise populations are some of the more important management tools which can be used in controlling URTD in wild populations of the desert tortoise.

URTD appears to be spreading, and may have been introduced to wild populations through illegal releases of captive desert tortoises that were ill (Jacobson 1994). Wild desert tortoises with signs of URTD are commonly found near cities and towns with concentrations of captive desert tortoises (Marlow and Brussard 1992).

A shell disease, characterized by lesions, is correlated with desert tortoise decline in the Chuckwalla Bench population in the eastern Colorado Desert (Jacobson et al. 1994, Berry 1992). Lesions

typically appear at seams between adjacent scutes and then spread toward the middle of each scute in an irregular pattern. A variety of mineral and metal deficiencies, as well as various toxicants, are known to cause integumentary pathology in mammals, suggesting a disease or toxicosis may be responsible for these observed shell abnormalities (Appendix D).

4. *Habitat destruction, degradation, and fragmentation.*

Changes in vegetation accumulating over almost a century and a half in the Mojave region have been substantial. In general, these changes are characterized by decreases in perennial grasses and native annuals and an increase in exotic ephemerals such as red brome (*Bromus rubens*). Continuous stands of exotic ephemerals provide fuel which can carry fire over large areas. Historically, fires were small or infrequent over vast areas of the Mojave region, and because native desert plants have not evolved with fire and are not adapted to it, they generally are killed by high-intensity fire. The increasing incidence and severity of fires in the Mojave region are already converting desert shrublands into ephemeral grasslands. The effects of invading exotic grasses on several ecosystems have recently been reviewed by D'Antonio and Vitousek (1992).

These vegetational changes can be detrimental to desert tortoises for a number of reasons. First, these animals require perennial shrubs for cover from the intense solar radiation in the desert. Second, perennial grasses are important secondary food sources for the desert tortoise in many areas. Third, recurrent fires and competition from exotic ephemerals may reduce the abundance and diversity of native forbs which are the major food source of the desert tortoise. Finally, major fires fragment desert tortoise habitat; fires can also kill desert tortoises (Appendix D).

Habitat fragmentation is a major contributor to population declines (Berry 1984b, Berry and Burge 1984, Berry and Nicholson 1984b, and Berry 1984c). Desert tortoises require a great deal of space to survive (Figure 2; see also Appendix C). Over its lifetime, each desert tortoise may require more than 1.5 square miles of habitat and may make forays of more than 7 miles at a time (Berry 1986b; Esque et al. in prep; K.H. Berry, pers. comm. 1993). In drought years, desert tortoises forage over larger areas (Figure 2) and thus have a greater probability of encountering potential sources of mortality. Roads and urban areas form barriers to movement and tend to create small, local populations which are much more susceptible to extinction than large, connected ones (Wilcox and Murphy 1985).

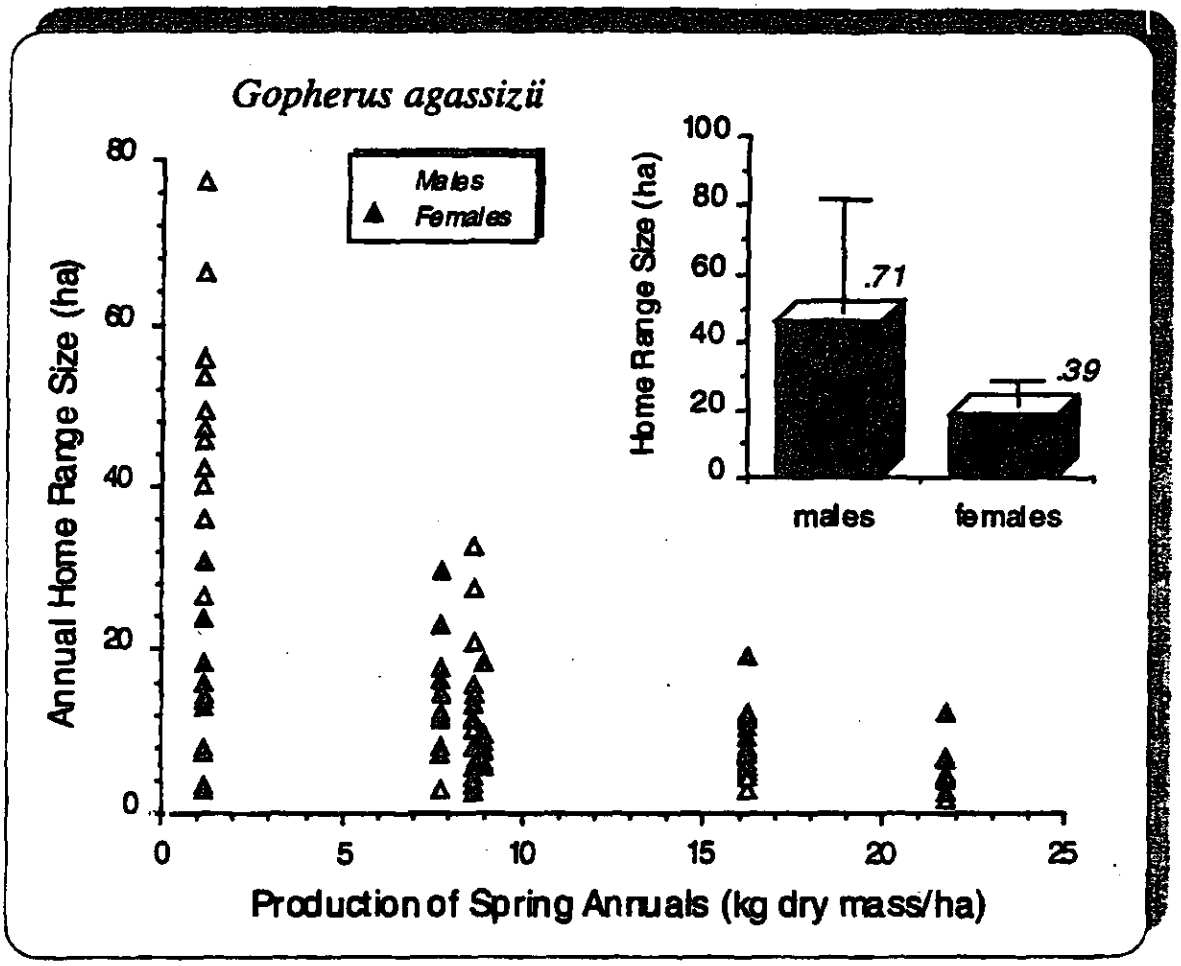


Figure 2. Annual home range sizes of desert tortoises as a function of the amount of food resources (spring annual plants) (from Esque et al., in prep.)

Grazing by cattle, domestic sheep, and feral equids can also affect desert tortoises and their habitats negatively. Livestock can kill desert tortoises and eggs directly by trampling. Grazing can also damage soil crusts, reduce water infiltration, promote erosion, inhibit nitrogen fixation in desert plants, and provide a favorable seed bed for exotic annual vegetation. Habitat destruction and degradation is especially evident in the vicinity of livestock water sources. Off-road vehicle (ORV) use also destroys, degrades, and fragments considerable areas of desert tortoise habitat; and disturbances from both grazing and ORVs facilitate the invasion of exotic plants and increased incidence of fire (Table 1, Appendix D).

A variety of other human uses have caused significant quantitative and qualitative losses of desert tortoise habitat. Urbanization; agricultural development; construction and use of transportation routes and corridors; development of utility corridors; exploration for and development of hard rock minerals, sand and gravel pits, oil and gas, and other mineral resources; and concentrated visitor use are all important causes of widespread habitat destruction. In some portions of the desert, military activities such as maneuvers, bombings, and explosions also contribute to the degradation and loss of desert tortoise habitat (Kryzik and Woodman 1991, Fish and Wildlife Service 1992). The combined effects of these various activities have resulted in extirpations and population declines of desert tortoises throughout the Mojave region. The relative contributions of these factors are well documented in some areas, but not in others (Table 1, Appendix D).

C. Current Management

1. Endangered Species Act protection.

Section 9 of the Endangered Species Act prohibits the take of any listed wildlife species, including the desert tortoise. The definition of "take" includes to harass, harm, hunt, shoot, wound, kill, trap, capture, collect, or attempt to engage in any such conduct. "Harm", in the definition of "take", includes significant habitat modification or degradation where it actually kills or injures wildlife by significantly impairing essential behavior patterns, including breeding, feeding, or sheltering (50 CFR 17.3). Sections 7 and 10 of the Endangered Species Act provide regulatory mechanisms for actions affecting desert tortoises on public and private lands, respectively. Section 7(a)(1) directs Federal agencies to use their authorities to carry out programs for the conservation of endangered and threatened species. Through the section 7(a)(2) process, all Federal agencies are required to ensure that any action they authorize, fund, or carry out in the United States or upon the high seas is not likely to jeopardize the continued existence of any listed species [50 CFR 402.01(a)]. Section 10(a)(1)(B) of the Endangered Species Act gives the Fish and Wildlife Service the authority to issue permits to non-Federal and private entities for the

take of listed wildlife species, as long as such taking is incidental to, and not the purpose of, carrying out otherwise lawful activities (16 U.S.C. 1539). A section 10(a)(1)(B) permit is granted only if the applicant institutes appropriate conservation measures for habitat maintenance, enhancement, and protection, coincident with the action.

Since the emergency listing of the desert tortoise in August 1989, the Fish and Wildlife Service has reviewed hundreds of proposals for activities that could adversely affect the desert tortoise. Over this time, the Fish and Wildlife Service, other Federal agencies, and State wildlife agencies, have developed and implemented measures to minimize harm and mortality to desert tortoises resulting from human activities. These measures include the following provisions for avoiding impacts to desert tortoises found in project areas: moving animals from harm's way to adjacent undisturbed habitat where their probability of survival is increased; land acquisition and protection as compensation for destruction of desert tortoise habitat; increased law enforcement; improved management; public education; and research. The Fish and Wildlife Service has specified that all handling of desert tortoises would be in accordance with procedures approved by them.

The section 7 process can influence the planning activities of Federal agencies to reduce impacts to desert tortoises and, in some cases, benefit desert tortoises. For example, through informal consultation with the Fish and Wildlife Service, the Marine Corps developed an alternative location for a new airfield that avoided impacts to the largest concentration of desert tortoises at the Marine Corps Air Ground Combat Center at Twentynine Palms, California. In another example, through the section 7 consultation process the Fish and Wildlife Service and the Navy developed a programmatic approach for desert tortoise management and routine operations at the Naval Air Weapons Station at China Lake, California. This consultation specified standard mitigation measures for Navy staff to implement whenever desert tortoises are encountered during an action. The Navy has established an area of approximately 200,000 acres in which it will attempt to avoid siting any new facilities that would result in the disturbance of greater than 2.5 acres of desert tortoise habitat at any one time. The Navy also committed to continue its ongoing efforts to remove feral burros from desert tortoise habitat and to fence its boundary to prevent livestock grazing on its lands. In Nevada, programmatic consultations directed urban development and ORV use in the Las Vegas Valley to areas of degraded or poor habitat, thereby reducing conflicts in areas necessary for desert tortoise recovery.

Other important section 7 consultations have resulted in time and space restrictions on domestic sheep and cattle grazing and reduced impacts to desert tortoises and their habitat resulting from ORV activities, right-of-way development, mining operations, military

actions, and many other activities authorized, funded, or carried out by Federal agencies.

In 1991, the Fish and Wildlife Service issued a 3-year section 10(a)(1)(B) incidental take permit to Clark County and the cities of Las Vegas, North Las Vegas, Henderson, and Boulder City in Nevada. As a condition of the permit, the permittees are implementing a habitat conservation plan (HCP) which provides for conservation and management of at least 400,000 acres in Clark County for the benefit of the desert tortoise (RECON 1991). Three types of mitigation measures are required by the terms of the permit: (1) conservation and management of desert tortoise habitat, (2) initiation of a desert tortoise research and relocation program, and (3) imposition of a $550-per-acre mitigation fee on projects in the permit area. Key management actions to be implemented on the 400,000 or more acres of conservation lands include: acquisition and retirement of grazing privileges; designation of roads and trails and elimination of off-highway vehicle events over most of the conservation lands; no new landfills or intensive recreation sites; and adequate enforcement, biological monitoring, and maintenance actions needed to implement these actions. The $550-per-acre mitigation fees are to be used to fund the conservation and mitigation measures. The permittees are pursuing a long-term incidental take permit which will address all of Clark County for a period of 20 years or more.

The Fish and Wildlife Service is also involved in preparation of HCPs for Washington County, Utah, and Nye County, Nevada, and several other section 10(a)(1)(B) permits have been issued or are pending for smaller projects. Washington County, Utah is in the process of applying for a 20-year incidental take permit for desert tortoise. On May 4, 1994, the Fish and Wildlife Service received a proposed Washington County HCP (Washington County Commission 1994), as part of a permit for incidental take of desert tortoise and its habitat. The major mitigation proposed for take of desert tortoise is increased protection of the remainder of desert tortoise habitat in the area through establishment of a desert habitat reserve, or desert wildlife management area. Land ownership within the reserve will be Federal, and land exchanges and acquisition are required to consolidate habitat and management efforts. Management of the desert habitat reserve is proposed to be by BLM through eventual establishment of a National Conservation Area. The proposed reserve extends from the eastern boundary of the Paiute Indian Reservation on the west, to the City of Hurricane on the east. Within the reserve, land uses will be carefully controlled and all management actions will place the desert tortoise/habitat conservation as the highest priority. Acquisition of habitat, fencing, enforcement, education, and removal of competing uses comprise the majority of mitigation measures for proposed take. The Washington County HCP also includes proposed conservation measures for other listed and candidate species. Funding for administration, implementation, and monitoring of the

Washington County HCP includes collection of county-wide fees: 0.2% of all new construction costs, plus $250 per acre for plotted housing developments. The Fish and Wildlife Service is currently reviewing the Washington County HCP.

The Bureau of Land Management's (BLM) California Desert District, in cooperation with the Fish and Wildlife Service, California Department of Fish and Game, and local governments, is currently developing the West Mojave Coordinated Management Plan. This multi-species management strategy for 8.6 million acres will provide for long-term conservation of the desert tortoise and other rare or sensitive species, such as the Mohave ground squirrel. The plan will be the basis for a programmatic section 7 consultation for BLM activities in the planning area and serve as an HCP for local governments to obtain section 10(a)(1)(B) permits. This plan is expected to be the first of several regional conservation planning efforts in California, which would implement the guidance provided in this Recovery Plan.

2. *BLM management.*

The BLM manages most desert tortoise habitat in the Mojave region and initiated management actions to conserve this species. In 1988, the BLM issued a habitat management plan for conservation of the desert tortoise on public lands throughout its range in the United States (Spang et al. 1988). The plan groups desert tortoise habitat into three goal-oriented categories:

> Category I—Maintain stable, viable populations and protect existing tortoise habitat values; increase populations, where possible.
>
> Category II—Maintain stable, viable populations and halt further declines in tortoise values.
>
> Category III—Limit tortoise habitat and population declines to the extent possible by mitigating impacts.

Habitat areas are categorized according to four criteria: (1) importance of the habitat to maintaining viable populations, (2) resolvability of conflicts, (3) desert tortoise density, and (4) population status (stable, increasing, or decreasing). BLM's goal is to maintain viable desert tortoise populations in category 1 and 2 habitats and to limit population declines to the extent possible in category 3 habitats. The plan identifies management actions needed to implement these goals, which address environmental education, ORV use, energy and mineral development, livestock use, lands and realty actions, and other activities which may affect desert tortoises. Included is a provision to compensate for residual impacts to desert tortoises after other mitigation measures are incorporated into proposed actions. A compensation formula was

developed and adopted to implement this provision (Desert Tortoise Compensation Team 1991).

The Federal Land Policy Management Act of 1976 (public law 94-579) directed the BLM to manage public lands for multiple use and sustained yield. Wildlife is identified as one of the major uses of public lands. The Sikes Act (public laws 93-452 and 95-420) authorizes the BLM to develop and implement plans in cooperation with State wildlife agencies for the development and protection of wildlife habitat. In response to these authorizations, the BLM has developed numerous habitat management plans which address the management and conservation of the desert tortoise. The California Desert Conservation Area Plan, 1980 (BLM 1980a), a management strategy for 12.1 million acres of public land, identified five areas where habitat management plans were to be developed to conserve desert tortoise habitat. This plan also designated eight crucial desert tortoise habitat areas with specific management actions to protect desert tortoises. In addition, the BLM carries out land exchanges and uses Land and Water Conservation funds to acquire desert tortoise habitat. Special land use designations such as Areas of Critical Environmental Concern and Research Natural Areas have also been established by the BLM for the desert tortoise in the Mojave region.

3. *Management by other agencies.*

The BLM is the primary land manager, but a number of other Federal, State, and local entities also manage desert tortoise habitat in the Mojave region. The National Park Service provides protection for desert tortoise habitat at Joshua Tree National Monument and at Death Valley National Monument in California, and Lake Mead National Recreation Area in Nevada. The Department of Defense manages large parcels of land, particularly in California at the Fort Irwin National Training Center, the Naval Air Weapons Station at China Lake, Edwards Air Force Base, the Marine Corps Air Ground Combat Center at Twentynine Palms, and the Chocolate Mountains Gunnery Range, and in Nevada at the Nellis Air Force Base. Desert tortoise management plans have been or are being prepared for some of these military lands. The Fish and Wildlife Service's Desert National Wildlife Refuge provides protection for a portion of the desert tortoise habitat in the Coyote Spring area of Nevada. Other lands are managed by State parks and wildlife agencies, Bureau of Indian Affairs, Bureau of Reclamation, and other government agencies.

4. *State laws protecting desert tortoises.*

All four states in which the Mojave desert tortoise occurs have laws that provide some protection for this species; for instance, the collection of desert tortoises is prohibited in all four states. In Nevada, section 501.110.1 (d) of the Nevada Revised Statutes prohibits transportation of desert tortoises within Nevada or across

State lines. The desert tortoise is also listed as a threatened species under the California Endangered Species Act of 1984. Similar to the Federal Act, this legislation requires State agencies to consult with the California Department of Fish and Game on activities which may affect a listed species. Compensation is required by California Department of Fish and Game for projects which result in loss of desert tortoise habitat.

D. Desert Tortoise Habitat.

1. Desert regions and vegetational communities.

The Mojave region includes portions of both the Mojave and Sonoran deserts. Within the Mojave region, the Mojave Desert is represented in parts of Inyo, Kern, Los Angeles, San Bernardino, and Riverside Counties in California; the northwestern part of Mohave County in Arizona; Clark County, and the southern parts of Esmeralda, Nye, and Lincoln Counties in Nevada; and part of Washington County, Utah. The Colorado Desert, a division of the Sonoran Desert, is located south of the Mojave Desert, and includes Imperial County and parts of San Bernardino, and Riverside Counties, California. The climatic, geological, and ecological features of those portions of the Mojave and Colorado deserts inhabited by the desert tortoise are described in Appendix E.

2. Habitat requirements.

Within the varied vegetational communities of the Mojave region, desert tortoises can potentially survive and reproduce where their basic habitat requirements are met. These requirements include sufficient suitable plants for forage and cover, and suitable substrates for burrow and nest sites. Throughout most of the Mojave region, desert tortoises occur primarily on flats and bajadas with soils ranging from sand to sandy-gravel, characterized vegetationally by scattered shrubs and abundant inter-shrub space for growth of herbaceous plants. Desert tortoises are also found on rocky terrain and slopes in parts of the Mojave region, and there is significant geographic variation in the way desert tortoises use available resources (see Section I.F. for further details).

E. Natural History of the Desert Tortoise.

1. Nomenclature and description.

The generic assignment of the desert tortoise has gone through a series of changes since its original description by Cooper (1863) as *Xerobates agassizii*. Until the status of the genus is further clarified, this Recovery Plan will use the more familiar *Gopherus agassizii*. Morafka and Brussard (in prep.) detail the history of this nomenclature.

The genus *Gopherus* contains between 15 and 19 fossil, and four living, species (Auffenberg 1976, Crumly 1984). Generally, these species are divided into two groups based on morphological and genetic evidence (Auffenberg 1976, Crumly 1984, Lamb et al. 1989). One group includes the living *G. agassizii* and the Texas tortoise (*G. berlandieri*). The extant Mexican bolson tortoise (*G. flavomarginatus*) and gopher tortoise of the southeastern United States (*G. polyphemus*) are included in the second group. The recently described peninsular Baja Californian *Xerobates lepidocephalus* would have added a fifth extant species to the genus, but this taxon is most probably based on individuals of Sonoran Desert *G. agassizii* which were released into the Cape region of Baja California (Crumly 1994).

The desert tortoise is the only naturally occurring tortoise in the Mojave region. It is distinguished from the other three species of the genus *Gopherus* by a combination of characters, including a rounded front head, interhumeral seam longer than integular seam, single triangular axillary scale, and distance from base of first claw to fourth claw equal for forefoot and hindfoot (Brame and Peerson 1969). In comparison to the Mojave *G. agassizii*, *G. berlandieri* exhibits a wedge-shaped head, relatively small adult size, a bifurcate and upturned gular projection in males, and a high-domed carapace (Bogert and Oliver 1945, Behler and King 1979). *G. polyphemus* has a rounded head and is similar in maximum size to *G. agassizii*, but its carapace is more elongate and tends to be widest at midbody, whereas in *G. agassizii* the carapace is widest at about the fourth costal scute (Grant 1960, Behler and King 1979). *G. flavomarginatus* attains the largest size of any of the four species. It is distinguished from *G. agassizii* by a broad head and the presence of a pale yellow lateral border on its carapace laminae (Morafka 1982). Escaped or released captive tortoises other than *G. agassizii* (particularly *G. berlandieri*) are occasionally encountered in the Mojave region.

2. *Paleontology and distribution.*

The earliest fossils of *G. agassizii* come from Pleistocene deposits (Brattstrom 1961). During the Holocene, *G. agassizii* ranged as far west as California's San Joaquin Valley (Miller 1942, VanDevender and Moodie 1977). Prior to European settlement of the Mojave region, its range included the Mojave and Sonoran deserts in southern California, southern Nevada, western Arizona, the southwestern tip of Utah, and Sonora and Sinaloa, Mexico (Stebbins 1954, 1966). This species is also found on Tiburon Island in the Sea of Cortez (Linsdale 1940). The desert tortoise is now considerably reduced in numbers throughout much of this area and has been extirpated from parts of its historic range (Spang et al. 1988, Berry 1978).

3. *Genetics and morphology.*

Jennings (1985) used starch-gel electrophoresis of allozymes encoded by about 20 loci to explore genetic variation in *G. agassizii*. Although he found no fixed genetic differences among samples, phenograms generated from genetic distance values suggest two major population groupings that correspond roughly with the Mojave region and Sonoran Desert in Arizona. In addition, a plasma protein was polymorphic in samples from the Mojave Desert, but monomorphic in samples from the Sonoran Desert (Glenn et al. 1990).

Based on mitochondrial DNA (mtDNA) restriction-fragment polymorphisms, Lamb et al. (1989) described three major genetic units within *G. agassizii*. One unit is found in the Colorado and Mojave deserts and a second in the Sonoran Desert from west-central Arizona to central Sonora. The Colorado River appears to have been a sufficient barrier for these two assemblages to have evolved independently since the Pliocene. The third major unit is found in southern Sonora and Sinaloa, south of the Yaqui River.

Morphological variation coincides reasonably well with the mtDNA genotypes found north of Mexico. There are three distinct shell phenotypes in the United States: (1) the California phenotype from California and southwestern Nevada; (2) the Sonoran Desert phenotype from Arizona south and east of the Colorado River, and (3) the Beaver Dam Slope phenotype from extreme southwestern Utah and Arizona north of the Grand Canyon (Weinstein and Berry 1987). The California and Sonoran Desert phenotypes correspond to the Mojave region and Sonoran Desert mtDNA genotypes, respectively.

Thus, based on genetic and morphological criteria, *G. agassizii* is divided into at least two well-differentiated entities, one in the Sonoran Desert in Arizona and one in the Mojave region. A third may exist in Sonora and Sinaloa, Mexico.

4. *Ecology and natural history.*

The most complete account of the biology, ecology, and natural history of the desert tortoise is that of Woodbury and Hardy (1948). These authors studied a population of desert tortoises on the Beaver Dam Slope in extreme southwestern Utah for more than 10 years. Their study presented details of reproduction, growth and development, longevity, food habits, behavior, movement patterns, and general adaptations to desert conditions. Although no other single study of *G. agassizii* covers as many topics as Woodbury and Hardy's, a reasonably large body of literature exists on most aspects of desert tortoise biology. Berry (1986c) lists over 30 papers

published between 1976 and 1985 on topics such as distribution, abundance, habitat use, size-age class distributions, sex ratios, mortality rates, time and energy budgets, thermal relations, metabolism, and the effects of land use on population dynamics. The following general account is based upon information contained in these papers except where otherwise referenced.

Desert tortoises spend much of their lives in burrows, emerging to feed and mate during late winter and early spring. They typically remain active through the spring, and sometimes emerge again after summer storms. During these activity periods, desert tortoises eat a wide variety of herbaceous vegetation, particularly grasses and the flowers of annual plants (Berry 1974, Luckenbach 1982). Desert tortoises are essentially "K-strategists" (MacArthur and Wilson 1967), with delayed maturity and long life. Eggs and hatchlings are quite vulnerable, and pre-reproductive adult mortality averages 98% (Wilbur and Morin 1988, Turner et al. 1987, Morafka in press). Adults, however, are well protected against most predators (other than humans) and other environmental hazards and consequently are long-lived (Germano 1992, Turner et al. 1987). Their longevity helps compensate for their variable annual reproductive success, which is correlated with environmental conditions.

Desert tortoises are well adapted to living in a highly variable and often harsh environment. In adverse conditions they retreat to burrows or caves, at which time they reduce their metabolism and loss of water and consume very little food. Adult desert tortoises lose water at such a slow rate that they can survive for more than a year without access to free water of any kind. During a recent drought, desert tortoises at a study site in eastern California not only survived with very little food or water, but they produced an average of three eggs per female per year (B. Henen, UCLA, pers. comm.). Desert tortoises apparently tolerate large imbalances in their water and energy budgets (Nagy and Medica 1986). This ability enables them to survive lean years and exploit resources that are only periodically available. During years of average or better than average precipitation and forage production, desert tortoises can balance their water budgets and have a positive energy balance, providing opportunity for growth and reproduction (Nagy and Medica 1986). All the mechanisms by which desert tortoises maintain their energy and water balance in the face of stochastic availability of resources are still not clear, but desert tortoises seem to be flexible in their mechanisms of energy and water gain and in their expenditures of these resources (Wallis et al., 1992).

F. Distinct Population Segments of the Desert Tortoise

1. Background.

As a general rule, most widespread species show substantial geographic variation in genetic, morphological, ecological, physiological, and behavioral traits. This is largely attributed to natural selection favoring different character states in different climates and biotic communities (Darwin 1859), or genetic drift (Wright 1931). Such divergence, which may arise from past or present barriers to dispersal or from mere distance (Williams 1992), requires at least the partial isolation of gene pools within a species .

The desert tortoise is no exception to this generalization, because groups of populations within the Mojave region exhibit different habitat preferences, food habits, periods of activity, selection of sites for burrowing and egg-laying, and social behavior (see Section I.F.2. below). This is not surprising, since this region encompasses two major North American deserts, eight vegetational provinces, and numerous vegetation types (Appendix E).

Sections 2(b and c) and 3(15) of the Endangered Species Act provide protection to "any distinct population segment of any [listed] species of vertebrate fish or wildlife which interbreeds when mature." Waples (1991) states that, "[a] vertebrate population will be considered distinct . . . for purposes of protection under the Act if the population represents an evolutionarily significant unit (ESU) of the biological species." An ESU is a population, or group of populations, that represents significant adaptive variation within a species (Ryder 1986). Evidence of current or past reproductive isolation is not, by itself, sufficient evidence for ESU designation. Rather, the identification of ESUs requires evidence that population units have undergone significant evolutionary differentiation. Thus the identification of ESUs requires data on range and distribution, natural history, morphometrics, and genetics; concordance among two or more of these data sets strengthens the case for ESU designation (Ryder 1986). The following questions are relevant (Waples 1991):

(1) Is the population genetically distinct?

(2) Does the population occupy unusual or distinct habitat?

(3) Does the population show evidence of unusual or distinct adaptation to its environment?

2. *Evolutionarily significant units of the desert tortoise within the Mojave region.*

Data from a variety of sources indicate that there are at least six ESUs of the desert tortoise within the Mojave region. These ESUs consist of populations or groups of populations that show significant differentiation in genetics, morphology, ecology, or behavior (Tables 2, 3, 4, and 5) and thus are important components of the evolutionary legacy of *Gopherus agassizii*. The conservation of all these ESUs will help to ensure that "the dynamic process of evolution [in this species] will not be unduly constrained in the future" (Waples 1991). Hereafter these ESUs are referred to as "recovery units" (Figure 3).

In the following accounts, information on the ecology and distribution of desert tortoises comes primarily from unpublished data and field notes of the Recovery Team.

Northern Colorado Recovery Unit.

This recovery unit is located completely in California. Here desert tortoises are found in the valleys, on bajadas and desert pavements, and to a lesser extent in the broad, well-developed washes. They feed on both summer and winter annuals and den singly in burrows under shrubs, in intershrub spaces, and rarely in washes. The climate is somewhat warmer than in other recovery units, with only 2 to 12 freezing days per year. The tortoises have the California mtDNA haplotype and phenotype. Allozyme frequencies differ significantly between this recovery unit and the Western Mojave, indicating some degree of reproductive isolation between the two.

Eastern Colorado Recovery Unit.

Desert tortoises in the eastern Colorado recovery unit, also located completely in California, occupy well-developed washes, desert pavements, piedmonts, and rocky slopes characterized by relatively species-rich Succulent Scrub, Creosote Bush Scrub, and Blue Palo Verde-Ironwood-Smoke Tree communities. Winter burrows are generally shorter in length, and activity periods are longer than elsewhere due to mild winters and substantial summer precipitation. The tortoises feed on summer and winter annuals and some cacti; they den singly. They also have the California mtDNA haplotype and shell type.

Upper Virgin River Recovery Unit.

This recovery unit encompasses all desert tortoise habitat in Washington County, Utah, except the Beaver Dam Slope, Utah population. The desert tortoise population in the area of St. George, Utah, is at the extreme northeastern edge of the species' range and experiences long, cold winters (about 100 freezing days) and mild summers, during which the tortoises are continually active. Here

the animals live in a complex topography consisting of canyons, mesas, sand dunes, and sandstone outcrops where the vegetation is a transitional mixture of Sagebrush Scrub, Creosote Bush Scrub, Blackbush Scrub, and a psammophytic community. Desert tortoises use sandstone and lava caves instead of burrows, travel to sand dunes for egg laying, and use still other habitats for foraging. Two or more desert tortoises often use the same burrow. Shell morphology and mtDNA have not been studied in this recovery unit, but allozyme variation is similar to that found in the northeastern Mojave recovery unit.

Eastern Mojave Recovery Unit.

Primarily in California, this recovery unit also extends into Nevada in the Amargosa, Pahrump, and Piute valleys. In the eastern Mojave recovery unit, desert tortoises are often active in late summer and early autumn in addition to spring because this region receives both winter and summer rains and supports two distinct annual floras on which they can feed. These desert tortoises occupy a variety of vegetation types and feed on summer and winter annuals, cacti, perennial grasses, and herbaceous perennials. They den singly in caliche caves, bajadas, and washes. This recovery unit is isolated from the western Mojave by the Baker Sink, a low-elevation, extremely hot and arid strip that extends from Death Valley to Bristol Dry Lake. This area is generally not suitable for desert tortoises. Desert tortoises have both the California and the southern Nevada mtDNA haplotype and the California shell type. They are also differentiated from desert tortoises in the northeastern Mojave recovery unit at several allozyme loci.

Northeastern Mojave Recovery Unit.

This recovery unit is found primarily in Nevada, extending into California along the Ivanpah Valley and into extreme southwestern Utah and northwestern Arizona. Desert tortoises here are generally found in Creosote Bush Scrub communities of flats, valley bottoms, alluvial fans, and bajadas, but they occasionally use other habitats such as rocky slopes and Blackbush Scrub. Two or more desert tortoises often den together in caliche caves in bajadas and washes, and they typically eat summer and winter annuals, cacti, and perennial grasses. Three mtDNA haplotypes are found in this recovery unit, but they exhibit low allozyme variability with relatively little local differentiation. A distinct shell phenotype occurs in the Beaver Dam Slope region.

Western Mojave Recovery Unit.

The Western Mojave recovery unit is completely in California and is exceptionally heterogeneous and large. It is composed of the Western Mojave, Southern Mojave, and Central Mojave regions, each of which has distinct climatic and vegetational characteristics. The most pronounced difference between the Western Mojave and

other recovery units is in timing of rainfall and the resulting vegetation. Most rainfall occurs in fall and winter and produces winter annuals, which are the primary food source of tortoises. Above ground activity occurs primarily in spring, associated with winter annual production. Thus, tortoises are adapted to a regime of winter rains and rare summer storms. Here, desert tortoises occur primarily in valleys, on alluvial fans, bajadas, and rolling hills in saltbrush, creosote bush, and scrub steppe communities. Tortoises dig deep burrows (usually located under shrubs on bajadas) for winter hibernation and summer estivation. These desert tortoises generally den singly. They have a California mtDNA haplotype and a California shell type.

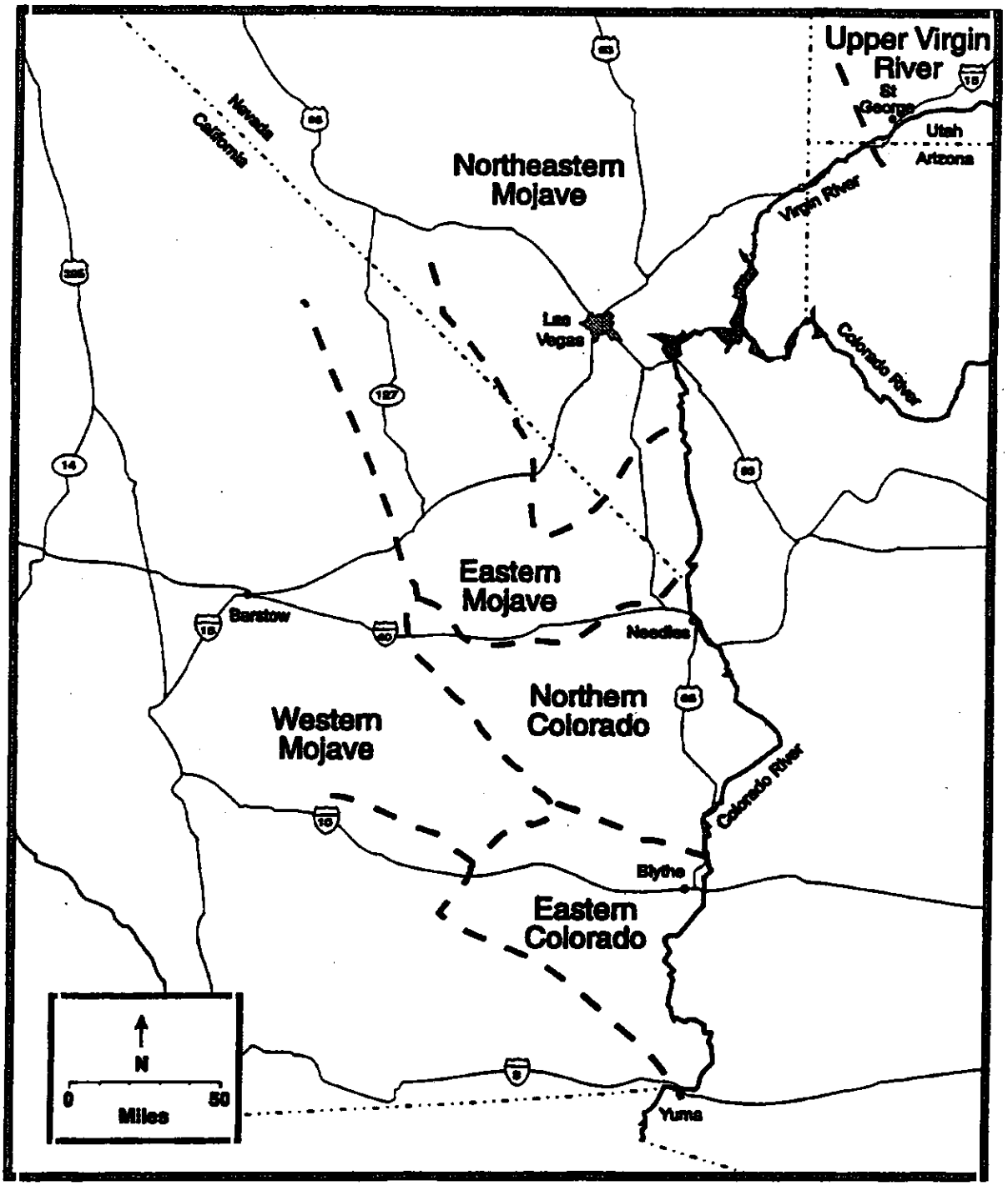


Figure 3. Approximate boundaries of recovery units of the desert tortoise in the Mojave region

Table 2. Vegetation communities and typical foods used by the desert tortoise (*Gopherus agassizii*) within recovery units.

Recovery Units	Vegetation Communities[1]	Plant Foods
Northern Colorado	(1) Succulent Scrub (*Fouquieria, Opuntia, Yucca*), (2) Blue Palo Verde-Smoke Tree Woodland, (3) Creosote Bush Scrub (lava flows)	Summer and winter annuals
Eastern Colorado	(1) Succulent Scrub (*Fouqueria, Opuntia, Yucca*), (2) Blue Palo Verde-Ironwood-Smoke Tree Woodland, (3) Creosote Bush Scrub (rocky slopes)	Summer and winter annuals, cacti
Upper Virgin River	Transitional Vegetation: (1) Sagebrush Scrub, (2) Psammophytes, Great Basin (sand sage), (3) Blackbush Scrub	Summer and winter annuals, perennial grasses, cacti (< 5%)
Northeastern Mojave	(1) Creosote Bush Scrub, (2) Big Galleta Scrub-Steppe, (3) Desert Needlegrass Scrub-Steppe, (4) Blackbush Scrub	Summer and winter annuals, cacti, perennial grasses
Eastern Mojave	(1) Big Galleta-Scrub Steppe, (2) Succulent Scrub (*Yucca, Opuntia* species), (3) Creosote Bush Scrub, (4) Cheesebush Scrub (east Mojave type), (5) Indian Rice Grass Scrub-Steppe	Summer and winter annuals, cacti, perennial grasses, herbaceous perennials
Western Mojave	(1) Creosote Bush Scrub, (2) Mojave Saltbush- Allscale Scrub (endemic), (3) Indian Rice Grass Scrub-Steppe, (4) Hopsage Scrub, (5) Big Galleta Scrub Steppe, (6) Cheesebush Scrub (west Mojave type), (7) Desert Psammophytes, (8) Blackbush Scrub	Winter annuals, few herbaceous perennials, cacti

[1]From Appendix E

Table 3. Topography, substrate, winter burrow site preference, and denning behavior of the desert tortoise (*Gopherus agassizii*) in each recovery unit.

Recovery Unit	Physical Attributes of Habitat	Burrow Sites	Denning Behavior
Northern Colorado	Flats, valleys, bajadas, rocky slopes, small washes	Under shrubs, in intershrub spaces, few in washes	Single
Eastern Colorado	Flats, valleys, fans, small washes, deeply dissected washes, rocky slopes	Shallow burrows, bajadas, more use of shrubs	Single
Upper Virgin River	Rock caves, sandstone crevices	Burrows in sand, and in sandstone crevices; (Do not use habitat like NE Mojave, even if available)	Multiple
Eastern Mojave	Flats, valleys, fans, bajadas, rocky slopes	Some caliche caves, bajadas, washes	Single
Northeastern Mojave	Flats, valleys, fans, bajadas, rocky slopes	Caliche caves, bajadas, washes	Multiple
Western Mojave	Flats, valleys, fans, rolling hills, mountainous slopes, rock outcrops, badlands, sand dunes, lava flows	Under shrubs, in bajadas, few in washes	Single

Table 4. Distribution of recovery units of the desert tortoise by genetic unit (mtDNA) and phenotype.

Recovery Unit	Genetic	Phenotype
Northern Colorado	California	California
Eastern Colorado	California	California
Upper Virgin River	Eastern Nevada/Utah	Unknown
Eastern Mojave	California, Southern Nevada	California
Northeastern Mojave	Western Nevada, Central Nevada, Eastern Nevada/ Utah	Beaver Dam Slope, Unknown
Western Mojave	California	California

Table 5. Numbers of freezing days and amounts and timing of precipitation within desert tortoise recovery units.

Recovery Unit	Mean number of freezing days annually	Precipitation	
		Mean annual precip. (mm)	%precip. July-Sept.
Northern Colorado	2-12	112-129	33-34
Eastern Colorado	12-16	96-100	32-37
Upper Virgin River	96	210	24-29
Eastern Mojave	24-46	112-208	28-38
Northeastern Mojave	46-127	100-210	24-31
Western Mojave (totals)	33-104	90-150	6-27
Fremont-Kramer DWMA	33-84	90-150	6-10
Ord-Rodman DWMA	57-104	108	18-27
Superior-Crones DWMA	57+	109	27

G. *Desert Tortoise Life History, Population Dynamics, and Other Factors Which Dictate a Slow and Uncertain Recovery.*

The life history strategy of the desert tortoise depends on longevity and iteroparity (reproduction many times per lifetime). Under natural conditions, this strategy allows the species to persist in spite of the stresses of extremely harsh and variable environments. Because adults normally live long enough to have multiple opportunities to reproduce, populations can grow or at least remain stationary (neither growing or declining) if long periods with unsuccessful reproduction are punctuated occasionally with a few successful years. These factors also make recovery of the desert tortoise more difficult, and one or two good years of reproductive success do not signal a trend toward recovery any more than several poor ones signal inevitable extirpation.

This life history strategy is advantageous where availability of resources is unpredictable and juvenile survival rates are highly variable, but even moderate downward fluctuations in adult survival rates can result in rapid population declines (Stearns 1976). Thus, maintaining high survivorship of adult desert tortoises is the key factor in the recovery of this species.

Even when adult survivorship is "normal" (approximately 98% per year), desert tortoise populations are not capable of rapid growth. For example, the 7-year average egg production at a study site near Goffs, California, was 5.8 eggs per female per year (Turner et al. 1986, B. Henen, UCLA, pers. comm.). At this rate of egg production and assuming "normal" adult survivorship, population growth would be less than 0.5% per year (Figure 4). At this growth rate, more than 140 years would be required for the population to double in size.

Under reasonably favorable conditions, a desert tortoise population might be able to grow at an average rate of 1% per year. At that rate of growth, its doubling time would be 70 years. This means that a population that has decreased to 10 adults per square mile would require three doublings, or 210 years, to reach a density of 80 per square mile.

No population with rates of growth as low as these can stand loss rates of breeding adults as high as those reported in the populations shown in Figure 1 without serious threat of extinction. Desert tortoise populations can withstand high rates of natural juvenile mortality as long as the probability of adults surviving each year does not drop below approximately 98% (Figure 5; Appendix C). Thus, the desert tortoise is extremely vulnerable to extinction in

areas in which the probability of adult survival has been significantly reduced. Other species with similar life history strategies (e.g., California condor, black rhinoceros, blue whale) have been caught in altered environments in which the probability of adult survival has decreased dramatically. These species are all in danger of extinction.

Other factors also affect recoverability of this species. For example desert tortoises have complex social behaviors and intimate familiarity with their home ranges, which are quite large. This means that translocating desert tortoises is not likely to be very successful (Berry 1986b) until research projects determine if translocation can be a successful means of recovery (Appendix B).

Desert tortoise recovery is further complicated by the large area involved. The Mojave region spans four states (each with different laws and regulations), two different deserts (Mojave and Colorado), and several hundred thousand square miles. There is considerable genetic and ecological variability within the desert tortoise throughout the Mojave region. Maintaining this variability is necessary for desert tortoises to adapt to these varied environmental conditions and possible future changes in the environment. In addition, the threats facing the desert tortoise differ in degree, although not necessarily in kind, in different parts of the Mojave region. Consequently management actions needed to promote recovery will have to be tailored to the needs of specific areas. If recovery is to be achieved, the cooperative efforts of a myriad of State, Federal, and local agencies will be necessary to abate these threats and implement the recovery strategy outlined in this Recovery Plan.

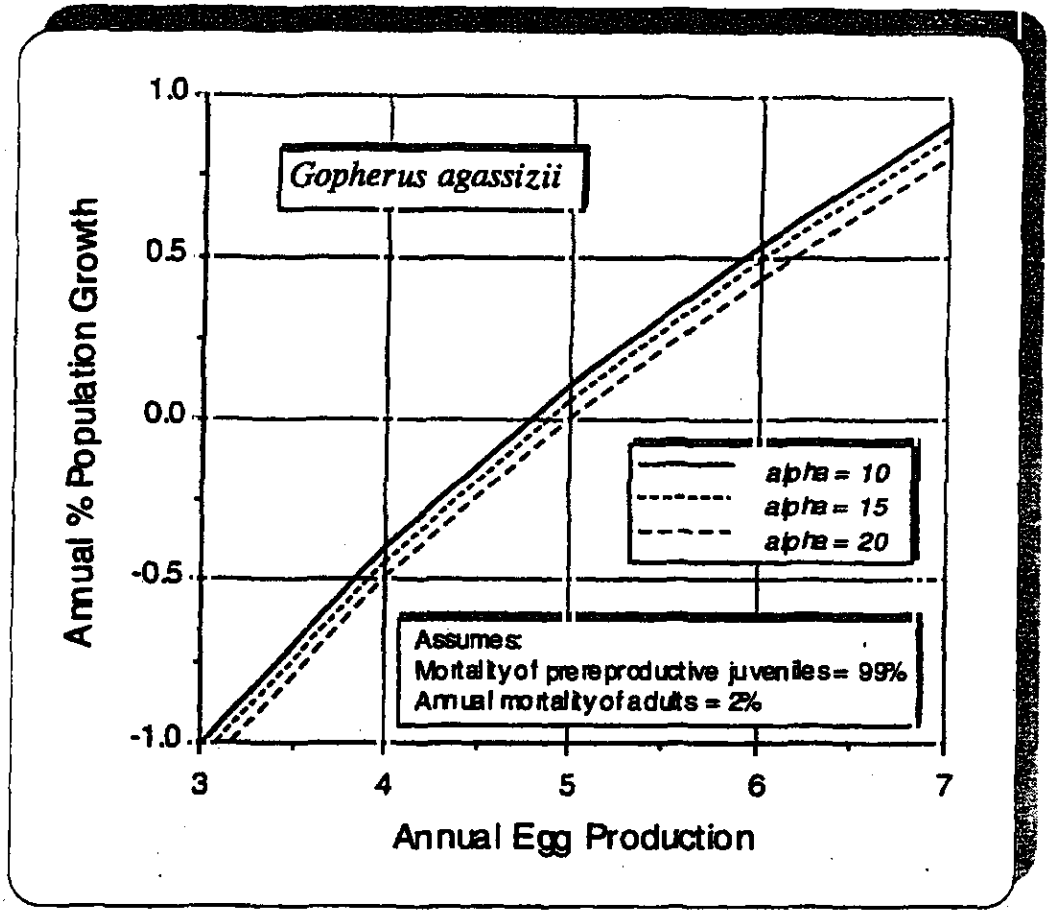


Figure 4. Simulated population growth rate of desert tortoises assuming various rates of mortality and maturation. Alpha is the age of first reproduction.

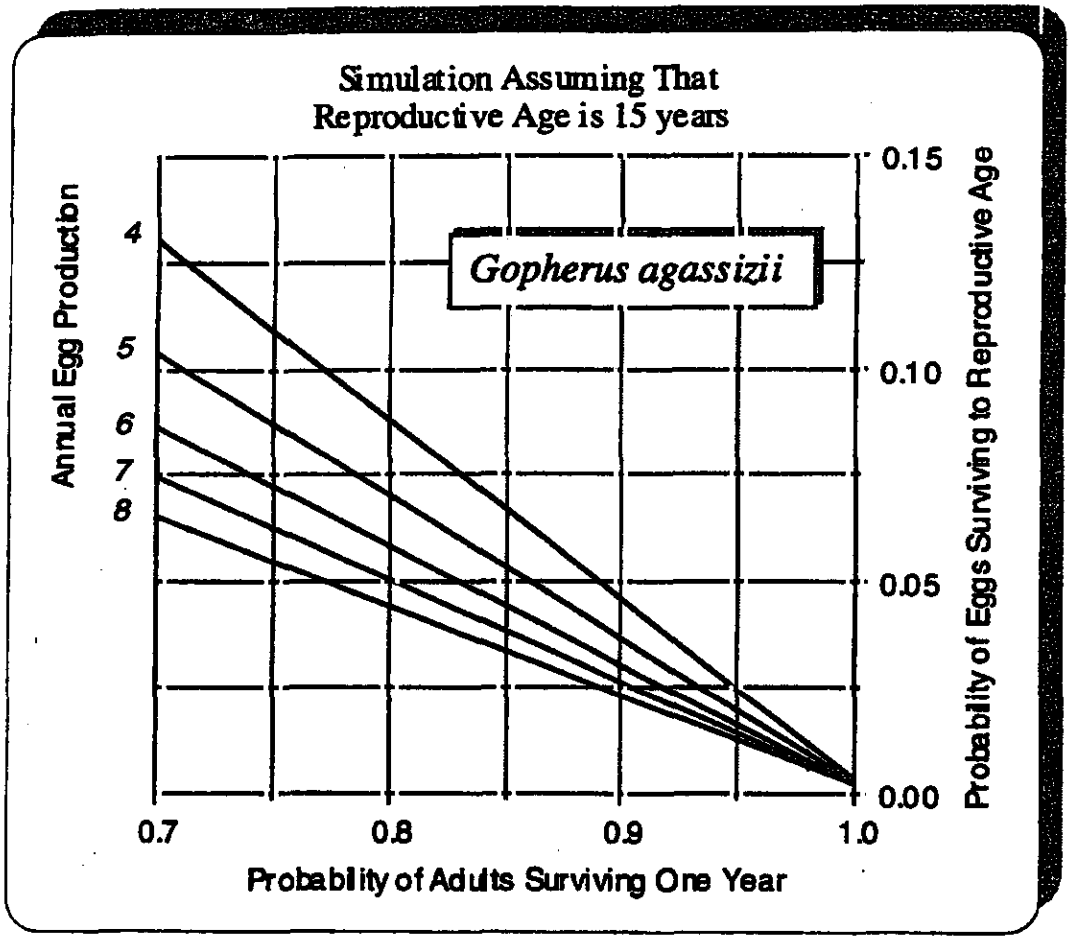
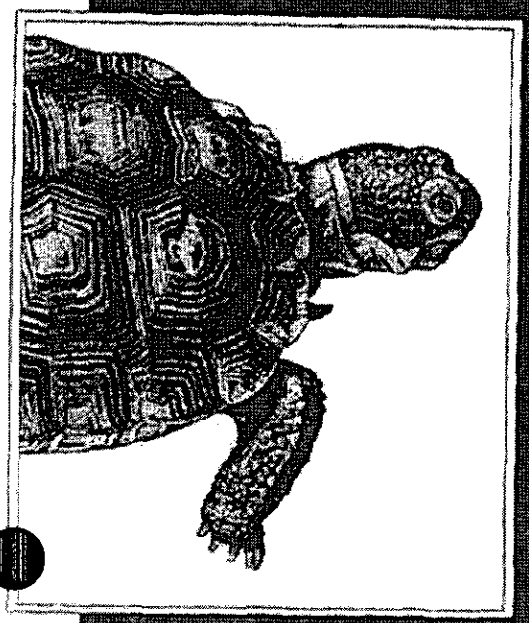


Figure 5. Adult and juvenile survivorship necessary to have a net reproductive rate of 1 (viz., a population neither growing nor declining) when females produce an average of 5 to 6 eggs per year.

Appendices

Desert Tortoise
(Mojave Population)



Recovery Plan

II. RECOVERY

A. Principles Followed in Developing Recovery Goals.

The following biological principles provide the framework for development of delisting criteria and the recovery strategy for the Mojave population of the desert tortoise.

1. Maintenance of distinct population segments.

Data on habitat use, general ecology, genetics, and behavior reviewed in section I.F. define six distinct population segments or recovery units of the desert tortoise within the Mojave region: the northern Colorado, the eastern Colorado, the Upper Virgin River, the eastern Mojave, the northeastern Mojave, and the western Mojave recovery units (Tables 2, 3, 4, and 5, Figure 3). Preserving viable populations of desert tortoises within each of these units is essential to the long-term recovery, viability, and genetic diversity of the species. Identification of these recovery units also facilitates the tailoring of recovery strategies to the varying biological requirements and management needs of each recovery unit. Within recovery units, Desert Wildlife Management Areas (DWMAs) need to be identified in which recovery actions will be implemented to provide for the long-term persistence of viable desert tortoise populations and the ecosystems upon which they depend.

2. Genetic considerations in population viability.

In small populations, short-term genetic deterioration occurs from inbreeding and loss of genetic heterozygosity (Frankel and Soulé 1981, Ralls and Ballou 1983). This genetic deterioration can cause problems in individual fitness and in the population's ability to increase. In the longer-term, inbreeding depression and loss of heterozygosity can limit the ability of the population to respond adaptively to changes in environment. Both of these problems can contribute to the probability of population extinction.

The extent to which genetic deterioration can affect populations is related to the genetically effective size (N_e) of the population (loosely defined as the number of individuals actually passing on their genes to the next generation). In vertebrates, N_e is usually between 0.1 and 0.5 of the total population size, N (Ryman et al. 1981, Shull and Tipton 1987). There are no data on N_e/N ratios in desert tortoises, but the age structure and mating strategies of this species indicate that its N_e/N ratio will be at the lower end of that range. The long-term evolutionary potential of populations requires an N_e of about 500 individuals, although this number is not very precise and might be off by an order of magnitude (Lande and Barrowclough 1987). Thus, if the N_e/N ratio for a desert tortoise

population is 0.1, and an N_e of about 500 to 5,000 individuals is required to maintain the long-term evolutionary potential of the species, then a population size (N) of 5,000 to 50,000 would be required for a genetically healthy population. Desert tortoise population age structures indicate that the percentage of adults in the population range between 4 and 40% (see Appendix C); thus, a population of 5,000 total individuals could have between 200 and 2,000 adult animals; a population of 50,000 total individuals could have between 2,000 and 20,000 adults. While estimates that vary over two orders of magnitude are not very satisfying, they indicate a need for caution in assessing the conditions under which a population will remain viable. Thus, a minimally viable population of desert tortoises from genetic considerations should probably contain at least 2,000 to 5,000 adult animals.

3. *Demographic considerations in population viability.*

In addition to genetic deterioration that can occur at very small population sizes, numerous negative demographic effects can occur when population sizes are small or when their densities are low. When population densities are very low, random variations in sex ratios, age distributions, and birth and death rates among individuals (called demographic stochasticity) can cause the population to fluctuate widely and potentially go extinct (Richter-Dyn and Goel 1972). In very sparse populations, males and females may have problems finding mates. This phenomenon is called the Allee effect, and it also can result in population declines or extinction (Ehrlich and Roughgarden 1987). In desert tortoises, the population densities below which demographic stochasticity and the Allee effect become a matter of concern are estimated to be approximately 10 adults per square mile (See Appendix C). Below this density extinction becomes increasingly possible.

Even at much larger sizes, populations can go extinct from a variety of random (stochastic) events, although large populations have a much lower probability of extinction than small ones. Recovery targets should be set at population levels that have comfortable extinction probabilities. To determine the likelihood of stochastic extinctions for desert tortoise populations of various sizes, three population viability analyses (PVAs) were performed (Appendix C). A PVA provides an estimate of how large a population has to be to have a given probability of persistence over a certain period of time.

The first PVA modeled population persistence as a function of the discrete population growth rate (lambda) and its variance. Using data from 13 study plots (see Appendix C), the average lambda was calculated to be 0.985 and its variance 0.08. Using these figures, the model predicted that 50% of the populations starting with 20,000 adult animals would go extinct within about 500 years, or 20 tortoise generations. This prediction was based upon observed variability in population growth rates during 1979-89, relatively equitable years for desert tortoises, at least with respect to food

production. Even so, the average lambda of 0.985 shows that populations declined during these years, although not drastically. However, during 1990 and 1991, population growth rates declined substantially because of the cumulative effects of drought and disease. Thus, an additional analysis was conducted which incorporated greater variability in population growth rates on the assumption that droughts and epizootics are likely to recur during the next few centuries. Increasing the variation in the 1979-89 growth rates by 50% resulted in the model predicting that a minimum population size of approximately 40,000 to 60,000 adult desert tortoises would be required in order for the population to persist for a 500-year median extinction time.

A second PVA was based on detailed demographic data from the Goffs study site in California and samples from 19 populations in California and Nevada which have been monitored for a number of years (Berry 1990, as amended). The mean lambda for this more extensive sample was determined to be 0.975 with a standard deviation of 0.019 (due entirely to random variation around population trends; the other sources of variation had been partitioned out). This model predicted that a population with this mean lambda (0.975) could never persist for more than about 390 years, or approximately 15 tortoise generations, regardless of initial population size. Running the model with lambdas of 1.0 and a standard deviation of 0.019 gave quite long times to extinction. A third PVA also emphasized the importance of lambdas near 1.0 for population persistence.

4. *Comprehensive considerations in population viability.*

These analyses of minimal viable populations and population persistence probabilities suggest several things. First, tortoise populations at minimum densities (10 adults per square miles) require at least 200 to 500 square miles to be genetically viable (see Sections II.A.2 and II.A3). Second, if lambdas are slightly below 1.0 but vary over a range of approximately 25%, extremely large reserves (5,000 square miles to support 50,000 adults at minimal density) are necessary to support populations that are relatively resistant to extinction within the next half century. Third, if lambdas are below 0.975 on average, no population size is large enough for persistence to 500 years.

These findings indicate that suitable DWMAs could be somewhere between 200 to 5,000 square miles, a fairly wide range of choices. In view of this uncertainty, at least 1,000 square miles is recommended as the target size. Reserves of this size will likely provide sufficient buffering from demographic stochasticity and genetic problems at low population densities, and they are large enough to support recovered populations that have reasonable probabilities of persistence into the future. The utility of large reserves in preventing extinction is one of the best established tenets

of conservation biology (e.g., Terborgh and Winter 1980; Soulé and Simberloff 1986). And, all else being equal, large reserves will conserve more species than small ones (Wilcox 1980; Simberloff and Abele 1982; Wilcove et al. 1986).

Large reserves will also facilitate managing desert tortoise populations within the DWMAs to maintain average lambdas of 1.0 or more during the recovery process. Large reserves are more likely to have sufficient internal environmental heterogeneity and enough isolated areas in their interiors to ensure that some subpopulations will be growing even if others are declining. In summary, genetic, demographic, and other considerations point to the inescapable conclusion that small reserves in a highly fragmented habitat are a recipe for extinction of the desert tortoise.

A preliminary analysis suggests that there may be a mechanistic link between mean annual production of grasses and forbs and maximum tortoise densities (see Appendix G). However, additional research is necessary to ascertain what properties of the environment determine the maximum number of tortoises that can be supported in particular regions of the desert. Information from this kind of research is critical to a proper evaluation process of the efficacy of management schemes.

5. *Reserve architecture.*

DWMA size is not the only important consideration in determining the probability of success in preserving desert tortoise populations. Principles of reserve design dictate that the shape of DWMAs is also very important (see Section II.D.1.d). Population persistence will be maximized in a recovery unit if the unit has several large DWMAs (each of which is at least 1,000 square miles; see Section II.A.3). Furthermore, these DWMAs should be designed to minimize perimeter relative to area. The optimal shape for such a DWMA is circular, but this configuration may not be feasible (see Figure 6A). Fewer large DWMAs per recovery units diminish persistence probabilities; a minimally acceptable condition is one large DWMA with a minimum perimeter/area ratio (Figure 6B). When no other choice is available, it may be necessary to create smaller DWMAs. These must be connected with very wide strips of suitable tortoise habitat (Figure 6C). In extreme cases, it may be necessary to create DWMAs that are smaller than the recommended size and unconnected to other DWMAs by functional habitat. Such DWMAs must be intensely managed to control extrinsic sources of mortality (Figure 6D). More details on reserve design are found in Section D.1.b.

RECOVERY UNITS

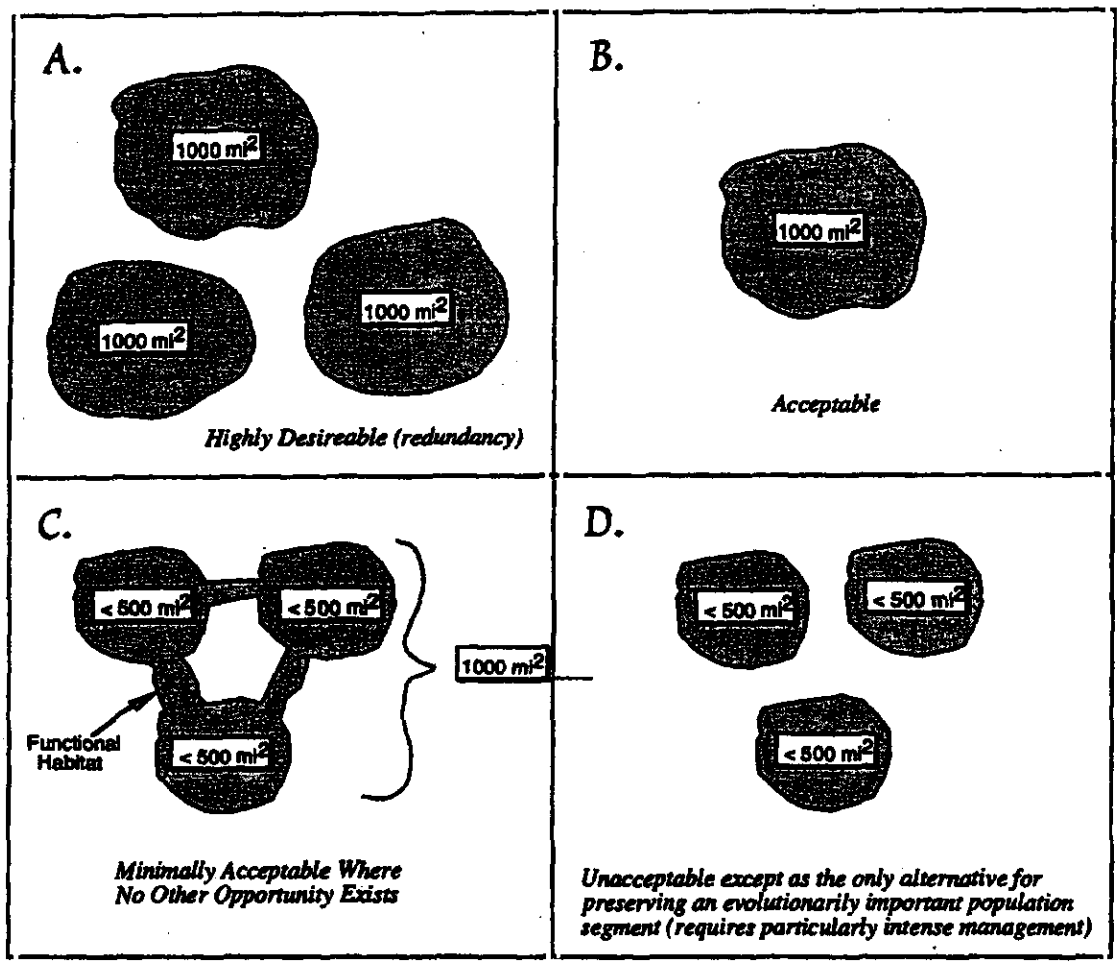


Figure 6. Schematic representation of possible wildlife reserves within recovery units; (A) The recommended arrangement in which several DWMAs will be located in each recovery unit; (B) The minimally acceptable arrangement in which there is no redundancy in DWMAs, (C) The minimally acceptable arrangement in situations in which it is not possible for a round DWMA - corridors of suitable habitat need to connect smaller units of a DWMA; (D) The generally unacceptable alternative of small, unconnected DWMAs. Such reserves must be intensely managed in perpetuity to ensure population persistence.

6. Ecosystem protection.

Section 2(b) of the Endangered Species Act provides for protection of the ecosystems on which threatened or endangered species depend. Thus, survival and recovery of the desert tortoise should occur in its natural habitat, not in zoological gardens or other artificial situations, and DWMAs should protect the environments in which the desert tortoise lives. In preserving these environments, other species will benefit, including many rare and/or sensitive species. Land managers are strongly encouraged to take a multi-species approach to reserve design and include habitat of other rare or declining species into DWMAs. Such an approach would reduce the need to list other species of plants and animals in the Mojave region.

B. Recovery Strategy

This Recovery Plan describes a strategy for the recovery and delisting of the Mojave population of the desert tortoise. This strategy includes: (1) identification of six recovery units within the Mojave region, (2) establishment of a system of DWMAs within recovery units, and (3) development and implementation of specific recovery actions within DWMAs. This recovery strategy will be revised as recovery actions are implemented and new information becomes available from research and monitoring.

1. Size and number of reserves.

The key to this recovery strategy is timely establishment of at least one DWMA in each recovery unit and prompt implementation of reserve-level protection within them. DWMAs must be located in areas with good desert tortoise habitat currently supporting a minimum of several hundred adult animals at a density of no fewer than 10 per square mile (See Section II.A). More than one DWMA within each recovery unit will increase the probability that a population within a recovery unit will recover. The Recovery Plan identifies 14 proposed DWMAs (Table 6, Figures 7, 8, 9, 10, Apendix F), some of which occur in more than one recovery unit. Summary descriptions of the 14 proposed DWMAs are presented in Appendix F and Brussard et al. (1994).

2. Experimental management zones.

All DWMAs should restrict human activities that negatively impact desert tortoises (Section II.E.1., Appendix F, Brussard et al. 1994). However, a maximum of 10% of tortoise habitat within a DWMA may be designated as an experimental management zone (EMZ) where certain prohibited activities (e.g., intrusive research on desert tortoises) may be permitted on an experimental basis during the recovery period. EMZs should be located toward a DWMA's periphery.

3. Modification of the Recovery Plan.

Conservation biology works with the best available knowledge for any given species in its current situation as the basis for hypotheses or models that will best effect the recovery of the species. These models originate, and are debated, on the scientific side of conservation biology. They evolve quite slowly, and are usually stable throughout the planning process. However, new data can become available at any time, and such new data should be able to influence management practices. Thus, this Recovery Plan should be reassessed every three to five years or at any time it becomes apparent that the plan is not fulfilling its function to guide recovery. Reassessment should be based on recent and ongoing research, on population and habitat trends, and on the results of any restoration efforts both inside and outside of the DWMAs. The reassessment team should consist of representatives from all affected Federal, state, and local wildlife and land management agencies, and experts in the field from other agencies, the private sector, and academia. The Desert Tortoise Management Oversight Group should facilitate this review process.

Table 6. List of Desert Wildlife Management Areas, their current estimated densities (adults per square mile), and degree of threat (1=low, 5=extremely high).

Recovery Unit	DWMA	Estimated Density (adults/mi^2)	Degree of Threat
Northern Colorado			
	Chemehuevi	10-275	1
Eastern Colorado			
	Chuckwalla	5-175	4
Upper Virgin River			
	Upper Virgin River	up to 250	5
Eastern Mojave			
	Fenner[1]	10-350	3
	Ivanpah[2]	5-250	3
	Piute-Eldorado[2]	40-90	2
Northeastern Mojave			
	Beaver Dam Slope	5-60	5
	Coyote Spring	up to 90	2
	Gold Butte-Pakoon	5-60	2
	Mormon Mesa	40-90	3
Western Mojave			
	Fremont-Kramer	5-100	5
	Ord-Rodman	5-150	4
	Superior-Cronese	20-250	5
	Joshua Tree[3]	up to 200	1

1 Located in both the eastern and northern Colorado recovery units.
2 Located in both the eastern and northeastern Mojave recovery units.
3 Southeastern corner of this DWMA is located in the eastern Colorado recovery unit.

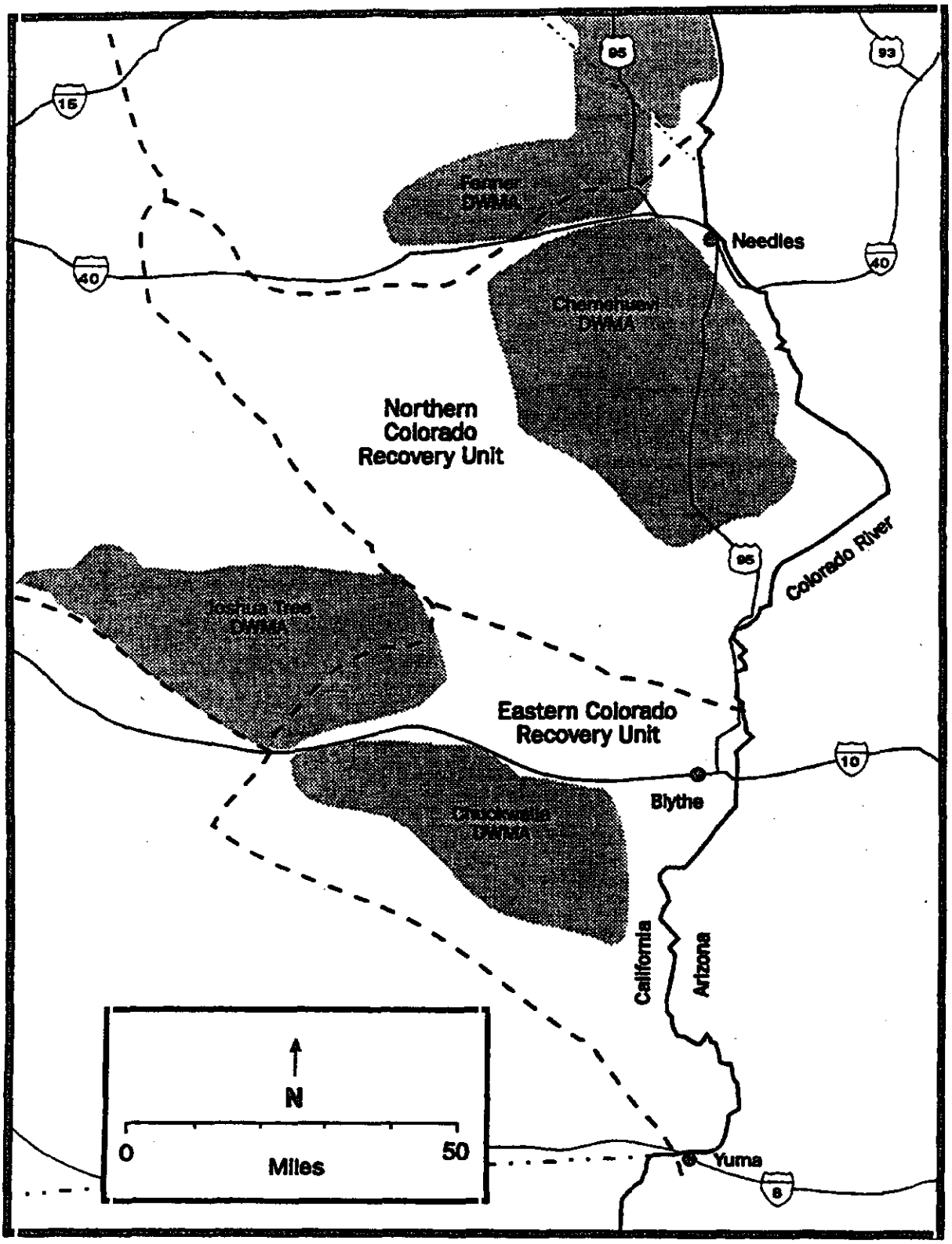


Figure 7. Proposed DWMAs in the northern Colorado and eastern Colorado recovery units.

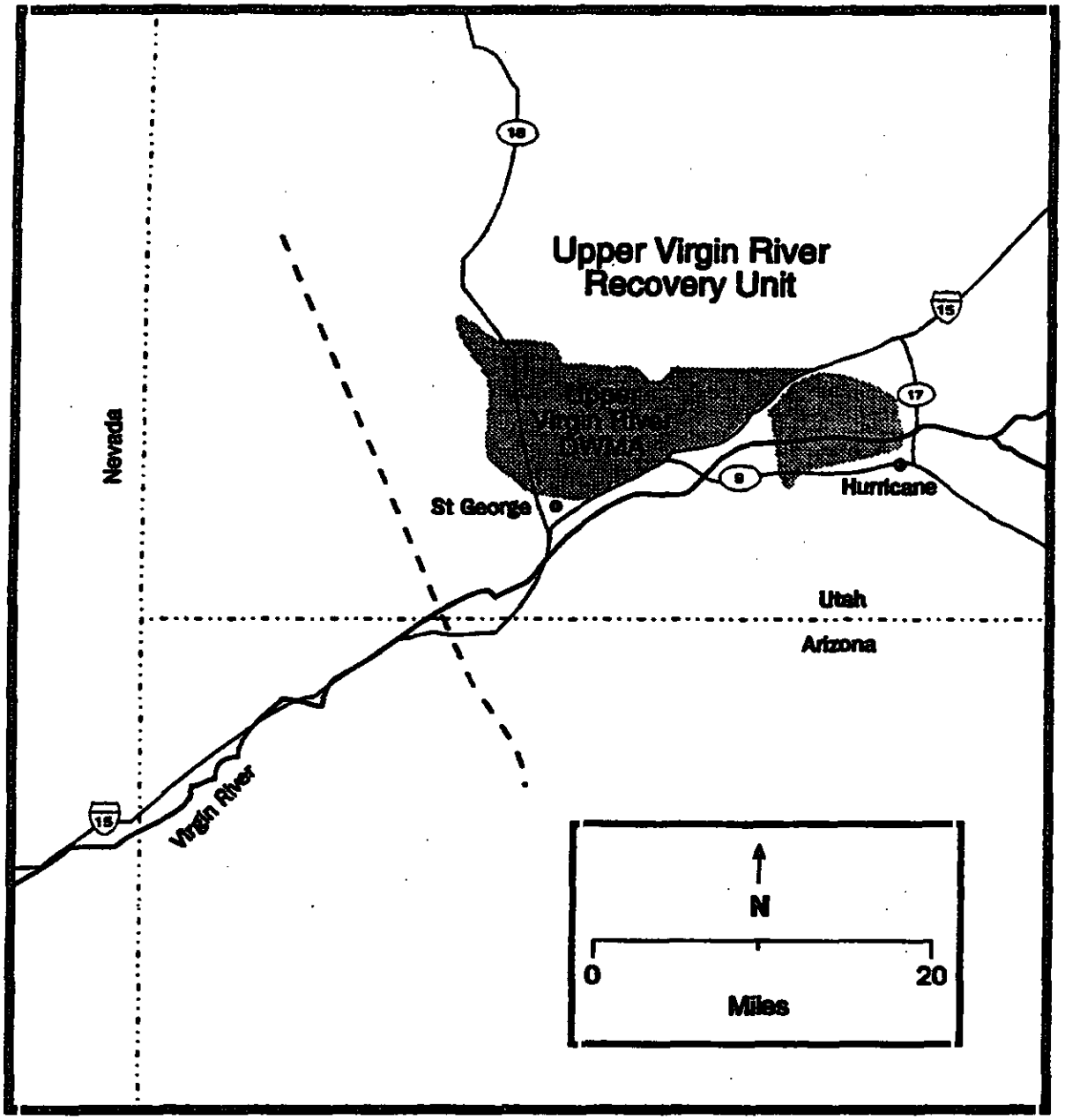


Figure 8. Proposed Upper Virgin River DWMA in the Upper Virgin River recovery unit.

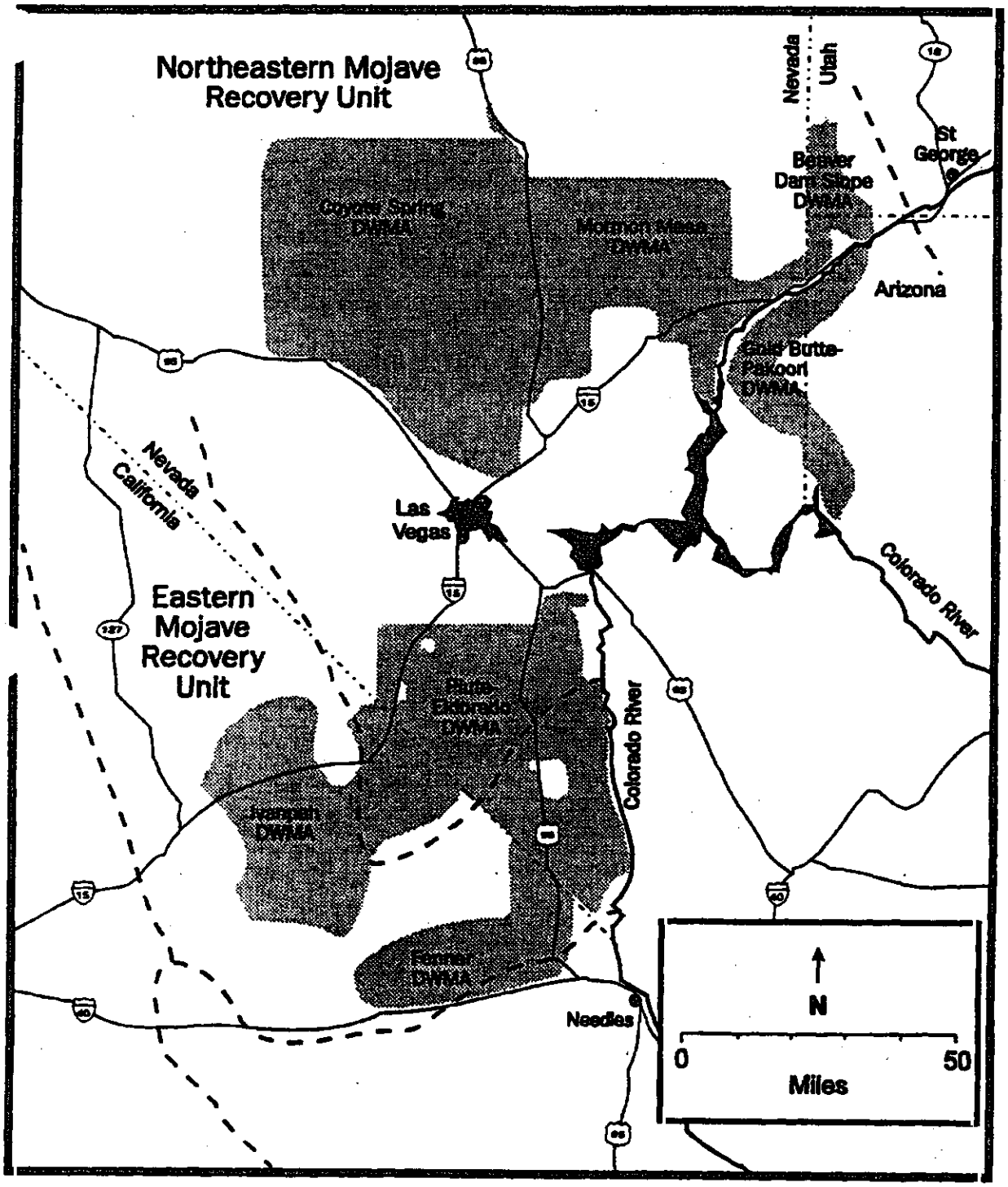


Figure 9. Proposed DWMAs in the eastern and northeastern Mojave recovery units.

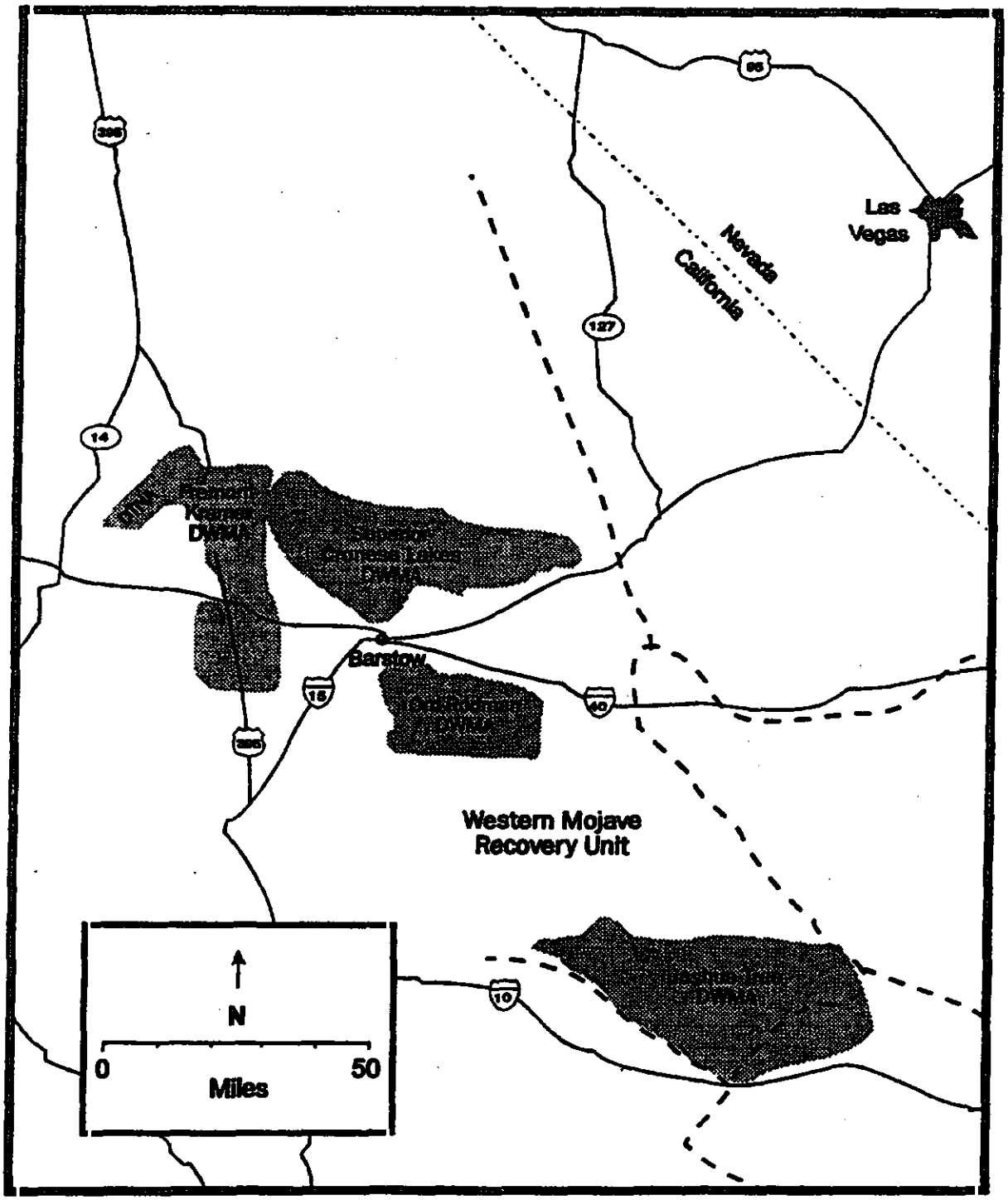


Figure 10. Proposed DWMAs in the western Mojave recovery unit.

C. Recovery Objective and Delisting Criteria.

1. Recovery objective.

The objective of this Recovery Plan is the recovery and delisting of the Mojave population of the desert tortoise. Management actions and research necessary to effect recovery are described, supported, and scheduled.

2. Recovery criteria.

Desert tortoise populations, which are only capable of very slow growth, have declined substantially throughout much of the Mojave region in the last two decades. Therefore, desired improvement in the status of these populations will necessarily be a very long process, measured in decades or centuries. Nevertheless, delisting may be considered if population size is stationary or increasing (long-term trends in lambda are equal to or less than 1.0), sufficient habitat is protected or managed for recovery and long-term persistence, regulatory mechanisms are in place, and the population is unlikely to become threatened again in the foreseeable future.

Recovery units are considered distinct population segments and may be individually delisted if they meet the recovery criteria. Specifically, the population within a recovery unit may be considered for delisting when **all** of the following criteria are met:

Delisting Criterion 1:

As determined by a scientifically credible monitoring plan, the population within a recovery unit must exhibit a statistically significant upward trend or remain stationary for at least 25 years (one desert tortoise generation). Consistent with Appendix A, a sampling plan should be instituted in each recovery unit to monitor the progress of recovery. Appendix A calls for a population estimation every 5 years; thus data from at least five estimates need to be considered in evaluating population trends. Monitoring should continue following delisting to ensure population stability.

Delisting Criterion 2:

Enough habitat must be protected within a recovery unit, or the habitat and the desert tortoise populations must be managed intensively enough, to ensure long-term population viability. Consistent with section II.A., at least one DWMA must be established in each recovery unit that is, except under unusual circumstances, at least 1,000 square miles in area.

Delisting Criterion 3:

Provisions must be made for population management at each DWMA so that populational lambdas are maintained at or above 1.0 into the future.

Delisting Criterion 4:

Regulatory mechanisms or land management commitments have been implemented that provide for adequate long-term protection of desert tortoises and their habitat, such as those described in Sections II.D. and E. Delisting would be followed by a loss of protection under the Endangered Species Act; therefore adequate protection through alternative means is essential before delisting can occur. For example, management plans for Federal lands should provide adequate assurances of habitat protection prior to consideration of delisting. The form of these regulations, commitments, and their implementation should be determined during future land management planning efforts and will likely vary throughout the Mojave region and by agency, reflecting the differing management needs of different areas. Reasonable assurance must exist, on a case by case basis, that conditions which brought about population stability will be maintained, or as necessary, improved during the foreseeable future.

Delisting Criterion 5:

The population in the recovery unit is unlikely to need protection under the Endangered Species Act in the foreseeable future. Detailed analyses of the likelihood that a population will remain stable or increase must be carried out before determining whether it is recovered. These analyses should include observed and anticipated effects of: (a) fluctuations in abundance, fecundity, and survivorship; (b) movements of desert tortoises within the area and to or from surrounding areas; (c) changes in habitat, including catastrophic events; (d) loss of genetic diversity; and (e) any other threats to the population which might be significant.

When the population within a recovery unit meets all of these five criteria it may be considered recovered and eligible for delisting. When all recovery units are considered recovered, the Mojave population of the desert tortoise could be considered for delisting. These recovery criteria were designed to provide a basis for consideration of delisting, but not for automatic delisting. Before delisting may occur, the Fish and Wildlife Service must determine that the following five listing factors are no longer present or continue to adversely affect the listed species: (1) the present or threatened destruction, modification, or curtailment of the species' habitat or range; (2) overutilization for commercial, recreational, scientific, or educational purposes; (3) disease and predation; (4) inadequacy of existing regulatory mechanisms; and (5) other human-made or natural factors affecting the continued existence of

the species (50 CFR 424.11). The final decision regarding delisting would be made only after a thorough review of all relevant information by the Fish and Wildlife Service.

The five recovery criteria and the methods to determine densities will be revised as appropriate as new information pertinent to these topics becomes available. Revisions must be based on the best data available and must be approved by the Fish and Wildlife Service.

D. *Narrative Outline Plan for Recovery Actions Addressing Threats*

The desert tortoise was listed as threatened primarily because of a variety of human impacts which cumulatively have resulted in widespread and severe desert tortoise population decline and habitat loss. The destruction, degradation, and fragmentation of desert tortoise habitat and loss of individual desert tortoises from human contact, predation, and disease are all important factors in the decline of the Mojave population (section I.B.). If the desert tortoise is to be recovered within its native range, the causes of the decline must stop, at least within the DWMAs. Some factors are likely more important than others; for instance, urbanization has probably caused more habitat loss than light cattle grazing. However, eliminating all factors that are deleterious to desert tortoise populations will certainly result in faster recovery than will selective elimination of a few.

Because of the many political jurisdictions in the Mojave region, implementation of recovery actions will require unprecedented interagency cooperation. Delays in implementing this Recovery Plan caused by political constraints would increase the costs of recovery and decrease the likelihood that recovery efforts will successfully avert extinction of the desert tortoise. Interagency cooperation could be facilitated by the Desert Tortoise Management Oversight Group. All agencies with management responsibilities for the desert tortoise need to participate in the implementation of the recovery strategy.

Desert tortoises outside of DWMAs will still be protected by section 9 of the Endangered Species Act. Take of desert tortoises is prohibited unless specifically authorized by the Fish and Wildlife Service pursuant to sections 7 or 10 of the Endangered Species Act. These desert tortoises may be important in recovery of the Mojave population by providing a source of adult desert tortoises for repopulating extirpated populations in DWMAs once translocation techniques have been perfected. Habitat outside DWMAs may provide corridors for genetic exchange and dispersal of desert tortoises among DWMAs.

In addition, isolated populations of healthy desert tortoises found outside of DWMAs should be noted, but no active management is

recommended for these populations unless it is needed to ensure their viability. These isolated populations may have a better chance of surviving the potentially catastrophic effects of URTD or other diseases than large, contiguous populations.

Accomplishment of the recovery actions described in this section is needed to reduce or eliminate human-caused impacts in the recovery units and to implement the recovery strategy described in section II.C. Recovery actions are listed in a stepdown form in which broad categories of recovery actions are stepped down to specific tasks. Tasks listed here also appear in the Implementation Schedule (Section III), in which costs and scheduling are estimated and lead Federal agencies are identified for specific actions. DWMA-specific tasks and costs, which will be crucial to implementation of management plans, are not detailed here or in the Implementation Schedule because they will vary depending on the number, location, and size of DWMAs selected and the management needs of specific areas. The contributions of state agencies will come into play when specific management plans are written for each recovery unit.

Although DWMA-specific management actions cannot yet be precisely defined, the reduction and elimination of threats necessary to recover the desert tortoise broadly define the range of actions necessary within DWMAs. Actions which will likely be needed in all DWMAs to address these threats are listed in Section II.E. The summary descriptions for each DWMA in Appendix F include recommendations to address site-specific management needs of the 14 proposed DWMAs. These recommendations are presented to aid land managers in the development of management plans. These plans should implement the guidance provided in this Recovery Plan. The costs associated with the following recommended tasks are provided in the Implementation Schedule (Section III). The Implementation Schedule will be amended and expanded as management plans are developed and DWMA-specific management actions are identified. In addition, as new information becomes available and recovery actions are implemented, ongoing recovery actions may be modified to speed recovery.

1. Establish DWMAs and implement management plans for each of the six recovery units.

Management plans should be developed and implemented for each of the six recovery units. Such management plans should determine the number, size, location, and boundaries of DWMAs; determine how habitat within DWMAs will be secured and managed, and describe how monitoring of the recovery effort will be accomplished. Plans should be developed by land management agencies in close coordination with the Fish and Wildlife Service, State wildlife agencies, local governments, and the public. Splitting recovery units by political or other boundaries and developing more than one management plan to address a single recovery unit should be discouraged. Nevertheless, additional site-specific plans to address

management of individual DWMAs may be appropriate to implement guidance provided in the recovery unit management plans.

DWMAs have great potential to serve as multi-species reserves which could conserve habitat for a variety of species. Land managers should be strongly encouraged to consider this multi-species approach in development of recovery unit management plans, as it could preclude the need for Federal listing of other sensitive species of the Mojave region. The Western Mojave Coordinated Management Plan, currently being developed by the BLM, California Department of Fish and Game, Fish and Wildlife Service, and local governments, could be the first of these recovery unit management plans.

1.a. Select DWMAs.

General requisites for determining number and size of DWMAs in a recovery unit are described in the Recovery Strategy (Section II.B.). Generally, reserves should be established within each recovery unit which are at least 1,000 square miles in extent, or if this is not possible, particularly intensive habitat and desert tortoise population management should be implemented to ensure long-term viability of the population. In many areas of the Mojave Desert, it is possible to establish DWMAs large enough to provide a high probability of recovery. However, some population segments will have to be recovered in smaller DWMAs. These will have to be particularly well managed to prevent extinctions because of the higher probabilities of extinction ascribed to small populations (see Appendix C). Many population segments within most recovery units are currently declining, and human-caused mortality, habitat loss, and the possible catastrophic effects of URTD or other diseases further endanger these populations. Thus, simply setting aside the minimum land area necessary to support a viable population will not be adequate to effect recovery.

The task of selecting DWMAs is listed in the Implementation Schedule in a stepdown fashion by recovery unit. Table 6 lists the Recovery Team's recommendations for DWMAs in the six recovery units. Proposed DWMAs are described in Table 6, Figures 7, 8, 9, 10, Appendix F, and in Brussard et al. (1994).

1.a.1. Northern Colorado Recovery Unit

1.a.2. Eastern Colorado Recovery Unit

1.a.3. Upper Virgin River Recovery Unit

1.a.4. Eastern Mojave Recovery Unit

1.a.5. Northeastern Mojave Recovery Unit

1.a.6. Western Mojave Recovery Unit

1.b. Delineate DWMA boundaries.

Whenever possible, DWMA boundaries should be drawn to include the best examples of desert tortoise habitat in specific vegetation regions. In addition, heterogeneous terrain, soil types, and vegetation within DWMAs will best provide protection for the entire ecosystems upon which healthy desert tortoise populations depend.

Boundary delineations for DWMAs (and contained EMZs) should be consistent with current theory and practice of reserve design (Thomas et al. 1990, Noss 1991). Land-management agencies should follow these guidelines when establishing boundaries for DWMAs and EMZs. These guidelines should also be followed in prescribing management goals.

(a) Reserves that are well-distributed across a species' native range will be more successful in preventing extinction than reserves confined to small portions of a species' range. Preservation of one or more viable populations within each of the six recovery units will ensure that the full range of variation within the species is maintained, enhancing the desert tortoise's ability to adapt or adjust to future environmental changes.

(b) Large blocks of habitat, containing large populations of the target species, are superior to small blocks of habitat containing small populations. While the persistence of all desert tortoise populations is subject to the effects of environmental stochasticity and catastrophes, the persistence of small populations is additionally threatened by demographic and genetic stochasticity (see Section II.A. and Appendix C). This means that the largest possible blocks of good desert tortoise habitat in an area, containing the most dense desert tortoise populations, should be included within DWMA boundaries.

(c) Blocks of habitat that are close together are better than blocks far apart. This arrangement facilitates dispersal of desert tortoises among habitat patches. Connecting habitat segments should be of medium to high quality and be wide enough to accommodate several desert tortoise home-range widths (several miles), but narrow enough to discontinue contact between DWMAs by double fencing, if necessary to impede the spread of disease (Figure 6). Such linkages are necessary both for a demographic "rescue effect" (Brown and Kodrik-Brown 1977) and for continued genetic interchange.

(d) Habitat that occurs in less fragmented, contiguous blocks is preferable to habitat that is fragmented. The desert tortoise does best in undisturbed environments where the presence of edge species, such as ravens, is minimized. Highly fragmented habitat is mostly edge (because small patches maximize the ratio of edge to interior area) and should be avoided to the extent possible within DWMAs.

(e) Habitat patches that minimize edge to area ratios are superior to those that do not. This means that round or square patches of habitat are more likely to retain desert tortoise populations than elliptical or rectangular ones. Long, linear strips are the least desirable.

(f) Interconnected blocks of habitat are better than isolated blocks, and linkages function better when the habitat within them is represented by protected, preferred habitat for the target species. Interpopulation dispersal, as mentioned above, is important for population persistence. One possible negative effect of interpopulation dispersal on the desert tortoise is the potential for spreading disease from infected to non-infected populations. Inclusion of isolated but healthy populations into DWMAs could be valuable in avoiding the possible catastrophic effects of this disease. However, aside from the problems of disease transmission, the advantages of dispersal often outweigh the disadvantages. Thus, maintaining linkages among habitat patches within DWMAs and among the DWMAs themselves is considered here to be important. This will require maintaining connecting segments of habitat that are at least marginally acceptable to the desert tortoise.

(g) Blocks of habitat that are roadless or otherwise inaccessible to humans are better than blocks containing roads and habitat blocks easily accessible to humans. Because declines in desert tortoise populations are associated with high densities of access routes, vehicular traffic, and human access (Appendix D, Schoenwald-Cox and Buechner 1992), the access must be limited in the DWMAs. Populations within DWMAs that are inaccessible to motorized recreation or similar activities will have a much better chance of recovery than those in DWMAs where human access is prevalent.

Delineation of DWMA boundaries should be guided by the above concepts and will be integral to development of recovery unit management plans.

1.b.1. Northern Colorado Recovery Unit

1.b.2. Eastern Colorado Recovery Unit

1.b.3. Upper Virgin River Recovery Unit

1.b.4. Eastern Mojave Recovery Unit

1.b.5. Northeastern Mojave Recovery Unit

1.b.6. Western Mojave Recovery Unit

1.c. Secure habitat within DWMAs.

To ensure manageability, private and State lands in DWMAs (exclusive of State parks or other lands managed for the benefit of the desert tortoise) should be acquired or conservation agreements developed to protect desert tortoise habitat. Land acquisitions should include surface and subsurface mineral rights whenever possible. Habitat conservation plans, or similar efforts, should consider this as appropriate mitigation for the take of desert tortoises and/or habitat.

1.c.1. Northern Colorado recovery unit

1.c.2. Eastern Colorado recovery unit

1.c.3. Upper Virgin River recovery unit

1.c.4. Eastern Mojave recovery unit

1.c.5. Northeastern Mojave recovery unit

1.c.6. Western Mojave recovery unit

1.d. Develop reserve-level management within DWMAs.

Because the factors causing the decline of the desert tortoise are primarily human-related (see Section I.B.), many human activities within DWMAs will need to be strictly regulated or eliminated. Because the kinds and levels of human uses vary among recovery units and proposed DWMAs, defining specific management actions needed for recovery must be preceded by DWMA selection and boundary delineation. DWMA management needs could be identified in recovery unit management plans or in specific DWMA plans. Section II.E. describes recommended recovery actions in DWMAs which should become part of recovery unit management plans if DWMAs are selected and delineated as described here. Recommended management actions should be tailored to the needs of specific DWMAs and include activities such as eliminating burro, horse, and domestic livestock grazing; limiting vehicular access, including prohibiting new vehicular access and reducing existing access; and prohibiting new surface disturbances, except to improve the quality of wildlife habitat, watershed protection, or improve opportunities for non-motorized recreation; among others (see Section II.E.).

1.d.1. Northern Colorado recovery unit

1.d.2. Eastern Colorado recovery unit

1.d.3. Upper Virgin River recovery unit

1.d.4. Eastern Mojave recovery unit

1.d.5. Northeastern Mojave recovery unit

1.d.6. Western Mojave recovery unit

1.e. Implement reserve-level management within DWMAs.

Once habitat is secured, management necessary to remove threats to the desert tortoise and its habitat must be implemented. Specific actions are recommended in Section II.E. and include activities such as partial fencing of DWMA boundaries to control livestock, burros, and horses; increased law enforcement; closure of vehicle routes and designation of vehicle ways; and construction of barrier fencing and highway underpasses that can be used by desert tortoises, thus reducing mortality of animals on and near roads and railroad tracks.

DWMAs will serve as recovery sites for the desert tortoise, but they will also be important as ecosystem reserves and as habitat for other rare and/or sensitive species or communities. DWMAs also can play a secondary role in providing watershed protection and some forms of recreation which are compatible with desert tortoise recovery. Management actions should be tailored to meet these other needs whenever possible. These concepts helped shape the management recommendations in Section II.E., Appendix F, and Brussard et al. (1994).

Although specific tasks are difficult to define at this time, implementation of recovery unit plans will be a crucial step in recovering the desert tortoise. As a result, implementation is included in the Implementation Schedule. Most costs and scheduling are listed as "to be determined", as they are contingent upon size and location of DWMAs.

1.e.1. Northern Colorado recovery unit

1.e.2. Eastern Colorado recovery unit

1.e.3. Upper Virgin River recovery unit

1.e.4. Eastern Mojave recovery unit

1.e.5. Northeastern Mojave recovery unit

1.e.6. Western Mojave recovery unit

1.f. Monitor desert tortoise populations within recovery units.

Monitoring of desert tortoise populations will be crucial to determining if desert tortoise populations are stationary, declining, or increasing (recovery criterion 1). Currently, monitoring of trends in population densities, such as described in Appendix A, is the only defensible way to evaluate recovery of desert tortoise populations. The advantages of this method include: (1) it assesses population trends over large areas, not just in single plots; (2) sample areas are selected randomly, allowing comparisons with standard statistical techniques; and (3) it violates no known assumptions of the underlying model.

Population trend monitoring should be funded by the appropriate land management agency, conducted by qualified biologists, and reviewed by the Fish and Wildlife Service and other appropriate agencies. If monitoring indicates that the desert tortoise population within a DWMA or recovery unit is not progressing towards recovery, management within DWMAs will need to be modified to ensure positive population growth or stability.

In addition to the population trend monitoring described in Appendix A, intensive, long-term study plots should also be maintained throughout the Mojave region, because the data they produce are critical for a thorough understanding of desert tortoise population biology and are necessary for delisting criterion #4.

1.f.1. Develop monitoring plan

A monitoring plan has been completed (Appendix A) and a workshop will be held in 1994 to further refine the techniques to be used for the desert tortoise.

1.f.2. Implement monitoring plan

Apply the monitoring plan developed in task 1.f.1. to each of the six recovery units.

1.f.2.a. Northern Colorado recovery unit
1.f.2.b. Eastern Colorado recovery unit
1.f.2.c. Upper Virgin River recovery unit
1.f.2.d. Eastern Mojave recovery unit
1.f.2.e. Northeastern Mojave recovery unit
1.f.2.f. Western Mojave recovery unit

2. Establish environmental education programs.

Start an aggressive and widespread effort in schools, museums, hunting clubs, and in BLM and National Park Service visitor centers and interpretive sites, etc. to inform the public about the status of the desert tortoise and its recovery needs. Develop interpretive kiosks or visitor centers near DWMAs to disseminate information about the desert tortoise and the need for regulated access and use of habitat. Education programs should include such subjects as: husbandry and adoption programs for captive tortoises, the illegality of releasing captive tortoises to wild lands, the illegality of translocating wild tortoises from one site to another, and the role of euthanasia in managing captive and wild populations where disease is a serious threat to survival of the species. Education efforts should be focused

on groups that use the desert on a regular basis, such as rockhounders. A permit system would offer one way to do this.

2.a. Develop environmental education programs.

Recovery unit management plans should include an environmental education feature, but such programs could also be developed by land management or other entities to educate contracted or in-house construction crews and other personnel who might encounter desert tortoises, or for educating the public in urban centers outside of recovery units.

2.b. Implement environmental education programs.

Implement the environmental education program developed in task 2.a.

3. *Initiate research necessary to monitor and guide recovery efforts.*

Unlike the situation with many threatened or endangered species, considerable data exist on many aspects of the biology of the desert tortoise. Unfortunately, few of these data are useful in recovery planning. The magnitude and scope of new research data essential for recovery planning requires an unprecedented level of coordination and cooperation within and among agencies. Biologists and research scientists in the Department of the Interior (BLM, NPS, Bureau of Reclamation, and National Biological Survey), Department of Defense, and other Federal agencies must work closely with their colleagues in state agencies to achieve this goal. No one agency can handle all the essential research, and monitoring. Employing talents of academic researchers will be essential. During the next two decades, research priorities on the desert tortoise should focus on the following areas:

3.a. Obtain baseline data on desert tortoise densities both inside and outside of DWMAs.

In addition to the population monitoring within DWMAs described in task 1.e., population density and distribution data are needed in some areas. The methodology recommended to determine densities is described in Appendix A. This methodology should be tested for replicability and accuracy in a variety of habitats.

3.b. Develop a comprehensive model of desert tortoise demography throughout the Mojave region and within each DWMA.

Such a model should be based on at least 25 years of data. This time span represents one desert tortoise generation and is necessary to capture the effects of normal environmental variability on desert tortoise survival and reproduction. Research should be done in both high- and low-density areas.

Research to develop documents for this model should include the following actions:

3.b.1. Initiate epidemiological studies of URTD and other diseases.

3.b.2. Research sources of mortality, and their representation of the total mortality, including human, natural predation, diminishment of required resources, etc.

3.b.3. Research recruitment and survivorship of younger age classes.

3.b.4. Research population structure, including the spatial scale of both genetic and demographic processes and the extent to which DWMAs and recovery units conform to natural population subdivisions.

3.c. Conduct appropriately designed, long-term research on the impacts of grazing, road density, barriers, human-use levels, restoration, augmentation, and translocation on desert tortoise population dynamics.

3.d. Assess the effectiveness of protective measures (e.g., DWMAs) in reducing anthropogenic causes of adult desert tortoise mortality and increasing recruitment.

3.e. Collect data on spatial variability of climate and productivity of vegetation throughout the Mojave region and correlate this information with population parameters (e.g., maximum sustainable population size, see Appendix G).

3.f. Conduct long-term research on the nutritional and physiological ecology of various age-size classes of desert tortoises throughout the Mojave region.

3.g. Conduct research on reproductive behavior and physiology, focusing on requisites for successful reproduction.

E. Desert Wildlife Management Areas: Management Recommendations

General requisites for siting DWMAs are found in Section II.B.; concepts of reserve design needed to guide delineation of DWMA boundaries and needed management actions are listed in the narrative outline of recovery actions (Section II.D.). The narrative outline contains only those actions which at this time can be identified. After DWMAs are selected and their boundaries delineated, DWMA-specific management actions must be defined to address specific threats and management problems in each DWMA. This chapter provides recommendations for management in the 14 proposed DWMAs (see Table 7). Although in some recovery units proposed DWMAs may be larger than 1,000 square miles (Appendix F and Brussard et al. 1994), declining populations and continuing threats from human-caused mortality and disease suggest that protecting only the minimum area necessary to support a viable population probably will not be adequate to achieve recovery. If DWMAs are selected and established as described in this Recovery Plan, and if DWMA-specific management actions recommended herein are implemented to protect habitat and to reverse current declines in desert tortoise populations, recovery should be an achievable goal.

Appendix F provides a broad range of information on each proposed DWMA including: (1) summary description, (2) current densities and population size, (3) land ownership, and (4) threats specific to individual DWMAs. Brussard et al. (1994) details further site-specific information which will be needed by land managers to delineate boundaries and assemble management plans for DWMAs. General boundaries are described in Figures 7, 8, 9, 10 and in Appendix F for each DWMA; however, these boundaries can be somewhat flexible.

Only one DWMA is proposed for the Upper Virgin River recovery unit. With intensive and careful management this recovery unit can support a viable population. Similarly, apart from a small portion of the Fenner DWMA, the Chemehuevi DWMA is the only proposed DWMA identified in the northern Colorado recovery unit and thus is a key area. The Chuckwalla DWMA is also very important because it is the only DWMA entirely contained within the eastern Colorado recovery unit. The Joshua Tree DWMA is partially in the eastern Colorado recovery unit, but most of the desert tortoises and most of the land area in this DWMA are in the western Mojave recovery unit.

The 1994 designation of critical habitat for the desert tortoise (59 FR 5823) was based on recommendations of the Draft Plan (Fish and Wildlife Service 1993), and is consistent with the recommendations of this final Plan (Appendix H). Areas not included in critical habitat, but recommended as DWMAs in the Draft Plan, were

considered to have current management policies which provided adequate protection against potential habitat-altering activities because they are primarily managed as natural ecosystems. The regulation of activities within critical habitat through section 7 (of the Endangered Species Act) consultation will be based on recommendations in this Plan (Section II C.1.). Critical habitat does not accomplish the same goals or have as dramatic an effect upon tortoise conservation as does a recovery plan because critical habitat does not apply a management prescription to designated areas. However, designation of critical habitat does provide protection of desert tortoise habitat until such time as the Desert Tortoise Recovery Plan is implemented and DWMA management is employed.

The management needs of DWMAs will likely be influenced by some important regulatory decisions in the near future. For instance, the California Desert Protection Bill (S.21, H.R. 518), currently before Congress, may affect proposed DWMA management needs. If passed into law, proposed DWMAs in the California portion of the eastern Mojave recovery unit could be managed wholly or in part by the National Park Service, and they may contain significant land area designated as wilderness.

The following actions are recommended for each DWMA. However, until DWMA boundaries are established, cost estimates cannot be derived. The Implementation Schedule (Section III) will be updated as these costs become available.

1. Recommended regulations in DWMAs.

For reasons given in Section I.B., if DWMAs are to function well as desert tortoise reserves, some human activities must be restricted. Extensive, rigorously obtained data which unambiguously define activities that are incompatible with desert tortoise recovery are largely unavailable. However, extensive anecdotal as well as other data do exist and they suggest strongly that the following activities should be prohibited throughout all DWMAs if population trends are to be reversed and recovery is to occur within a reasonable period of time. Implementation of these regulations will require intensive enforcement and willing cooperation.

The following activities should be prohibited throughout all DWMAs because they are generally incompatible with desert tortoise recovery and other purposes of DWMAs:

- all vehicle activity off of designated roads; all competitive and organized events on designated roads;

- habitat-destructive military maneuvers, clearing for agriculture, landfills, and any other surface disturbance that diminishes the capacity of the land to support desert tortoises, other wildlife, and native vegetation;

- domestic livestock grazing;
- grazing by feral ("wild") burros and horses;
- vegetation harvest, except by permit;
- collection of biological specimens, except by permit;
- dumping and littering;
- deposition of captive or displaced desert tortoises or other animals, except under authorized translocation research projects (see Appendix B.);
- uncontrolled dogs out of vehicles;
- discharge of firearms, except for hunting of big game or upland game birds from September through February; and

The following activities are compatible with tortoise recovery and may be allowed in DWMAs:

- non-intrusive monitoring of desert tortoise population dynamics and habitat;
- limited speed travel on designated, signed roads and maintenance of these roads;
- non-consumptive recreation (e.g., hiking, birdwatching, casual horseback riding, and photography);
- parking and camping in designated areas;
- fire suppression that minimizes surface disturbance;
- permitted or otherwise controlled maintenance of existing utilities;
- surface disturbances that enhance the quality of habitat for wildlife, enhance watershed protection, or improve opportunities for non-motorized recreation. This includes the construction of visitor centers, wildlife guzzlers, camping facilities, etc. where appropriate;
- population enhancement of native wildlife species such as desert bighorn, Gambel's quail, etc;
- mining on a case-by-case basis, provided that the cumulative impacts of these activities do not significantly impact desert tortoise habitats or populations, that any potential effects on desert tortoise populations are carefully mitigated during the operation, and that the land is restored to its pre-disturbance condition; and
- non-manipulative and non-intrusive biological or geological research, by permit.

DWMAs are intended to provide suitable habitat for the desert tortoise and effect recovery. They will also serve as ecosystem reserves, refuges for other plants and animals, and play secondary roles in watershed protection and in furnishing non-motorized recreational opportunities. Permit requirements (on some activities listed above) provide an opportunity for the land-management agency to instruct users on these goals. Manipulative or intrusive biological or geological research should generally be discouraged in DWMAs except under unusual circumstances, and none should be allowed except by permit.

Whether or not livestock grazing should be allowed in DWMAs is extremely controversial. At this time, there are no data showing that continued livestock grazing is compatible with recovery of the desert tortoise, although it appears that cattle grazing under certain circumstances can be compatible with desert tortoise survival (Tracy et al., in prep.). Because tortoise recovery is the goal of management within DWMAs, until such data are forthcoming, no grazing should be permitted within the DWMAs. Data required to show that cattle grazing can be compatible with recovery include a demonstration that adult tortoise densities are stationary or increasing and that regular recruitment is occurring into the adult age classes in areas where cattle are grazed. Such studies must be adequately controlled, replicated, and statistically robust.

2. *Recommended management actions.*

Actions recommended for immediate implementation inside DWMA boundaries to effect recovery of the desert tortoise are shown in Table 6. These and other necessary actions are discussed below:

2a. Control vehicular access in DWMAs.

Paved highways, unpaved and paved roads, trails, and tracks have profound impacts on desert tortoise populations and habitat. In addition to providing many opportunities for accidental mortality, they also provide access to remote areas for collectors, vandals, poachers, and people who do not follow vehicle-use regulations. Substantial numbers of desert tortoises are killed on roads. Thus, desert tortoises thrive best where the density of access routes is low, traffic on them is low, and human access is limited. The following actions should be implemented in all DWMAs to control vehicular access:

1. Restrict establishment of new roads in DWMAs.

2. Implement closure to vehicular access with the exception of designated routes, including Federal, State, and County maintained vehicle routes.

3. Implement emergency closures of dirt roads and routes as needed to reduce human access and disturbance in areas where human-caused mortality of desert tortoises is a problem.

4. Fence or otherwise establish effective barriers to tortoises along heavily-traveled roads; install culverts that allow underpass of tortoises to alleviate habitat fragmentation.

2b. Enforce regulations.

Several DWMAs have serious problems with vandalism, collecting of desert tortoises, release of captives, and unauthorized vehicle use, all of which contribute to abnormally high desert tortoise mortality rates. Therefore, regular and frequent patrols of such DWMAs by law enforcement personnel will be essential.

2c. Restore disturbed areas.

Surface disturbance in DWMAs should be restored to pre-disturbance conditions (defined as the topography, soils, and native vegetation that exist in adjacent undisturbed or relatively undisturbed areas). This includes such actions as closing access to non-designated roads and restoring non-designated roadbeds to their pre-disturbance state.

2d. Sign and fence DWMAs as needed.

The periphery of some DWMAs (on a case-by-case basis) should be fenced with material such as raised hog wire in areas where conflicts with adjacent land uses exist and where access cannot otherwise be controlled. In any event, it is essential that the boundaries of the DWMAs be clearly marked to regulate authorized use and to discourage unauthorized use. Boundaries of EMZs also should be clearly marked.

2e. Implement appropriate administration.

For the DWMAs to function effectively as reserves, local residents should understand and support them, as some traditional uses will be eliminated. Each DWMA may require a reserve manager, additional staff, and law enforcement personnel. In some cases, adjacent DWMAs could be managed by the same staff. DWMA personnel should be hired locally whenever possible. The relevant agencies and the DWMA employees should meet with various user groups to discuss implementation of land use restrictions in the DWMAs. The formation of local advisory committees to assist with this task is strongly recommended. Certain incentives may be necessary to encourage local people to respect DWMA boundaries; these might be paid for from funds collected through regional habitat conservation plans. As funds become available, each DWMA or group of DWMAs managed as a unit should have an associated visitor center or set of interpretive sites and panels and perhaps other amenities such as campgrounds or provisions for guided tours. These amenities would attract tourists and needed revenue to the local area. However, increased tourist traffic will need to be prevented from coming into conflict with the biological needs of the desert tortoise.

Table 7. Actions recommended for immediate implementation in proposed Desert Wildlife Management Areas to effect recovery of the desert tortoise.

Desert Wildlife Management Areas (DWMAs)	UV RV	BDS	FK	SC	CHU	OR	MM	IV	FE	PE	CS	GBP	CHE	JT
Level of Threats to DWMAs (1 = low; 5 = high)	5	5	5	5	4	4	3	3	3	2	2	2	1	1
ISSUES														
Modify Planned and Ongoing actions			X	X		X		X	X		X			X
Withdraw Grazing		X	X	X	X	X	X	X	X					
Withdraw Mining			X		X			X						
Develop DWMA Management Plans	X	X	X	X	X	X	X	X	X	X	X	X	X	X
Develop Education Program	X	X	X	X			X			X		X		
Secure Habitat	X		X	X	X						X			
Modify/Control Landfills			X	X	X	X		X						
Sign and Fence Boundaries	X		X	X		X	X			X				
Halt Unauthorized ORV Use			X	X		X								
Halt Vandalism of Desert Tortoises		X	X	X	X	X	X			X				
Halt Collecting of Desert Tortoises			X	X	X	X	X	X	X	X				
Halt Releases of Captive Tortoises			X	X		X	X	X	X	X				
Control Vehicle Access			X	X	X	X		X	X					

UVRV = Upper Virgin River Valley; BDS = Beaver Dam Slope; FK = Fremont-Kramer; Superior-Cronese; CHU = Chuckwalla; OR = Ord-Rodman; MM = Mormon Mesa; IV = Ivanpah; FE = Fenner; PE = Piute-Eldorado; CS = Coyote Spring; GBP = Gold Butte-Pakoon; CHE = Chemehuevi; JT = Joshua Tree

2f. Modify ongoing and planned activities.

Ongoing and planned activities should be modified so they are consistent with the recovery objective and recommendations of this Recovery Plan.

2g. Control use of landfills and sewage ponds by desert tortoise predators.

Identify and clean up unauthorized dumps in DWMAs. Reduce or eliminate use of authorized landfills and sewage ponds in and near DWMAs by predators of desert tortoise (e.g., ravens & coyotes). Allow no new landfills or sewage ponds within DWMAs.

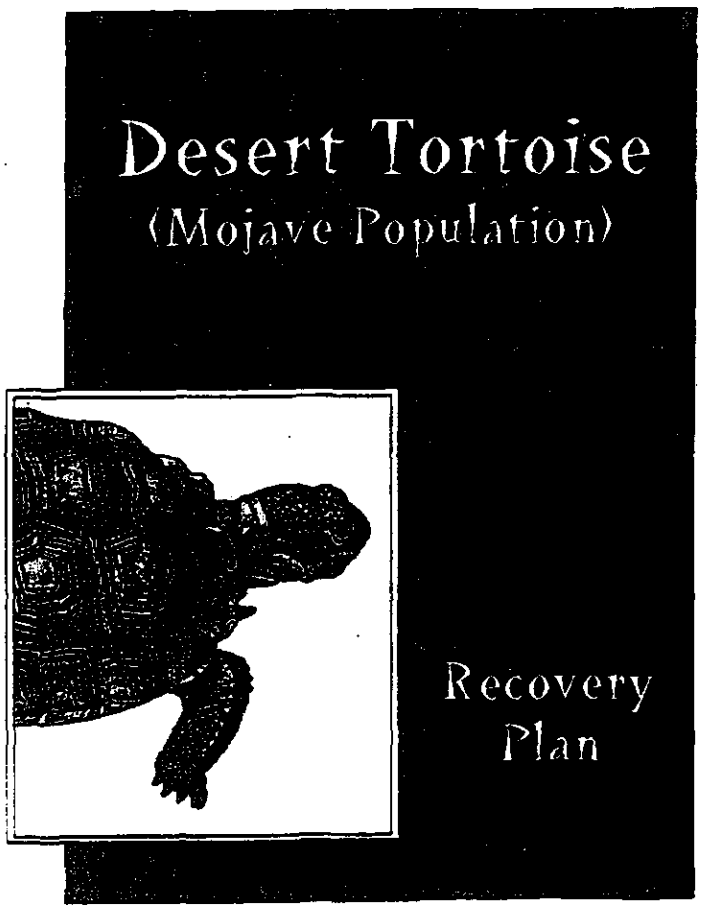
2h. Establish environmental education programs and facilities.

As described in Task 6, visitor centers, interpretive sites, guided tours, and campgrounds are all appropriate in towns near DWMAs to educate the public about the status and management needs of the desert tortoise and its habitat. In addition, desert tortoise programs should be developed for use in schools, museums, clubs, the media, etc. Education efforts should be focused on groups using the desert regularly, such as rockhounders.

These actions are recommended to increase manageability, establish an enforcement presence, effect an immediate reduction in the threats to extant desert tortoise populations in DWMAs, and build local support for the reserve concept. In addition to these actions, emergency closures of cattle and domestic sheep allotments, or placement of allotments and licenses into nonuse categories will be needed in many DWMAs. Mineral withdrawals will likely be needed in some DWMAs to prevent impacts to desert tortoises and their habitat. Other actions critical to recovery in DWMAs have been defined in Section II.D. and the Implementation Schedule (Section III), including research necessary to guide recovery efforts, and monitoring. In addition, land managers are encouraged to implement management actions which promote the conservation of other species and biotic communities.

If extinction occurs in any DWMA, efforts to recolonize the DWMA with wild desert tortoises from the same recovery unit should be undertaken. Long-term research and monitoring would be necessary to ensure the success of any such recolonization effort. All translocations should be done in accordance with the guidelines in Appendix B.

III. Implementation Schedule



III. IMPLEMENTATION SCHEDULE

The table that follows is a summary of scheduled actions and costs for this recovery program. It is a guide to meet the recovery objective. This table indicates the scheduling priority for each task, which agencies are responsible for performing these tasks, and the estimated costs to perform them. Implementation of all tasks listed in the Implementation Schedule will lead to recovery. Initiation of these actions is subject to availability of funds.

Priorities in column two of the implementation schedule are assigned as follows:

1. **Priority 1:** An action that must be taken to prevent extinction or to prevent the species from declining irreversibly in the foreseeable future.

2. **Priority 2:** An action that must be taken to prevent a significant decline in population or habitat quality, or some other significant negative impact short of extinction.

3. **Priority 3:** All other actions necessary to meet the recovery objective.

ACRONYMS USED IN THE IMPLEMENTATION SCHEDULE

*	= Lead Agency
AGFD	= Arizona Game and Fish Department
BLM	= Bureau of Land Management
CC	= Clark County
CDSP	= California Department of State Parks
CDFG	= California Department of Fish and Game
CEC	= California Energy Commission
DOD	= Department of Defense
DOE	= Department of Energy
DWMA	= Desert Wildlife Management Area
ECRU	= Eastern Colorado recovery unit
EMRU	= Eastern Mojave recovery unit
FWS	= Fish and Wildlife Service
FHWA	= Federal Highway Administration
NCRU	= Northern Colorado recovery unit
NDOW	= Nevada Division of Wildlife
NEMRU	= Northeastern Mojave recovery unit
NPS	= National Park Service
TBD	= To be determined
UDWR	= Utah Division of Wildlife Resources
UNR	= University of Nevada, Reno
USP	= Utah State Parks
UVRRU	= Upper Virgin River recovery unit
URTD	= Upper respiratory tract disease

Clearly, managers must be able to alleviate detrimental impacts on a population so that the expected growth is at least zero. At zero the population will stay constant in total size. However, even with such management, there will still be random forces that impel a population both up and down. These are the stochastic factors discussed in Section 3 of this appendix. There is often a threshold in total population size, density, or spatial arrangement below which these stochastic factors can result in a high probability of extinction within a given time period. A PVA may be able to predict this threshold--the minimum viable population.

Catastrophes. - A catastrophe is an extreme event which, by itself, can result in population extinction. Fires, floods, and epizootics are commonly cited catastrophes. In general, catastrophes are rare events whose probabilities are hard to estimate, and because of the difficulty they are typically handled in ad hoc fashion outside of a formal PVA. The Upper Respiratory Tract Disease (URTD) is a possible catastrophe threatening desert tortoises. However, its rate of spread and potential ultimate impact have not yet been estimated by epidemiological models.

The only protection against catastrophes is to have redundancy built into the management system--several widely-spaced populations would not likely be struck by the same catastrophic event at the same time. For threats such as drought or flooding, local populations would have to be distributed over a region that is large compared to the total spatial scale of catastrophes. Since the epidemiology of URTD is not yet understood, managing this epizootic is extremely problematic.

Desert Tortoise Genetics.

A comprehensive PVA requires considering population genetics--including loss of heterozygosity, inbreeding depression, outbreeding depression, long-term loss of adaptability, pedigrees, paternities, population structure, etc. However, most PVAs involve much smaller total populations (Table C1) than currently exist for the desert tortoise (although population density must be considered vis-a-vis short-term genetic deterioration as well).

Table C1. The number of individuals modeled in PVAs for endangered species.

Species	Number of Individuals
Blackfooted Ferrets	6
California Condors	28
Whooping Cranes	50
Yellowstone Grizzlies	200
Northern Spotted Owls	2000

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	1.a.6	Select DWMAs in Western Mojave Recovery Unit	1	FWS*	20		20			
				BLM	20		20			
				NPS	10		10			
				DOD	10		10			
				CDFG	10		10			
1	1.b.1	Delineate DWMA boundaries in Northern Colorado Recovery Unit	1	FWS*	20		20			
				BLM	20		20			
				CDFG	10		10			
1	1.b.2	Delineate DWMA boundaries in Eastern Colorado Recovery Unit	1	FWS*	20		20			
				BLM	20		20			
				CDFG	10		10			
				DOD	10		10			
1	1.b.3	Delineate DWMA boundaries in Upper Virgin River Recovery Unit	1	FWS*	20	20				
				BLM	20	20				
				UDWR	20	20				
				USP	10	10				
1	1.b.4	Delineate DWMA boundaries in Eastern Mojave Recovery Unit	1	FWS*	20	10	10			
				BLM	20	10	10			
				NPS	10	5	5			
				NDOW	10	5	5			
				CDFG	10		10			
				CDSP	10		10			

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	1.b.5	Delineate DWMA Boundaries in Northeastern Mojave Recovery Unit	1	FWS*	20		20			
				BLM	20		20			
				DOD	10		10			
				NPS	10		10			
				AGFD	10		10			
				NDOW	10		10			
				UDWR	10		10			
1	1.b.6	Delineate DWMA boundaries in Western Mojave Recovery Unit	1	FWS*	50		50			
				BLM	100		100			
				NPS	20		20			
				DOD	20		20			
				CDFG	20		20			
1	1.c.1	Secure DWMAs in Northern Colorado Recovery Unit	5	FWS*	TBD					
				BLM	TBD					
				CDFG	TBD					
1	1.c.2	Secure DWMAs in Eastern Colorado Recovery Unit	5	FWS*	TBD					
				BLM	TBD					
				CDFG	TBD					
				DOD	TBD					
1	1.c.3	Secure DWMAs in Upper Virgin River Recovery Unit	5	FWS*	TBD					
				BLM	TBD					
				UDWR	TBD					
				USP	TBD					

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	1.c.4	Secure DWMAs in Eastern Mojave Recovery Unit	5	FWS*	TBD					
				BLM	TBD					
				NPS	TBD					
				NDOW	TBD					
				CDFG	TBD					
				CDSP	TBD					
1	1.c.5	Secure DWMAs in Northeastern Mojave Recovery Unit	5	FWS*	TBD					
				BLM	TBD					
				DOD	TBD					
				NPS	TBD					
				AGFD	TBD					
				NDOW	TBD					
				UDWR	TBD					
1	1.c.6	Secure DWMAs in Western Mojave Recovery Unit	5	FWS*	TBD					
				BLM	TBD					
				NPS	TBD					
				DOD	TBD					
				CDFG	TBD					
1	1.d.1	Develop DWMA Management Plan in Northern Colorado Recovery Unit	1	FWS*	20		20			
				BLM	40		40			
				CDFG	10		10			
1	1.d.2	Develop DWMA Management Plan in Eastern Colorado Recovery Unit	1	FWS*	20		20			
				BLM	40		40			
				CDFG	10		10			
				DOD	10		10			

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	1.d.3	Develop DWMA Management Plan in Upper Virgin River Recovery Unit	1	FWS*	20		20			
				BLM	40		40			
				UDWR	20		20			
				USP	10		10			
1	1.d.4	Develop DWMA Management Plan in Eastern Mojave Recovery Unit	1	FWS*	40		40			
				BLM	40		40			
				NPS	20		20			
				NDOW	10		10			
				CDFG	10		10			
				CDSP	10		10			
1	1.d.5	Develop DWMA Management Plan in Northeastern Mojave Recovery Unit	1	FWS*	50		50			
				BLM	40		40			
				DOD	10		10			
				NPS	10		10			
				AGFD	10		10			
				NDOW	10		10			
				UDWR	10		10			
1	1.d.6	Develop DWMA Management Plan in Western Mojave Recovery Unit	1	FWS*	50		50			
				BLM	250		250			
				NPS	50		50			
				DOD	50		50			
				CDFG	10		10			

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
1	1.e.1	Implement DWMA Management Plans in Northern Colorado Recovery Unit	Cont.	BLM*	TBD					
1	1.e.2	Implement DWMA Management Plans in Eastern Colorado Recovery Unit	Cont.	BLM* DOD	TBD TBD					
1	1.e.3	Implement DWMA Management Plans in Upper Virgin River Recovery Unit	Cont.	BLM* USP	TBD TBD					
1	1.e.4	Implement DWMA Management Plans in Eastern Mojave Recovery Unit	Cont.	BLM* NPS	TBD TBD					
1	1.e.5	Implement DWMA Management Plans in Northeastern Mojave Recovery Unit	Cont.	BLM* DOD NPS FWS	TBD TBD TBD TBD					
1	1.e.6	Implement DWMA Management Plans in Western Mojave Recovery Unit	Cont.	BLM* DOD NPS	TBD TBD TBD					
2	1.f.1	Develop Monitoring Plan	1	FWS* UNR CC	10 10 30	10 10 30				

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	1.f.2.a	Implement Monitoring Plan in Northern Colorado Recovery Unit	Cont.	BLM*	400		100			100
2	1.f.2.b	Implement Monitoring Plan in Eastern Colorado Recovery Unit	Cont.	BLM*	300		75			75
				DOD	100		25			25
				NPS	100		25			25
2	1.f.2.c	Implement Monitoring Plan in Upper Virgin River Recovery Unit	Cont.	BLM*	140		35			35
				USP	60		15			15
2	1.f.2.d	Implement Monitoring Plan in Eastern Mojave Recovery Unit	Cont.	BLM*	960		240			240
				NPS	200		50			50
				CDSP	40		10			10
2	1.f.2.e	Implement Monitoring Plan in Northeastern Mojave Recovery Unit	Cont.	BLM*	800		200			200
				NPS	80		20			20
				FWS	160		40			40
2	1.f.2.f	Implement Monitoring Plan in Western Mojave Recovery Unit	Cont.	BLM*	600		150			150
				DOD	200		50			50
				NPS	400		100			100
		Subtotal costs needs 1			6320	200	2715	0	0	1135

Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
		Needs 2: Establish Environmental Education Program								
2	2.a	Develop Environmental Education Programs	1	FWS*	200	200				
				BLM	200	200				
				DOD	50	50				
				NPS	200	200				
				CDGF	50	50				
				AGFD	50	50				
				NDOW	50	50				
				UDWR	50	50				
				CDSP	50	50				
				USP	50	50				
2	2.b	Implement Environmental Education Programs	Cont.	FWS*	TBD					
				BLM	TBD					
				DOD	TBD					
				NPS	TBD					
				CDGF	TBD					
				AGFD	TBD					
				NDOW	TBD					
				UDWR	TBD					
				CDSP	TBD					
				USP	TBD					
		Subtotal costs needs 2			950	950	0	0	0	0

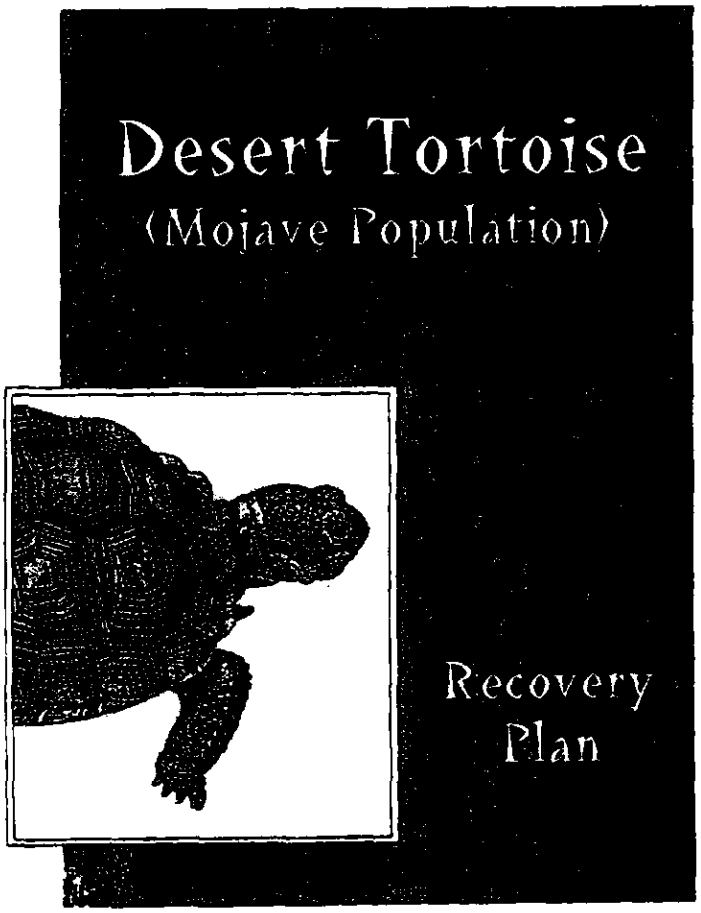
Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
		Needs 3: Conduct Tortoise Research								
2	3.a	Research on Tortoise Densities	5	FWS*	25	5	5	5	5	5
				BLM	250	50	50	50	50	50
				DOD	100	20	20	20	20	20
				NPS	100	20	20	20	20	20
				CDSP	25	5	5	5	5	5
				USP	25	5	5	5	5	5
				UDWR	25	5	5	5	5	5
2	3.b.1	Research on Upper Respiratory Tract Disease and other Diseases	3	BLM*	1000	350	350	300		
				AGFD	3	3				
				UDWR	10	10				
				FWS	25	25				
2	3.b.2	Research on Mortality	10	BLM*	400	40	40	40	40	40
				CC	200	100	100			
2	3.b.3	Research on Recruitment and Survival	10	BLM*	440	20	20	50	50	50
				DOE	100	50	50			
				DOD	20	10	10			
				UDWR	45	5	5	5	5	5
2	3.b.4	Research on Population Structure	10	BLM*	1000	100	100	100	100	100
				NPS	400	40	40	40	40	40
				DOE	60	20				
				FWS	60	20				

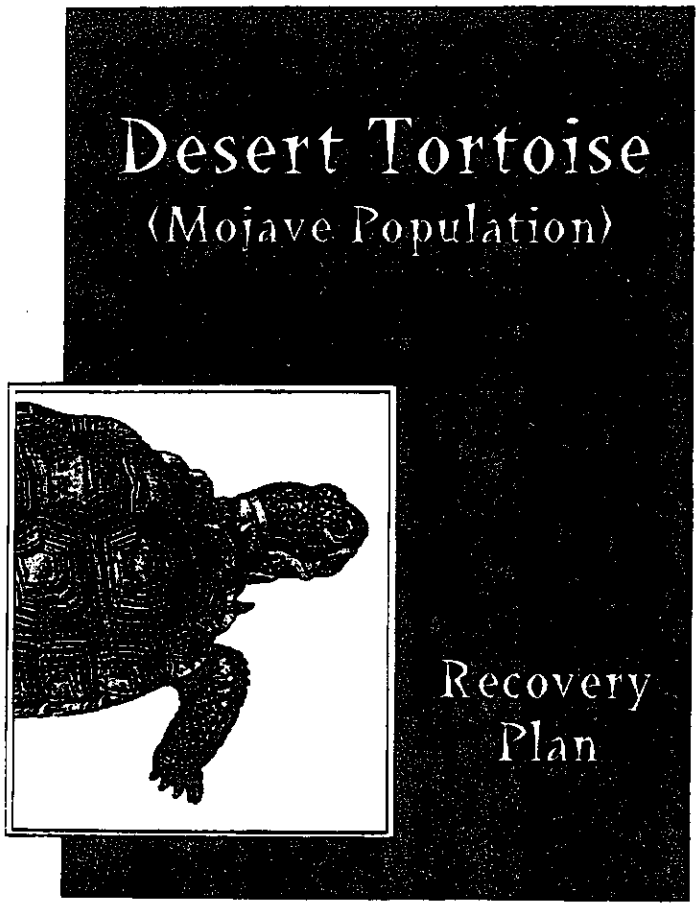
Desert Tortoise (Mojave Population) Implementation Schedule

Priority Number	Task Number	Task Description	Task Duration (YRS)	Responsible Party	Total Cost	Cost Estimates ($1,000) FY 1994	FY 1995	FY 1996	FY 1997	FY 1998
2	3.c	Research on Human-use Impacts	5	BLM*	2940	420	420	700	700	700
				DOD	80		20	20	20	20
				NPS	80		20	20	20	20
				CC	225	105	120			
				CEC	40	20	20			
				FHWA	250	40	140	70		
				CDFG	4	2	2			
3	3.d	Research on Effectiveness of Protection	cont.	FWS*	550			50	50	50
3	3.e	Research on Climate and Vegetation	cont.	NPS	100	20			20	
3	3.f	Research on Nutrition and Physiology	5	BLM*	260	100	100	60		
				NPS	100	20	20	20	20	20
				UDWR	100	20	20	20	20	20
				CC	240	80	80	80		
3	3.g	Research on Reproductive Behavior	5	BLM*	150	30	30	30	30	30
				UDWR	45	5	5	5	5	5
		Subtotal costs needs 3			9432	1760	1817	1715	1225	1205
		Total costs			16702	2910	4532	1715	1225	2340

Appendices



Appendix A



Appendix A: Estimation of Regional Densities

I. Introduction

Accurate determination of desert tortoise densities is a critical component of this recovery plan. Densities should be monitored both inside and outside of Desert Wildlife Management Areas (DWMAs) to determine whether or not protection from human activities within DWMAs is effective in reversing current population declines. Comparisons of population growth rates between experimental management zones (EMZs) and other reserve areas will be necessary to assess the impact of activities permitted in the former and not in the latter and to adjust management actions accordingly.

The method described herein is to be used for estimating desert tortoise densities throughout a recovery unit. It should not be confused with the widely-used strip transect and study plot techniques (Berry 1984a; Berry and Nicholson 1984a, 1984b; Karl 1983). Strip transects provide data to map desert tortoise distribution and may allow estimation of relative densities if properly calibrated on nearby study plots in similar habitats. Intensive surveys of study plots produce detailed data on habitat condition, human uses, and such population attributes as densities, size-age class structure, sex ratios, recruitment, causes of death, and mortality rates in localized areas. However, neither of these techniques is suitable for economical and reliable estimates of desert tortoise densities on a regional scale.

II. Hypothesis to be tested

Most desert tortoise populations in the Mojave region have experienced rapid declines, and recovery depends on reversing these trends. Because most population declines appear to be directly or indirectly caused by various human activities, the establishment of a network of DWMAs where such activities are curtailed or carefully managed should result in positive population growth rates and the eventual achievement of recovery goals. Thus, monitoring of desert tortoise density should be performed to test the following hypothesis:

H_1. If protection afforded by DWMAs has no effect on desert tortoise population dynamics, there will be no significant differences between the densities of populations inside and outside of the DWMAs.

III. Methods

A. Number and Location of Sample Plots Within Each DWMA.

Each sample plot should be 1 square kilometer in area. The number of sample plots per DWMA will depend upon its size, but at least 5% of the total area of the DWMA must be sampled in each sampling cycle (e.g., 10 square miles [25.9 square kilometers]), or 26 sample plots, would be the minimum acceptable area to sample within a DWMA of 200 square miles). No fewer than three control plots must be sampled outside of each DWMA. These plots must be located no closer than 2 miles and no farther than 10 miles from the DWMA boundary. Adjacent DWMAs may share one or more control plots that fit these criteria.

The DWMAs should be divided into plots 1 square kilometer in area using Universal Transverse Mercator coordinates, and each plot should receive a unique number. Plots to be sampled should be chosen from a random number table. If a randomly chosen plot is in an area that is very unlikely to contain desert tortoises, it should be excluded and another plot chosen. Such exclusions include (1) plots with average elevations over 4000 feet, (2) plots transected by paved highways, (3) plots largely consisting of playas or other areas with no natural vegetation, and (4) plots with large areas of human-caused surface disturbance (e.g., agricultural field, gravel pit). Control plots should be chosen using the same criteria as plots within the DWMAs. New plots should be chosen each time the DWMA and the control areas are sampled.

B. Data Collection - Scheduling.

Initial population estimates to establish baseline densities must be accomplished as soon as DWMA boundaries are established. Resampling must occur every 3 years. Because population estimations must coincide with periods of high desert tortoise activity, all surveys must be completed during the months of February through May. This 16-18 week period is sufficient for a team of properly trained biologists to survey at least 10 sample plots, allowing for periods of inclement weather and other complications.

Each square kilometer plot may require up to 7 days of complete sampling by a team of four experienced desert tortoise biologists. If ten DWMAs required 26 plots plus three outside controls each, this would mean a total of 290 plots to sample. However, it is unlikely that all DWMAs will be established simultaneously, and with a 3-year resampling schedule, approximately one-third of this number, or 97, would have to be sampled every year. Thus, nine teams, starting in areas with early greenup and moving into regions with later phenologies, could accomplish these sampling goals.

C. Data Collection - Methods.

The removal method (Southwood 1978; Zippin 1956, 1958) should be used to estimate densities of large immature and adult desert tortoises (carapace length > 140 mm) in the square-kilometer plots. The principle behind this method is that if a known number of animals is "removed" (in this case, marked and released in situ) on each sampling occasion, the rate at which new captures fall off will be directly related to the size of the total population and the total number "removed." Thus, the removal method, unlike capture-mark-release methods, requires that animals be handled only once during a survey. The assumptions of this method are that (1) the catching procedure does not lower the probability of other animals being caught, (2) the population remains stationary during the sample period, (3) the population is not so large that the capture of one individual interferes with the capture of another, and (4) the chance of capture is equal for all animals. By restricting the sample to adult and large immature animals and by analyzing males and females separately, none of these assumptions is violated.

All samples should be made by a four-person team of experienced desert tortoise biologists. The biologists should proceed to a previously selected, randomly chosen plot and use a global positioning device to locate its four corners. Temporary flags, to be removed after the sample period, should be used to mark plot boundaries. The plot should be searched thoroughly for desert tortoises each day of the sample by all four biologists, concentrating on times of high activity. Each biologist should search one quarter of the plot to achieve complete coverage each day. Desert tortoises are to be sampled only on the surface, except when they can be coaxed out of their burrows by thumping. No desert tortoises will be pulled from their burrows with hooks or other devices.

Upon capture, adult desert tortoises should be sexed and measured, in millimeters, along the midline of the carapace. Those with midline carapace length of 140 mm or greater will be included in the sample. These animals should be marked with a small dot of acrylic paint placed on the dorsal surface of both the anterior and posterior marginals; the paint marks will enable the survey team to recognize previously handled ("removed") desert tortoises.

Even if no desert tortoises are encountered, each plot should be sampled for a minimum of 3 days in weather suitable for the animals to be above ground. If desert tortoises are found, sampling should continue for 7 days or until no unmarked desert tortoises have been encountered for 2 consecutive days.

D. Data analysis.

Zippin's (1956, 1958) maximum likelihood method, as described in Southwood (1978, pp. 232-236), should be used to estimate desert tortoise densities and their standard errors in each square-kilometer

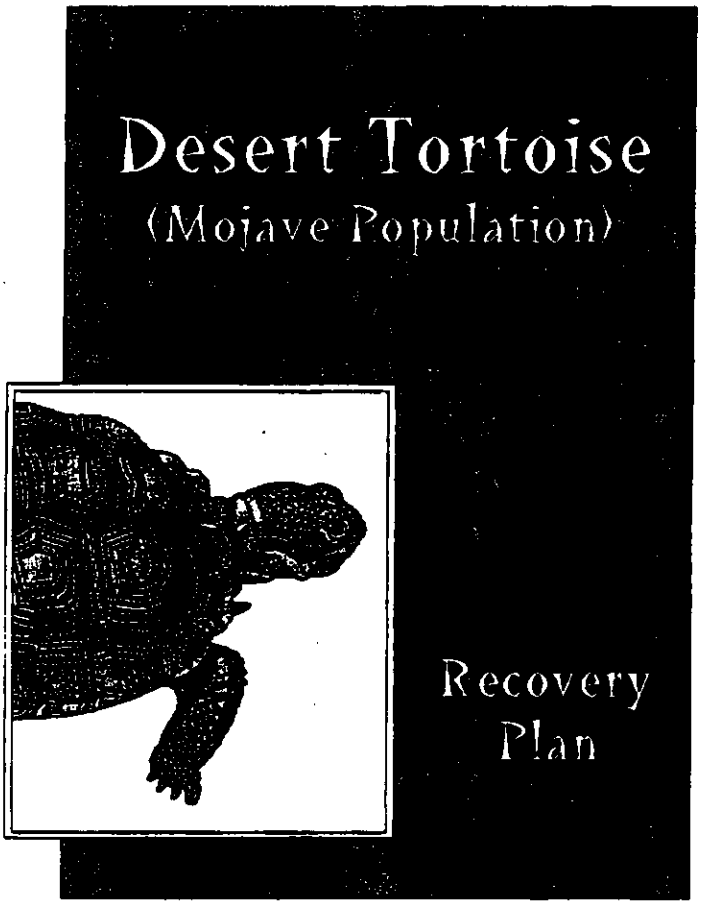
plot. Because plots were randomly selected, these estimates will provide an accurate picture of desert tortoise densities and spatial variation within the DWMA and surrounding areas.

IV. Interpretation of results.

The immediate goal of these samples is to obtain reliable estimates of desert tortoise densities in the DWMAs and adjacent, non-protected areas. The long-term goals are to assess the success of the recovery strategy developed in this plan, adjust management goals as appropriate, and determine when recovery has been achieved. Sufficient data to accomplish the long-term goals will require many sampling periods. Estimated densities and their standard errors accumulated over at least 12 years, or five samples, will be necessary to adequately falsify the hypotheses posed above and to consider delisting a recovery unit.

If it appears that desert tortoise densities are still declining after the second sample, these data should trigger a reassessment of management practices and suggest additional research. For example, examining the effectiveness of management efforts directed at curtailing human activities within the DWMA would be appropriate under these circumstances. On the other hand, research may show that desert tortoise habitat has been so degraded by previous management practices that it will take several more years of freedom from disturbance before conditions for desert tortoises will improve within the DWMA.

Appendix B



Appendix B: Guidelines for Translocation of Desert Tortoises

(1) Experimental translocations should be done outside experimental management zones. No desert tortoises should be introduced into DWMAs—at least until relocation is much better understood.

(2) All translocations should occur in good habitat where the desert tortoise population is known to be substantially depleted from its former level of abundance. Translocation of reproductively competent adults into depopulated areas can have beneficial effects on population growth. Before population growth can occur, however, individuals must establish home ranges and enter into any existing social structure. Desert tortoises should be periodically evaluated against a defined health profile (proportional weight/size, fecal scans, and blood panels).

(3) Areas into which desert tortoises are to be relocated should be surrounded by a desert tortoise-proof fence or similar barrier. The fence will contain the desert tortoises while they are establishing home ranges and a social structure. If the area is not fenced, past experience suggests that most animals will simply wander away from the introduction site and eventually die. (Fencing is not cheap; estimates range from $2.50 to $5.00 per linear foot). Once animals are established some or all of the fencing can be removed and probably reused.

(4) The best translocations into empty habitat involve desert tortoises in all age classes, in the proportions in which they occur in a stable population. Such translocations may not always be possible, since young desert tortoises are chronically underrepresented in samples, often due to observer sampling error, and may now actually be underrepresented in most populations due to poor recruitment and juvenile survivorship during the last several years. Desert tortoises smaller than the 7-year age-size class are particularly vulnerable to predation and may be a poor investment for translocation, unless predator exclusion (fencing, for example) is incorporated into such endeavors. Mature females would probably be the best sex/age class to introduce into below carrying capacity extant populations because of their high reproductive value (low potential mortality, high potential fecundity for many years).

(5) The number of desert tortoises introduced should not exceed the pre-decline density (if known). If the pre-decline density is not known, introductions should not exceed 100 adults or 200 animals of all age classes per square mile in category 1 habitat (Bureau of Land Management designation for management of desert tortoise habitat) unless there is good reason to believe that the habitat is capable of supporting higher densities. Post-introduction mortalities

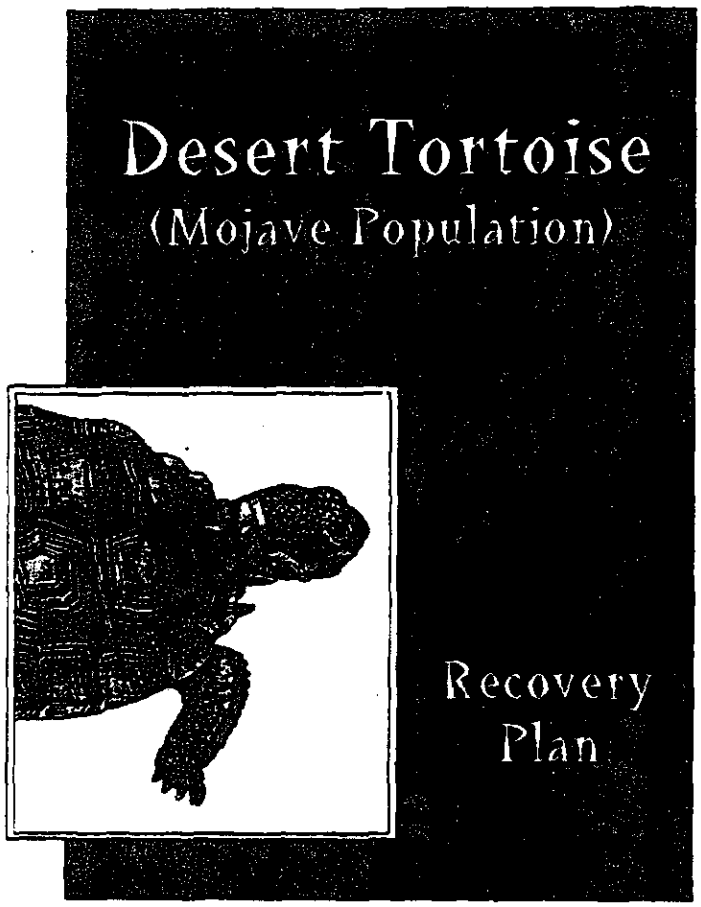
might be compensated by subsequent introductions if ecological circumstances warrant this action.

(6) All potential translocatees should be medically evaluated in terms of general health and indications of disease, using the latest available technology, before they are moved. All translocatees should be genotyped unless the desert tortoises are to be moved only very short distances or between populations that are clearly genetically homogeneous. All translocated animals should be permanently marked, and most should be fitted with radio transmitters so that their subsequent movements can be closely tracked.

(7) If desert tortoises are to be moved into an area that already supports a population--even one that is well below carrying capacity--the recipient population should be monitored for at least 2 years prior to the introduction. Necessary data include the density and age structure of the recipient population, home ranges of resident desert tortoises, and general ecological conditions of the habitat.

Areas along paved highways can serve as good translocation sites, if properly fenced. Many such areas support good habitats, but vehicle-caused mortalities and/or collecting have substantially reduced or totally extirpated adjacent desert tortoise populations. Any translocation sites should be isolated by a desert tortoise barrier fence or similar barrier next to the highway or road. The purpose of fencing the highway is obvious--to keep translocated animals from being crushed by vehicles on the road. However, fencing the other sides of the translocation area is critical for establishment. If a fenced area or strip of habitat approximately 0.125 to 0.25 mile wide is established along highways, some translocatees should establish home ranges and a social structure within this strip. When the inside fence is removed, the translocated desert tortoises and those from the extant population farther away from the road will eventually expand their home ranges into the remaining low-density areas. A second reason for inside fencing is to prevent any diseased, but asymptomatic, desert tortoises from infecting nearby, healthy populations. In the event that disease is an issue and a resident population is present nearby, double inside fencing should be considered.

Appendix C



Appendix C: Desert Tortoise Population Viability

I. Introduction

Because desert tortoises live to such great age, are found in very sparse populations, and are very difficult to study, we know very little about the tortoise population dynamics. Thus, computer modeling has been used as a means of supplementing our knowledge in this area. We present here a life history analysis of the consequences of demographic characteristics in tortoise populations, an analysis of trends in these populations, and, finally, an analysis of the population viability of desert tortoises in the Mojave. These exercises have all supported the necessity for large reserves (DWMAs) for the recovery of the species.

II. Life history analysis

Understanding the life-history consequences of modifications to mortality and/or fecundity to population persistence is crucial to management decisions on desert tortoise populations. Nevertheless, the quality of data for such an analysis are understandably poor for this extremely long-lived species that may undergo huge natural temporal and spatial swings in population density in response to a stochastically varying environment. Mertz (1971) developed an approach to investigate life-history consequences to changing environments of a long-lived species. We have used this approach to estimate the relative contributions of juvenile and adult mortality, as well as fecundity, to the ability of desert tortoise populations to maintain themselves at stable population densities. The basis of the analysis is a model of the demography of the desert tortoise. This model purposely does not contain great demographic detail, since the questions asked do not require great detail. Mertz used a similar low-resolution model to ask "broad-brush" questions about California Condors.

The basis of the model comes from the work of Leslie (1966). The model is based upon transition matrices containing age-specific mortality and fecundity. The following simplifying assumptions were made:

1. Mortality for eggs and juveniles were lumped into a probability of surviving to reproductive age, β.

2. Mortality of reproductive adults was taken to be the same regardless of age and was represented as the probability of surviving one year, ρ.

The model predicting net reproductive rate is:

$$R_o = (\beta * f * C * (1 - F) * (1 - \rho^{(\omega - \alpha)}) / (1 - \rho^{T})$$

where:

R_o = The net reproductive rate or the proportional change in population size per generation.

β = The probability of surviving to reproductive age.

ρ = The probability of an adult surviving one year.

f = The proportion of females in the population.

C = The clutch size.

F = The proportion of females failing to breed.

ω = The age at which reproduction ends.

α = The age at which reproduction begins.

T = The time interval at which reproduction occurs.

Simulations illustrated the conditions that produced a net reproductive rate, R_o, of zero (or stable population size). These simulations included the following additional assumptions for the purpose of the analysis:

1. Sex ratio was assumed to be 0.5.

2. All reproductive-aged females were assumed to reproduce.

3. Reproduction was assumed to continue to age 100 (this assumption was checked separately and found not to affect the results greatly).

4. The age of first reproduction was taken to be 15 years (this assumption has no effect on simulations confined to R_o = 1.0).

5. Egg laying, multiple clutching, and years without reproduction were all condensed to an average number of eggs produced per year (thus, separate mortality probabilities for different clutches, and clutches in bad years were not considered).

Three variables were considered:

1. ρ, differences in which can be taken as reflecting elevated adult mortality.

2. β, differences in which can be taken as elevated mortality of eggs or juveniles.

3. C, differences in which can be taken as reflecting conditions more or less optimal for reproduction.

Figures C1 and C2 present simulations showing the combinations of r, b, and C necessary to have $R_0 = 1.0$. Clearly, if a population is healthy, and relatively free from sources of adult mortality, and thus having a r of > 0.95 and a fecundity > 9 eggs/year, then very few juveniles need survive to adulthood. Indeed, somewhere in the order of only 1% of all eggs need survive to reproductive age. On the other hand, a 10% increase in adult mortality can require a 300% increase in juvenile survivorship. Furthermore, any reduction in fecundity of adults exacerbates this still further. These results illustrate the requirements of desert tortoises in their natural environments, particularly the premium placed upon adult survival. The life-history strategy of desert tortoises may have evolved in an environment in which 99% of all juveniles die before reaching reproductive age. However, this life-history strategy may not work for desert tortoises faced with increased mortality on adults. Desert tortoises may very well have been able to handle high juvenile mortality in the past, but in populations suffering high mortality from URTD, off-road vehicles, and pet collection, juvenile survivorship becomes increasingly important.

The simulations also point to the necessity of considering all sources of age-specific mortality in management plans, not just mortality in a particular age group. Finally, the simulations point to the extremely potent effect that climate change could have if new conditions resulted in abandoning reproduction altogether in numerous bad years interspersed among somewhat better years for production of food resources.

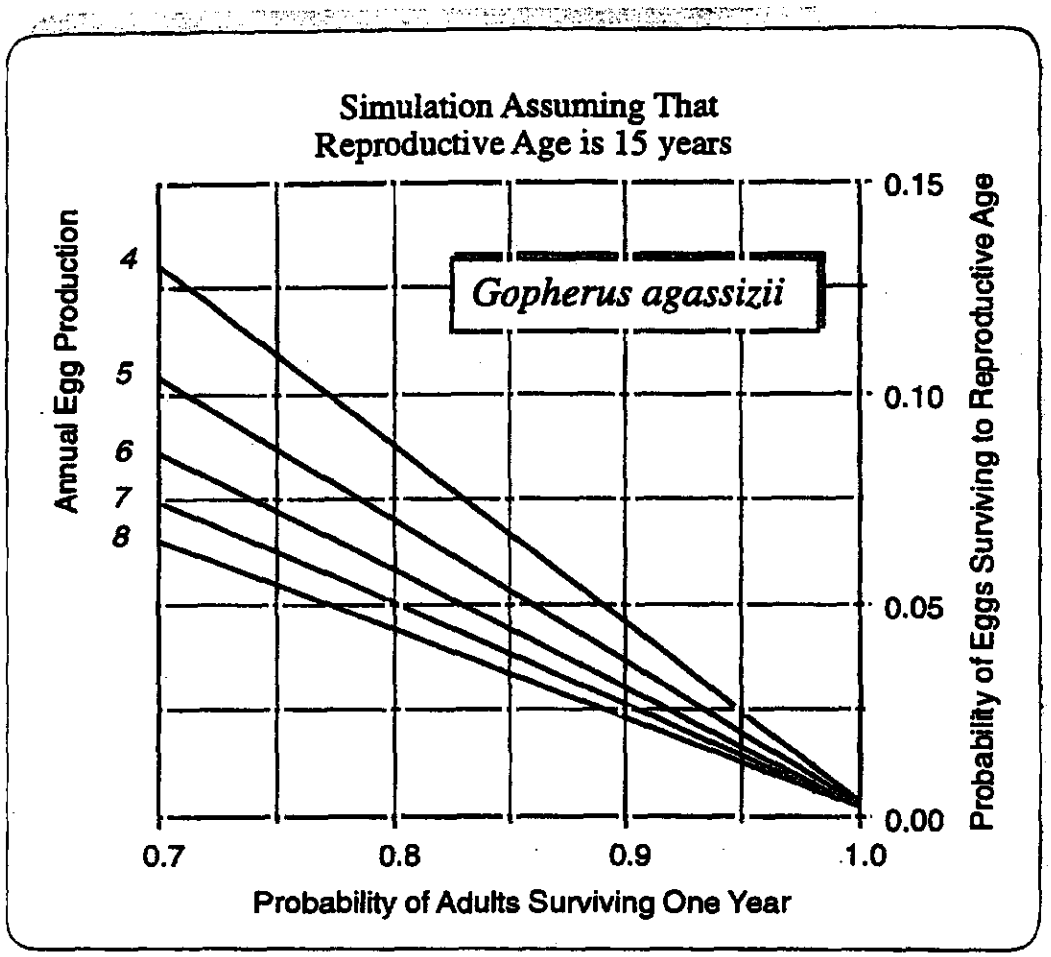


Figure C1. Calculated requirements for adult and juvenile survivorship in order to have a net reproductive rate of 1 (viz., a population neither growing nor declining) as a function of the average number of eggs produced per year.

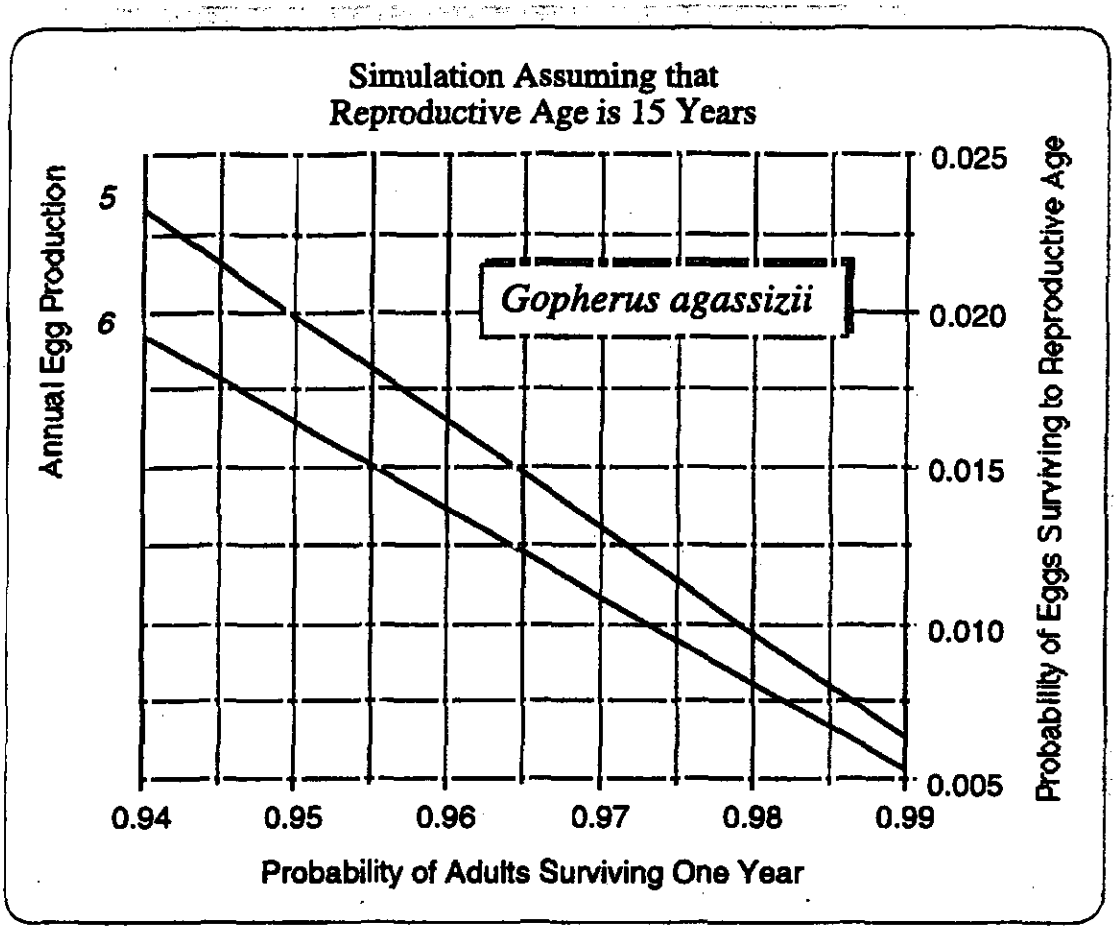


Figure C2. Calculated requirements for adult and juvenile survivorship in order to have a net reproductive rate of 1 (viz., a population neither growing nor declining) when females produce an average of 5 to 6 eggs per female per year.

III. Population Trends in the Mojave Desert Tortoise in Different Parts of the Mojave Desert

The desert tortoise has been listed as a threatened species because of disturbing downward trends in population sizes in many portions of the species range. Some desert tortoise populations have reached such low numbers that extirpation is highly probable. Furthermore, the population dynamics of this species are so ponderous that recovery from major reductions in population size is problematic. Nevertheless, desert tortoises have persisted in the Mojave Desert for thousands of years even though there have almost certainly been random local extinctions and subsequent reinvasions (Hanski 1991). Today, many desert tortoise populations are so fragmented that they have little ability to recover from major population declines. Thus, it is very important to distinguish between the forces causing "normal" fluctuations in population sizes and those that threaten population persistence.

There are two kinds of population change: stochastic fluctuations and trends. Population trends are monotonic changes in population size caused by some persistent demographic change in the population (Figure C3). For example, persistently reduced fecundity or increased rates of mortality will cause changes in the "equilibrium" population size as well as changes in the ability of populations to grow. In the desert tortoise, such changes could be caused by increased predation by animals or humans, reduction in the forage base due to changes in climate or competition with domestic grazers, etc. Clearly, downward population trends must be halted in order for a population to persist.

Stochastic fluctuations (Figure C3) occur when some random event causes a downturn from which the population begins immediate recovery. These events can be caused by such things as drought, fire, and disease. Recovery from stochastic fluctuations will depend upon their frequency and severity. Thus, a large population which is infrequently influenced by random events will have a high probability of persistence; alternatively, small populations repeatedly assaulted by stochastic increases in mortality or decreases in fecundity will have a lower probability of persistence.

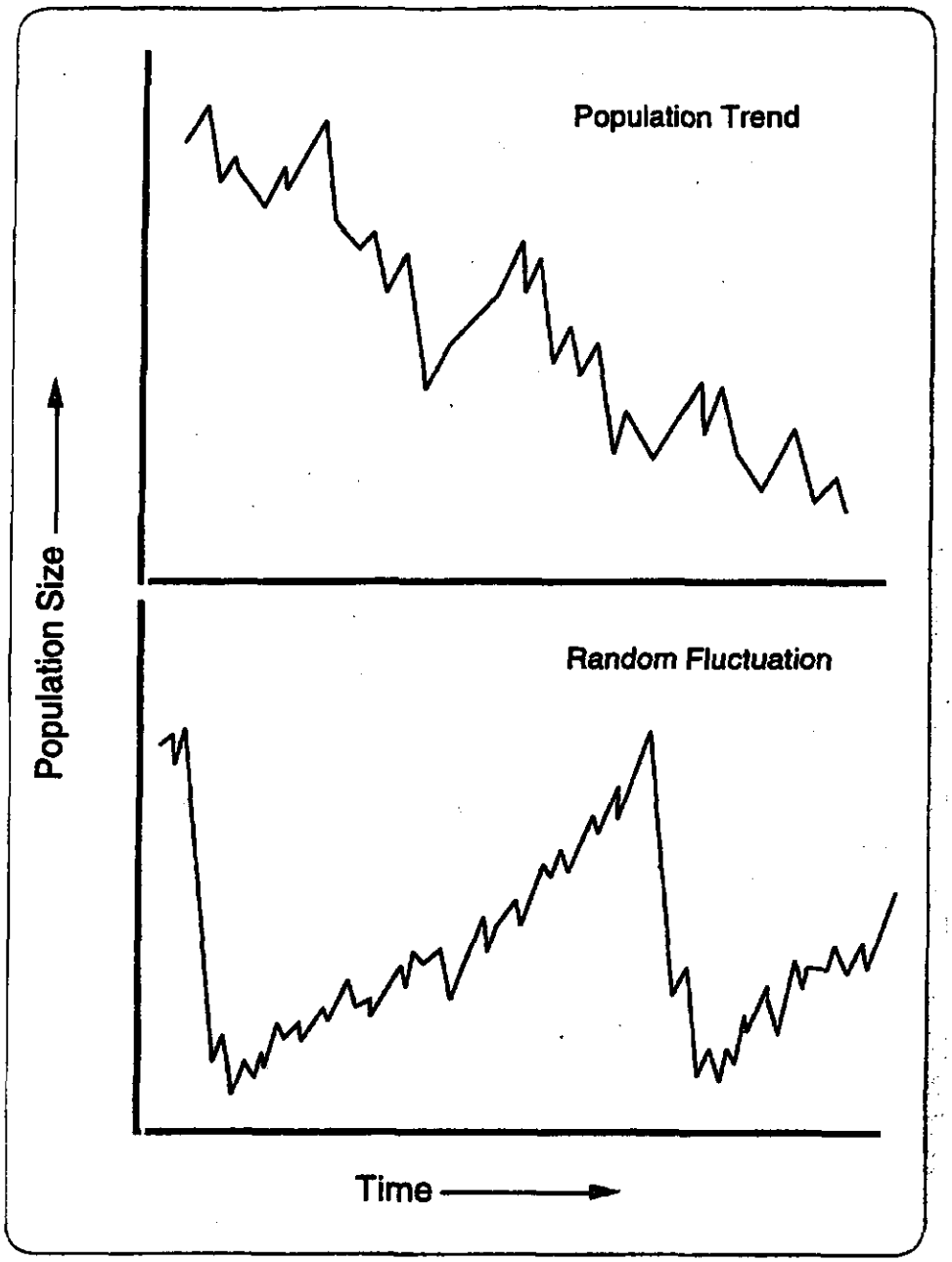


Figure C3. Hypothetical population dynamics over time for a population undergoing a trend in numbers and a population undergoing stochastic declines followed by recovery in numbers.

Populations undergoing steady downward trends will go extinct. The likely time to extinction is easily calculated. However, extinctions can also occur in populations that, on average, are stochastically fluctuating around some long-term mean. Thus, it is critical that existing data on the population dynamics of desert tortoises can be classified as trends or as stochastic fluctuations. Clearly, the severe droughts in 1989 and 1990 contributed to severe crashes in population sizes for many tortoise populations (Berry 1990, as amended). Droughts are stochastic events that will, of course, occur in the desert, and desert tortoise populations have a long history of recovering from the effects droughts. However, populations that have been fragmented into smaller units or with densities reduced by the effects of increased predation, human vandalism, or competition with grazers will have a lower probability of persistence in the face of these stochastic events.

Because of the difficulty of obtaining accurate population size estimates on these cryptic, semi-fossorial, and sparse animals, most data collected over the last 15 years on the dynamics of desert tortoise populations are insufficient to determine whether a population is stationary, fluctuating stochastically, or undergoing a population trend. However, the data from many samples may be statistically "blocked" according to similarities among sites in order to sort out possible trends and their causes.

Data collected by the Bureau of Land Management (Berry 1990, as amended) has been sorted into two categories: the Western Mojave, which includes areas that both do not normally receive summer rains and also have heavy human-induced mortality of tortoises, and the Eastern and Northeastern Mojave and Eastern and Northern Colorado areas which receive summer as well as winter rains and where relatively little mortality is directly attributable to humans. Our analysis indicates that areas receiving summer rains and are relatively free from human-induced mortality show no statistically significant population trend (Figure C4), whereas areas in the Western Mojave clearly show a downward trend in population size during the same time period (Figure C5).

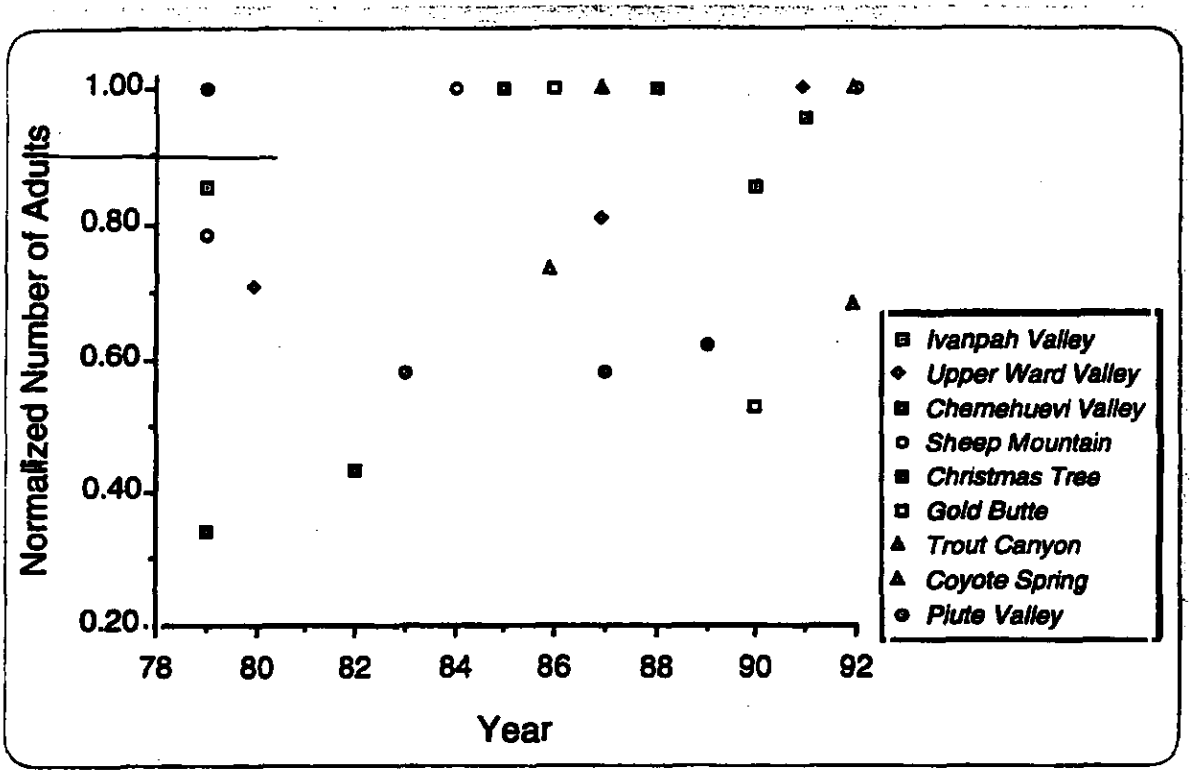


Figure C4. The number of adult desert tortoises found on BLM trend plots located in areas receiving summer rains and relative freedom from human-induced tortoise mortality. Only those trend plots sampled at least twice are included in the analysis. All data are normalized to the highest population size recorded within the years populations were monitored.

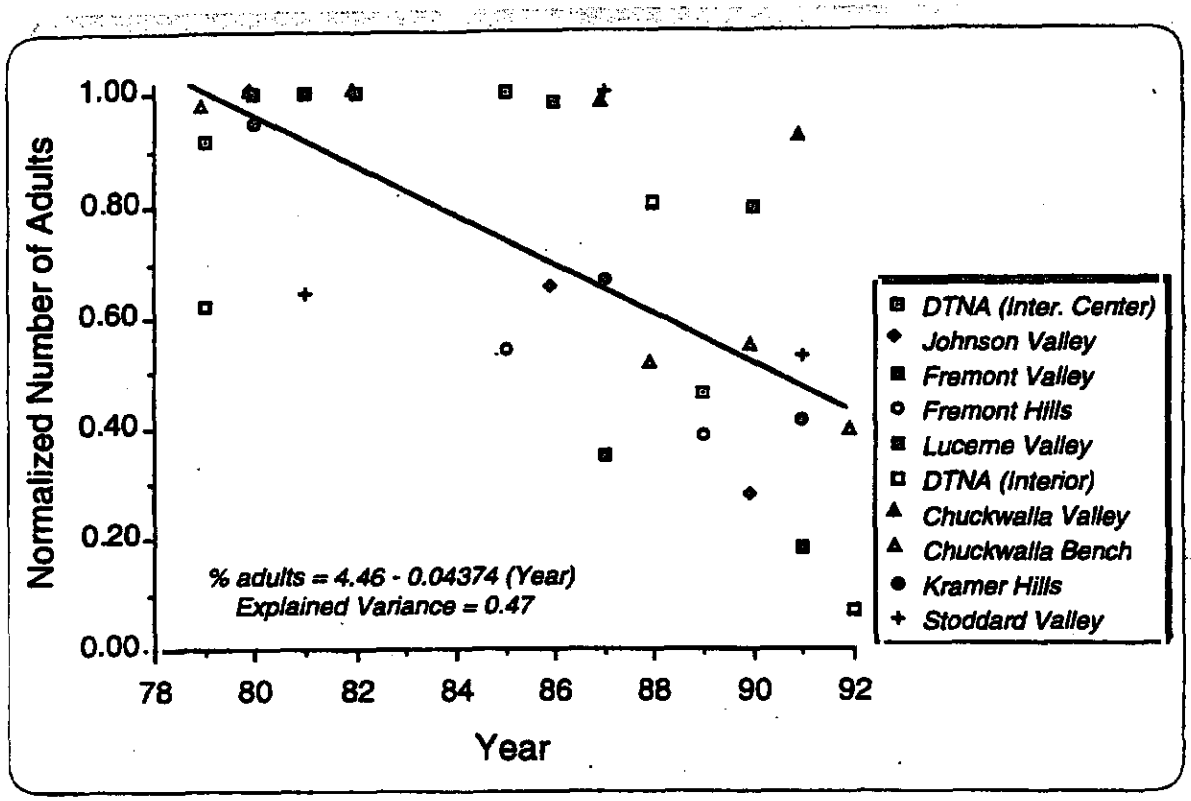


Figure C5. The number of adult desert tortoises found on BLM trend plots located in the Western Mojave. All data are normalized to the highest population size recorded within the years populations were monitored. The downward trend in population density is highly significant. ($F_{1,14} = 28.4$, $p < 0.0001$).

This analysis emphasizes that management of tortoise populations requires recognition of two separate types of population change: population trends and stochastic fluctuations. Uncorrected downward trends are disastrous and must be corrected or else the population will go extinct. Stochastic fluctuations can be disastrous for small populations or populations that are frequently victims of stochastic increases in mortality. However, large, "healthy" desert tortoise populations should be able to withstand normal stochastic fluctuations with a reasonable probability of persistence.

This analysis also shows that several areas within the Mojave region are seriously impacted by human-induced mortality. Specifically, all of the sampled sites located close to BLM designated Off-Highway Vehicle Areas and/or towns have high levels of known direct human-induced tortoise mortality. These areas have significant downward trends in population sizes; thus, these trends can only result in extinction of desert tortoises unless their causes are mitigated. The actual mechanisms of these downward trends cannot be determined from this analysis, but in all the sampled areas there is evidence of high mortality caused by off-highway vehicles and guns. Additionally, it is likely that tortoises from these areas are taken as pets, and it is also likely that diseased tortoise pets are released into these areas. Thus, the ultimate cause of downward trends in desert tortoise populations is uncontrolled human disturbance.

Finally, this analysis leads to the conclusion that the Desert Wildlife Management Area concept is the logical means by which human activity can be controlled in desert tortoise habitat, and it is perhaps the only way to reverse downward population trends in desert tortoise populations.

IV. Population Viability Analysis

Background

Earlier reviews have discussed the reasons why populations become extinct (Shaffer 1981, Soulé 1980, Simberloff 1986, Gilpin and Soulé 1986). Four explanations are generally implicated in **conditions for extinction** (CFE). Three of the CFEs are can act very quickly within a generation or two, and the fourth can take many generations.

One of the proximate conditions of extinction is **Demographic Stochasticity**, problems caused by random demographic imbalances which can occur in small populations (Richter-Dyn and Goel 1972). These events include imbalances in sex ratios, birth or death rates, or age distributions. In very small populations males or females may have difficulty finding mates, most of the population

may be post- or pre-reproductive, etc. These "accidental" demographic imbalances can occur when a population becomes very small or very sparsely distributed, and all of them can result in extinction. Demographic stochasticity certainly could be a force in highly fragmented and diminished desert tortoise populations such as can be found in the Western Mojave and Beaver Dam Slope.

A second condition of extinction is **Social Dysfunction**. This can occur by many mechanisms, and it also occurs in very small populations. In some populations, mating only occurs when it is socially facilitated. This is especially true in some birds and mammals that form leks, colonies, or herds. The selective forces leading to vulnerability through social dysfunction has been discussed by Simberloff (1986). This CFE is not likely to be important for desert tortoises because this species is widely distributed and mating does not occur in groups. However, no data exist on the extent to which breeding behavior is socially facilitated in this species.

A third CFE comes from any of several possible **Extrinsic Forces**. Extrinsic forces generally occur when there exists temporal variation in abiotic, habitat, or biotic conditions with which the population cannot contend. These can include random abiotic catastrophes such as floods, droughts, and fires. They could include epizootics (such as URTD), or shifts in prey base of predators (such as ravens switching from road-killed jackrabbits to hatchling or yearling tortoises). Other forces could include anthropogenic changes in habitat such as urbanization, mining, road development, or livestock grazing. This CFE can affect populations that are large or dense, particularly when the frequency of "damaging" extrinsic forces increase to levels never encountered by a species during its evolutionary history. This CFE is probably the most important one with which desert tortoises must contend today.

The fourth CFE is **Genetic Deterioration**. Short-term genetic deterioration results from inbreeding depression and loss of genetic heterozygosity (Frankel and Soulé 1981, Rall and Ballou 1983). These factors can cause problems in individual fitness and in a population's ability to increase. A longer-term problem resulting from loss of genetic heterogeneity is that a population may be unable to adapt to a changing environment. Generally, genetic problems occur only in very small populations. Thus, they may be a problem for the highly diminished populations of desert tortoise in the Western Mojave and Beaver Dam Slope areas.

Prescriptions for abating loss of genetic diversity has led to the "50/500 rule" (Franklin 1980) which suggests that a **genetically effective population size** of at least 50 is needed to avoid the problems of inbreeding depression in the short term and that a **genetically effective population size** of at least 500 is needed to retain enough genetic heterogeneity for long-term evolution. However, the 50/500 rule has been criticized for a variety of reasons, and Dawson et al. (1986) have speculated that a genetic

population size of at least 1500 is needed for long-term persistence of vertebrate populations such as the northern spotted owl.

Characteristics Important in Defining Minimum Population Sizes

To ensure persistence of the desert tortoise in the Mojave region it is necessary to determine the conditions under which a population will remain viable. This is called a Population Viability Analysis (PVA). Population viability is very difficult to determine (Dawson et al. 1986) largely because a PVA requires data that are often not collected for rare and difficult-to-study species. Determining population viability for the desert tortoise is especially difficult since the species has a long generation time, a complex demography, and it is being assaulted by ecological factors to which it may not have been previously exposed during its evolutionary history.

Conservation biologists and managers must understand a number of terms, definitions, and standards before the implications of a PVA can be clearly understood (Gilpin and Soulé 1986). These are:

Time Frame .- Population viability must be defined for a specific time horizon; i.e., the probability of being extant T years from now. Time spans, T, of 100 or 200 years are commonly used. However, desert tortoises may live 80 years or more, and generation time is around 25 years. Thus, for this species, a time horizon of 500 years (or approximately 20 generations) into the future is a reasonable time frame for evaluating population persistence probabilities.

Population Size .- Early work on Population Viability (Franklin 1980, Shaffer 1981) postulated that extinction probabilities were a function of population size alone. Shaffer (1981), working with data from the Yellowstone National Park grizzly bear population, looked solely to demographic and environmental factors that influenced population fluctuations. On the other hand, Franklin (1980) focused on loss of genetic variation through genetic drift, a process whose rate is inversely proportional to population size. Even though both of these early efforts at population viability determination were monofactorial, both processes can be important and should be considered in a PVA.

Population Density .- Under some circumstances, population dynamics may depend upon density of individuals per unit area rather than the total population number remaining in the region. For example, finding a mate becomes problematical in very sparse populations because few animals of the right sex are encountered.

Spatial Fragmentation .- In situations where a population is divided into a set of loosely-coupled spatial units exchanging a few animals per year, the configuration of these units in two-dimensional space may be more important than total population size. Thus, a system of small local populations, each of which is nonviable by itself, can nonetheless form a viable system if connectivity is

sufficient so that local populations that go extinct can be recolonized from other local populations in the system.

Deterministic vs. Stochastic Factors. - A population that has, on average, negative population growth is doomed to extinction. The time to extinction is straightforwardly calculated from the exponential growth equation, $dN/dt = rN$. If r is the negative per-year population change, then the time to extinction, T_{ext}, is

$$T_{ext} = \log(N/2)/r,$$

where N is the current (i.e., initial) population size. Suppose, for example, that a population of 25,000 is decreasing at 10% per year, as is the case for several local populations of the desert tortoise. The expected time to extinction is easily calculated--95 years. A doubling of N produces only a small increase in time to extinction. If N were 50,000, then the time to extinction is only increased to 102 years, hardly any gain at all. The following graph shows T_{ext} for some other negative growth rates:

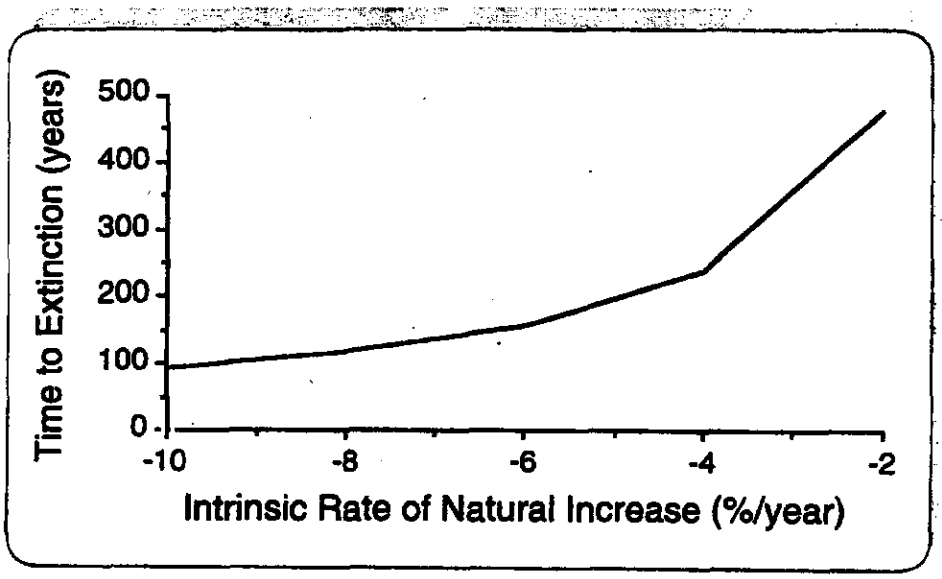


Figure C6. Time to extinctions for a population of 25,000 animals as a function of the intrinsic rate of natural increase expressed as percent decline per year.

Clearly, managers must be able to alleviate detrimental impacts on a population so that the expected growth is at least zero. At zero the population will stay constant in total size. However, even with such management, there will still be random forces that impel a population both up and down. These are the stochastic factors discussed in Section 3 of this appendix. There is often a threshold in total population size, density, or spatial arrangement below which these stochastic factors can result in a high probability of extinction within a given time period. A PVA may be able to predict this threshold--the minimum viable population.

Catastrophes. - A catastrophe is an extreme event which, by itself, can result in population extinction. Fires, floods, and epizootics are commonly cited catastrophes. In general, catastrophes are rare events whose probabilities are hard to estimate, and because of the difficulty they are typically handled in ad hoc fashion outside of a formal PVA. The Upper Respiratory Tract Disease (URTD) is a possible catastrophe threatening desert tortoises. However, its rate of spread and potential ultimate impact have not yet been estimated by epidemiological models.

The only protection against catastrophes is to have redundancy built into the management system--several widely-spaced populations would not likely be struck by the same catastrophic event at the same time. For threats such as drought or flooding, local populations would have to be distributed over a region that is large compared to the total spatial scale of catastrophes. Since the epidemiology of URTD is not yet understood, managing this epizootic is extremely problematic.

Desert Tortoise Genetics.

A comprehensive PVA requires considering population genetics--including loss of heterozygosity, inbreeding depression, outbreeding depression, long-term loss of adaptability, pedigrees, paternities, population structure, etc. However, most PVAs involve much smaller total populations (Table C1) than currently exist for the desert tortoise (although population density must be considered vis-a-vis short-term genetic deterioration as well).

Table C1. The number of individuals modeled in PVAs for endangered species.

Species	Number of Individuals
Blackfooted Ferrets	6
California Condors	28
Whooping Cranes	50
Yellowstone Grizzlies	200
Northern Spotted Owls	2000

Most desert tortoise populations are probably still larger than even the largest of these above-cited cases (although some populations may have become this small by the time the recovery plan is implemented). Furthermore, the generation time of the desert tortoise is long, at least 25 years, which slows genetic deterioration in calendar time. Beyond this, the current information about the genetics of the desert tortoise is extremely scant. All of these facts suggest that genetic considerations will be secondary to other problems threatening the desert tortoise with extinction--at least for the time being.

Nevertheless, genetical considerations are important in reserve design. DWMAs must support a tortoise population with a large enough genetically effective population size to maintain sufficient genetic diversity for long-term persistence. Genetically effective population, N_e, is usually between 0.1 and 0.5 of the total adult population size, N, in vertebrates (Ryman et al. 1981, Shull and Tipton 1987). Details of desert tortoise life history suggests that the N_e/N ratio will be at the low end of this range--certainly no larger than 0.1, particularly in populations of low densities. If we assume that a genetic population size of at least 500 is necessary to maintain the genetic diversity required for long-term evolutionary potential, DWMAs should contain no fewer than 5,000 adult tortoises.

V. *Home Range and Movements*

If we know the amount of area that a tortoise occupies, we can determine the probability that individuals will encounter one another for mating. If there is a diminished probability of encounter between males and females, then population growth will be impeded by stochastic demographic forces discussed in Section IV of this appendix. Thus, knowledge of home range size is critical for determining a minimum viable population *density* for desert tortoises.

Estimates of the home range sizes of desert tortoises are necessarily constrained by inadequate data. In particular, desert tortoises may live in excess of 50 years, and thus, data on the normal lifetime movements of desert tortoises simply do not exist for logistic reasons. Indeed, the difficulty of working with desert tortoises has resulted in estimates of home range size that are seriously in error. Although estimated home range sizes of desert tortoises have been summarized recently (Berry 1986b), most of these estimates are based upon very small sample sizes or questionable methods (Table C2). Small sample sizes tend to produce estimates that underestimate actual habitat use. On the other hand, many of the statistical estimates of home range size assume that tortoises use their habitat as "central-place foragers" resulting in a distribution of habitat use that is spatially Gaussian (see Turner et al. 1981). This

assumption of spatial normality tends to inflate estimates of home range size.

In spite of these problems, these data can produce insights into home range size in desert tortoises. First, some of these estimates can be used as an index of habitat use without claiming that these estimates are seasonal, annual, or lifetime home ranges of tortoises. If this is done, females seem to have habitat-use indices that are approximately 58 % (ranging from 40 to 73 %) of the indices of males. Thus, it would appear that habitat requirements of male tortoises are different from those of females. Data on habitat use by two populations of desert tortoises have been collected by Esque et al. (in prep.) who have monitored populations from sites in Utah and Arizona for three years. Their preliminary data show that estimates of home range size increase continually with the number of relocations of tortoises over time (Figure C7).

Table C2. Home range estimates (ha) for desert tortoises from six sites (after Berry 1986)

Location	Males	Females	All	Source
Argus, California	53 (39 -77)	21 (4 - 46)		Berry 1974
Ivanpah Valley, California			22 (3 -89)	Turner et al. 1981
			19 (2 - 73)	Medica et al 1982
Arden, Nevada	26 (20 - 38)	19 (11 - 27)		Burge 1977
Picacho, Arizona			-- (0.3 - 268)	J. Schwartzmann unpublished data
	26 (4 - 33)	15 (2 - 34)		Vaughan 1984
Beaver Dam Slope, Arizona	23 (5 - 59)	15 (2 - 34)		Hohman and Ohmart 1980
Beaver Dam Slope, Utah			-- (4 - 40)	Woodbury and Hardy 1948

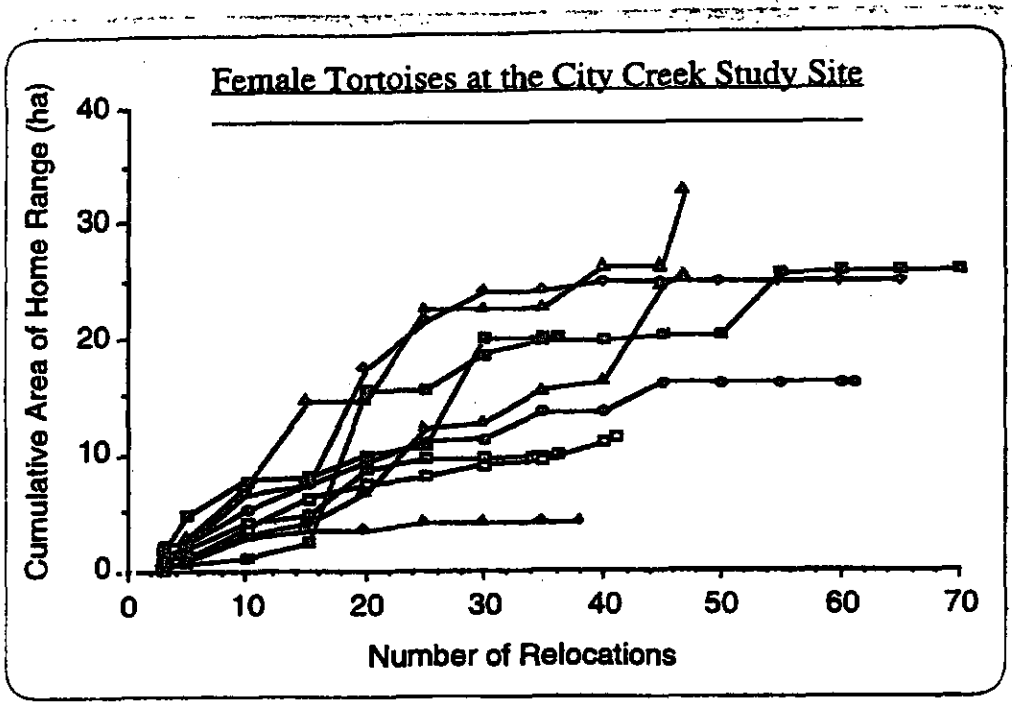


Figure C7. Cumulative estimate of home range size of adult female desert tortoises as a function of the number of relocations of each tortoise (Esque et al. in prep.). Relocations were separated in time by at least two days, and most relocations were spaced evenly over the activity season of the tortoises over a period of three years. Home range sizes were determined by the minimum convex polygon method.

This occurs for two reasons. First, the estimate depends upon the amount of data comprising the estimate. Too few data points will lead to an underestimation of the actual use of the habitat. Second, tortoises never occupy the same exact area of habitat from year to year, so that as more and more data are collected, the resulting estimate of home range size becomes larger and larger (Figure C8). It follows that to determine the lifetime home range size of desert tortoises, data would be needed on movements of tortoises over a period of at least 50 years. Clearly, this is not yet feasible, but the preliminary data may allow a reasonable estimate. Home range sizes appear to vary with site and among different years. However, in a data set covering four sites across most of the Mojave, and covering three years, the effect of site on home range size disappears ($F_{1,68}$ = 0.005, p = .94) when the effect of food availability (measured as production of spring annual plants, $F_{1,68}$ = 15.3, p = .0002) is entered into a statistical model (Figure C8). Furthermore, when both sexes of tortoises are considered at all sites, it is clear that home

range size is strongly predicted by food availability (Figure C9). When food becomes scarce, home range sizes become larger. However, when annual plant production exceeds approximately 30 kg dry mass/ha, home range sizes for both sexes appear to remain constant at a relatively small size. When each gender of tortoise is considered separately, it appears that female tortoises maintain approximately the same size home range regardless of site or food production at that site (Figure C10). However, male tortoises greatly increase their home range sizes in response to low food availability (Figure C10).

Many tortoises appear "to anchor" their annual movements to an overwintering site that may be used repeatedly in many seasons (Figure C11). This fidelity to an overwintering cave or burrow has also been seen by C. C. Peterson (unpublished data) at The Desert Tortoise Natural Area in the eastern Mojave and at Ivanpah Valley in the western Mojave of California. This does not mean that all tortoises invariably return to the same winter cave or burrow, but rather that fidelity to a well-developed cave or burrow appears to be fairly common. If a tortoise does indeed anchor its use of the habitat to an overwintering cave or burrow to which it remains faithful for many years, then it can be assumed that over its lifetime a tortoise would range in all directions from the overwintering site at distances similar to those seen in any one year. Thus, a circle can be drawn with the overwintering burrow as the center and the radius being the furthest point from the overwintering burrow. The resulting area is the estimated lifetime home range of the tortoise (Figure C12). From this analysis, the estimated lifetime home range for the City Creek tortoise ranging furthest in the three year study (female # 11.0 in Figure C11) is 180 hectares or about 0.7 square mile. The average estimate for all tortoises at City Creek is 97 ha (ranging from 38 to 180 ha).

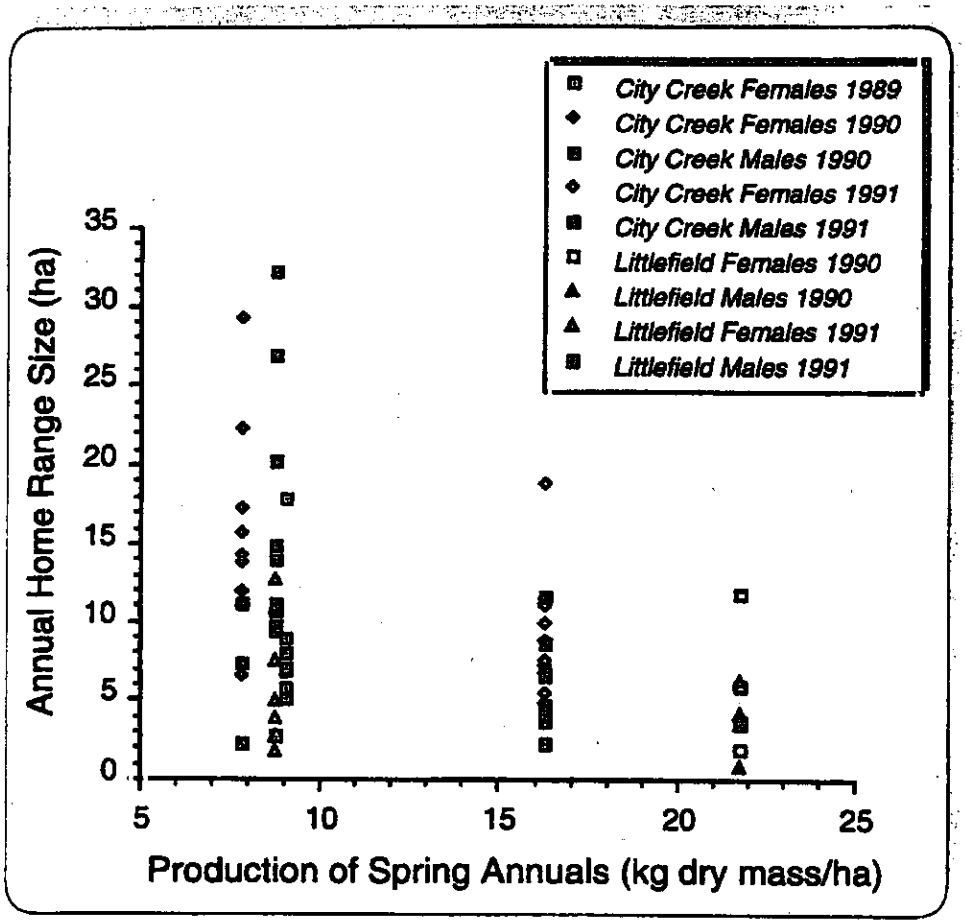


Figure C8. Annual home range sizes of tortoises at the City Creek and Littlefield Study Sites.

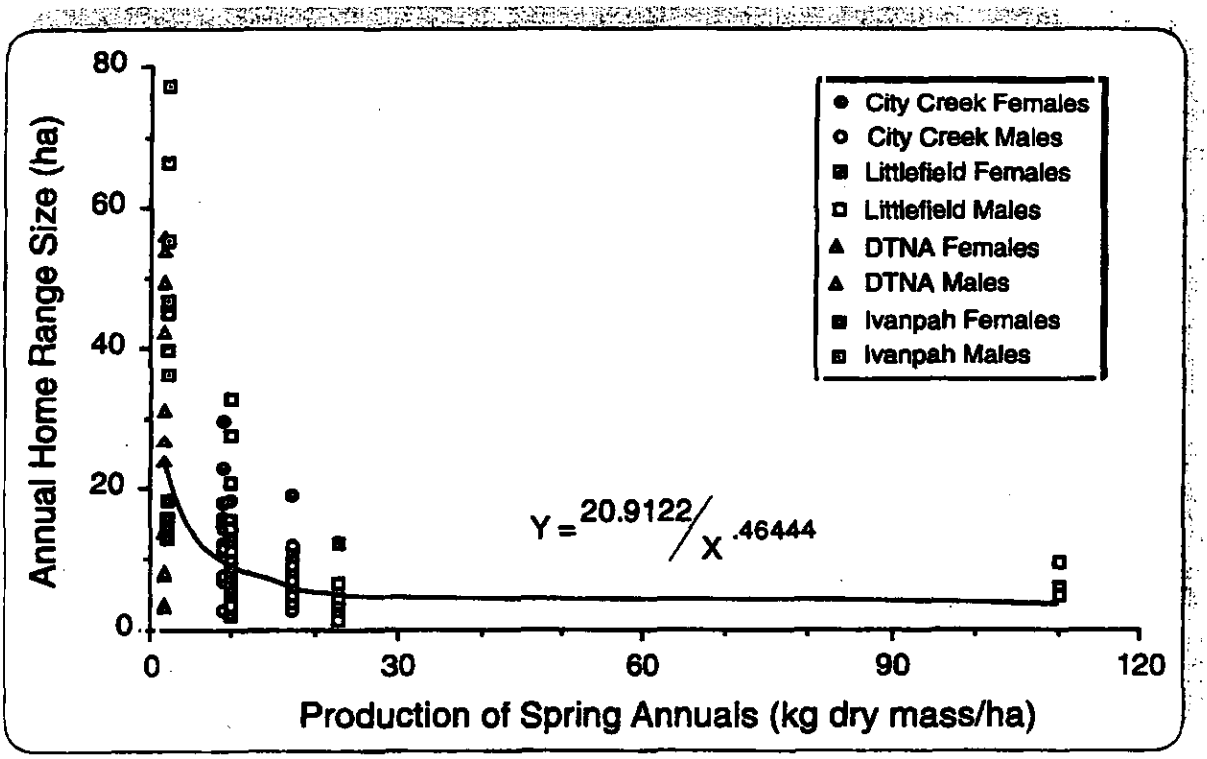


Figure C9. Annual home range sizes of desert tortoises at four sites in the Mojave Desert during the period of 1988 to 1991.

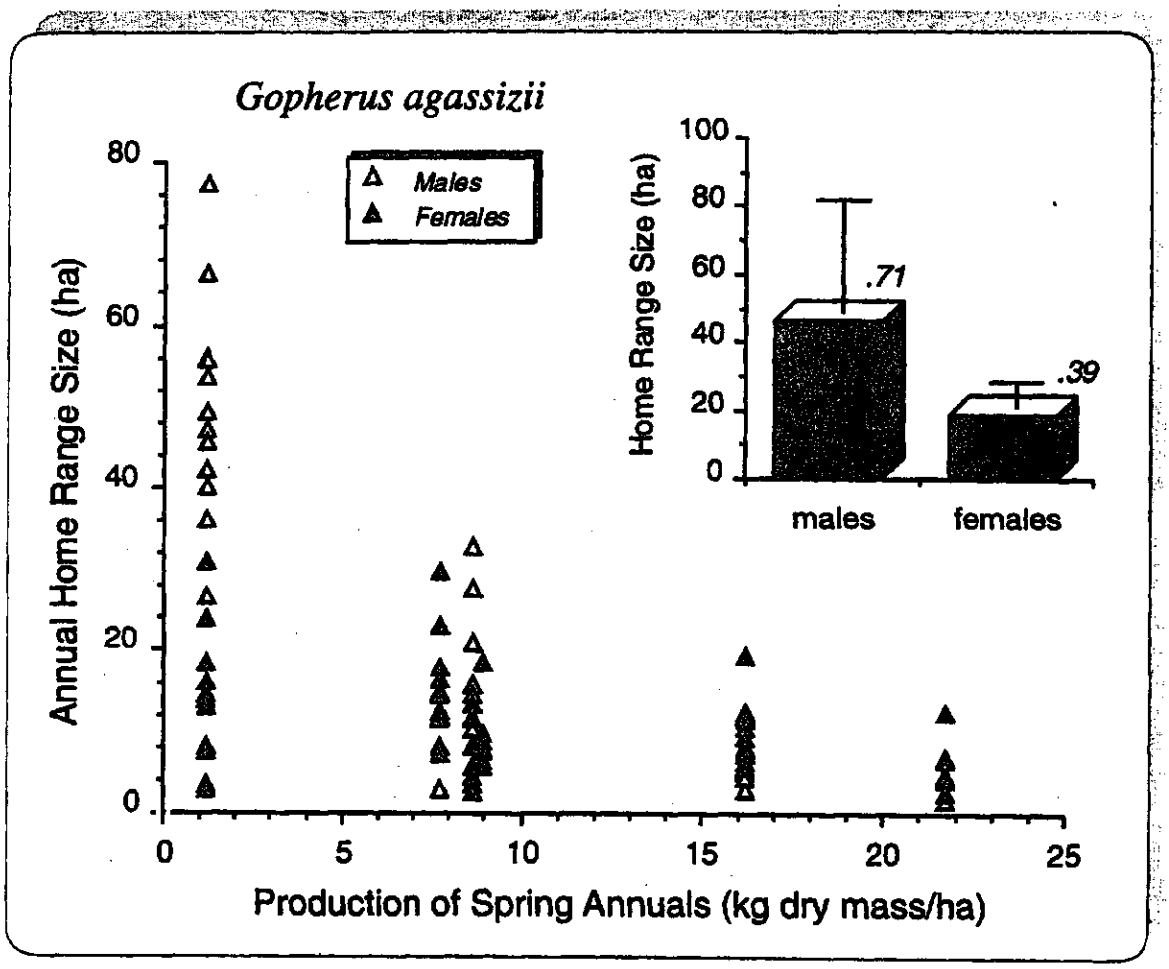


Figure C10. Annual home range sizes of desert tortoises at four sites in the Mojave Desert.

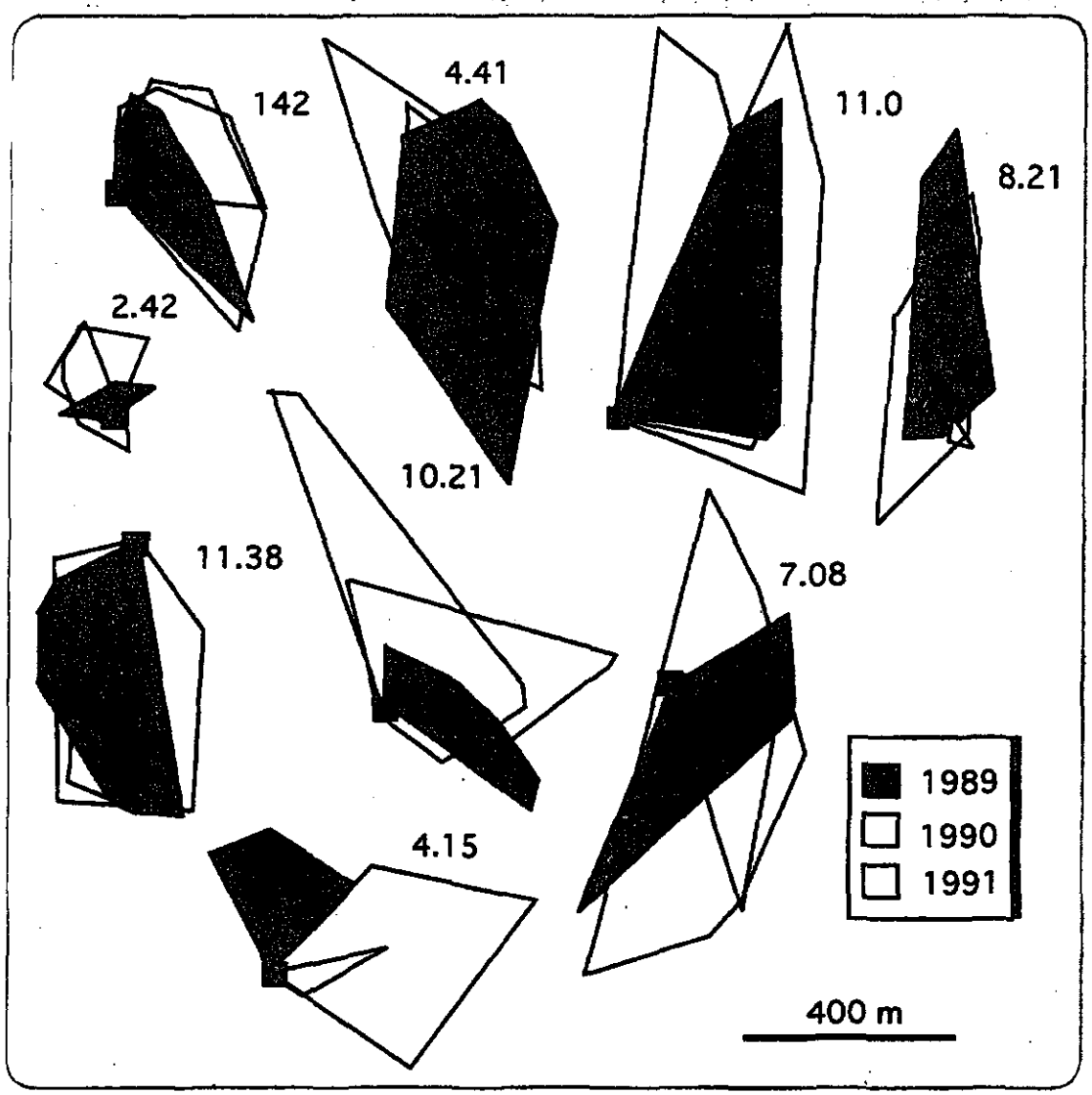


Figure C11. Home ranges estimated from the minimum convex polygons of relocations of nine adult female tortoises from the City Creek Study Site, St. George, Utah. Polygons were generated from 38-70 relocations (see Fig. 7) over a three-year period from 1989 to 1991. Relocations were evenly spaced over the activity seasons of each year. In most cases an overwintering cave was identified (black square), and in all of these cases, the overwintering cave was used repeatedly over the three-year period.

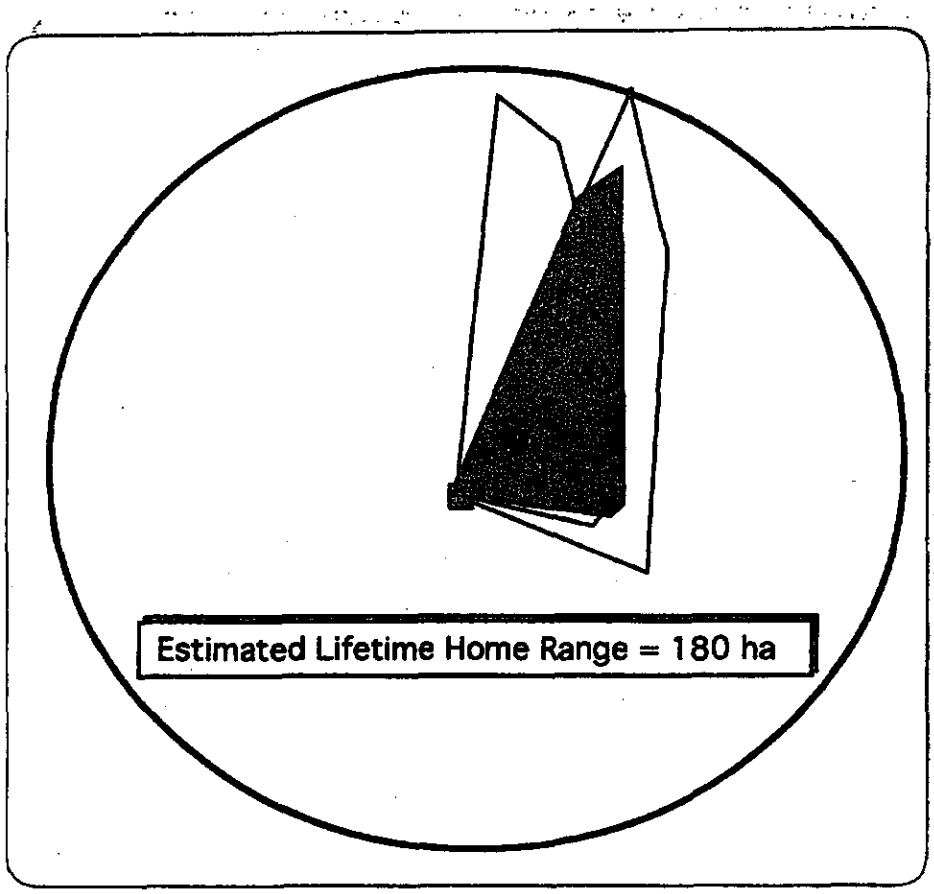


Figure C12. Estimated maximum lifetime home range of adult female tortoises at the City Creek Study Site, St. George, Utah.

Because these estimates are for females, and because females have home ranges that are about half that of males, it can be assumed that the lifetime home range of adult males may be twice these sizes, or about 194 ha (ranging up to 360 ha or about 1.5 square miles).

Even these estimates of lifetime home range size could substantially underestimate the habitat use of a tortoise that lives to a very old age. For example, tortoises are known to take lengthy forays from their home ranges and then return. Both male and female tortoises have been observed to make very long-distance forays (Figure C13). For example, at the DTNA Site, one female tortoise moved more than 8 km from its hibernation burrow over a period of between 11 and 58 days (the telemetry signal from the tortoise could not be found

during a sample 11 days after a previous sample, and the tortoise was not relocated until 58 days after its previous relocation). Two of four tortoises known to make long forays were found dead within three months of the initiation of the foray. One of those two tortoises was the first desert tortoise in nature to be observed with Upper Respiratory Tract Disease. Of the two tortoises that lived after having made a long-distance foray, one moved from a small area of activity (less than 10 ha) to another similar-sized area more than 2 km distant. This tortoise never returned to the area in which it was originally observed. The other tortoise was repeatedly relocated in an area totaling 38 ha before it made a foray of approximately 4km.

From these estimates of home range sizes of adult tortoises, we can estimate the minimum viable density of tortoise populations. Because we have very few data on mate-finding strategies in this species, this estimate is necessarily crude. Refinements, however, require considerable additional data.

Male and female tortoises have home ranges that are dynamic from year to year and from place to place. During years in which food resources are sparse, male tortoises expand their home ranges considerably, and female tortoises somewhat less (Figure C10). Averaging across several studies, male home ranges have been shown to expand to approximately 50 hectares, with considerable variability around the average, when food resources are scarce. Thus, in years when average home ranges are very large, approximately 5 male tortoises can "fit" into a square mile with no overlap of their annual home ranges. (This assumes that tortoises are "overdispersed," which may or may not be true.) At this density, males moving about as they have been seen to do in years when home ranges are very large, would theoretically patrol all of their habitat. Fewer than five males would result in some parts of this theoretical square mile not being patrolled, and females in the unpatrolled parts would not come into contact with males every year. Assuming that the population is 50% females, then the "minimum contact density" which would guarantee that all females would be mated every year is 10 adult animals per square mile, or higher if the population had more females than males.

This reasoning suggests that the minimum viable density of tortoise populations--the density below which the potential for population growth is diminished due to stochastic demographic forces--is about 10 adults per square mile. Thus, a DWMA has to be large enough to hold some predetermined number of tortoises at a density of no less than this.

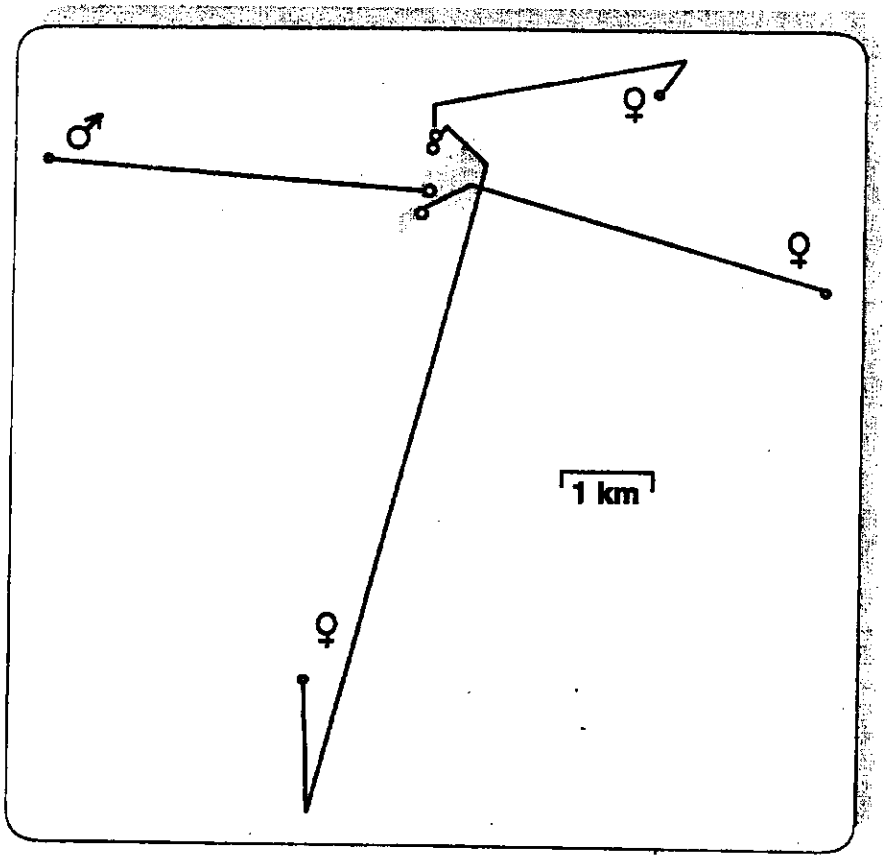


Figure C13. Long-range movements of tortoises at the DTNA site.

VI. Desert Tortoise Demography

Tortoise demography is complex but the overall features are well known. There is a long prereproductive period and females first reproduce at ages between 12 and 25 years (Turner et al. 1984) with animal size bing more important than age in determining vital rates. As a general rule-of-thumb, 185 mm is the carapace length for first reproduction. There seems to be no senescence; adults die off at a slow rate and may live for more than 80 years. Adults continue to reproduce throughout their lives. In general, females reproduce in most years and may have two clutches per year. The survival of juveniles is very low and probably varies from year to year.

Because of limited data on the demographic processes and parameters for desert tortoise, modeling of desert tortoise population dynamics is difficult and not independent of modeling assumptions. Thus, three separate modeling exercises were conducted to assess extinction probabilities in desert tortoises. These three exercises were conducted at different times during the production of the Recovery Plan. Thus, some had the benefit of more recent data. The first of the analyses, the Gilpin analysis, is the richest with respect to the diversity of questions asked of the models. The second, the Tracy analysis, partitioned the variance in the empirical data upon which the modeling is based into its different components. The third, the Peacock model, was done as a check on both of the previous modeling exercises by using a commercially available demographic program.

A. The Gilpin Model

A Projection Model. The data for this analysis come from the work of Turner et al. (1987) on a population near Goffs, California. From these data, it is straightforward to construct an age or stage projection matrix (Biehl and Gilpin 1990). A stage-structured matrix was constructed by collapsing Turner et al.'s (1987) more finely resolved data:

Stage 1 = hatchlings
Stage 2 = 1-5 years old
Stage 3 = 6-10 years old
Stage 4 = Subadults
Stage 5 = Adults

These correspond to a five element column vector. The output from one run of the program is:

Stage 1	Stage 2	Stage 3	Stage 4	Stage 5
.000	.000	.000	.000	6.200
.620	.706	.000	.000	.000
.000	.093	.802	.000	.000
.000	.000	.031	.719	.000
.000	.000	.000	.111	.937

Stage 1 had 23.4485% of the individuals.
Stage 2 had 48.3691% of the individuals.
Stage 3 had 21.9897% of the individuals.
Stage 4 had 2.38581% of the individuals.
Stage 5 had 3.80685% of the individuals.

Stage 1 Reproductive value = 1
Stage 2 Reproductive value = 1.62349
Stage 3 Reproductive value = 5.24694
Stage 4 Reproductive value = 34.402
Stage 5 Reproductive value = 89.1427

This output is for a single run of the model. Each of the parameters in the transition matrix has some uncertainties associated with it; thus, a sensitivity analysis was done on the matrix before any conclusions were drawn from the model. These conclusions are given in the following sections.

The per year growth rate of desert tortoises is low. The Turner et al. (1987) study found only 2% per year. If this rate is a maximum that is generally true for all populations, desert tortoises have low resistance to negative deterministic impacts (harvesting by humans, predation, disease, kills by motor vehicles, competitive interactions from livestock, etc.) to the population. Figure C14 illustrates this schematically.

Because of the extremely long prereproductive period (to an age as great as 25 years), the reproductive values of desert tortoises vary greatly. Figure C15 shows the reproductive values versus age for the Turner et al. (1987) desert tortoise data.

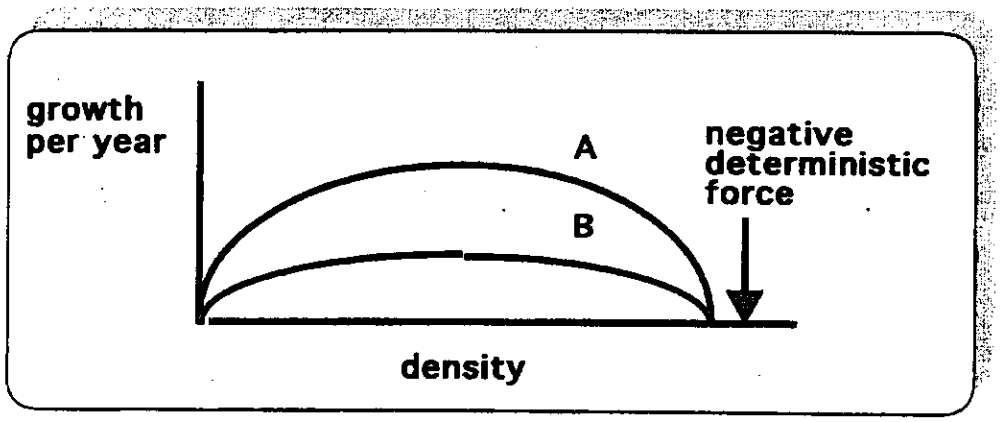


Figure C14. Two population growth curves. Both A and B have the same carrying capacity (the rightmost point on the abscissa where the growth curves intersect). Curve A has a higher intrinsic rate of increase. If a deterministic force indicated by the downward arrow at the right of the figure impacts the population, the population following curve A could adjust to a lower equilibrium density and could persist. Curve B, however, has too low a rate of increase and would be overwhelmed by the negative deterministic force and the population would go extinct.

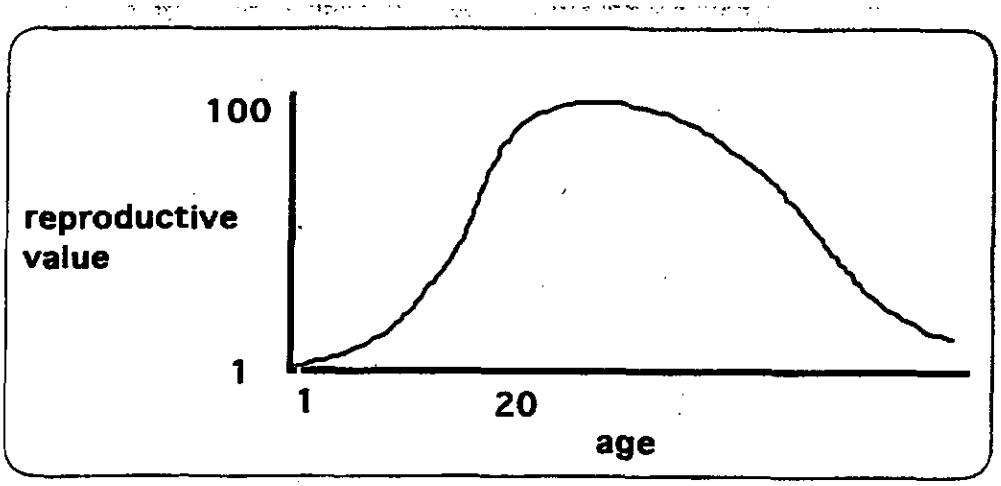


Figure C15. Reproductive values.

One consequence of this is that introductions of desert tortoises to empty habitat should best be accomplished with the addition of high reproductive value individuals; i.e., young adults. Of course, this mathematical result is consistent with common sense.

The age and size structure of a population of desert tortoises is very slow to return to the stable distribution following a perturbation. This is much like the human population, where, for example, in the United States the consequences of the baby boom will be felt for a century. An out-of-equilibrium age/size distribution could have implications for desert tortoise social structure. Figure C16 shows one simulation of age-structured growth that begins from a disturbed (non-steady) state. Note that the initial oscillations have a period of about 14 years. This implies that any trend analysis for less than 14 years could give very misleading projections.

Density dependence.- Nothing is known about the mechanism of density dependent population regulation in the desert tortoise. That is, what sets a carrying capacity, K? Is K ever reached? If so, what determines K - food resources, soil available for burrows? There is some suggestion that maximum densities of desert tortoises are set by levels of primary productivity (See Appendix G). Other relevant questions include: Are tortoise densities held down by predation? Is there social regulation of population density?

Demography and deterministic population regulation is an area that needs further research and study. These processes may vary over the range of the desert tortoise, and applications of details from the Goffs study to desert tortoise populations in the far western Mojave or to northern populations in

Nevada and Utah, may be inappropriate. However, the general character of desert tortoise demography as revealed by the Goffs study is probably valid throughout the range.

Variable Growth Rates of Desert Tortoises (Environmental Stochasticity). Growth rates for desert tortoise populations are variable from time period to time period and from one local population to the next local population. With variable growth rates comes the possibility of stochastic extinction: the population will have a run of bad luck and its density will drop below the threshold of extinction. This is environmental stochasticity.

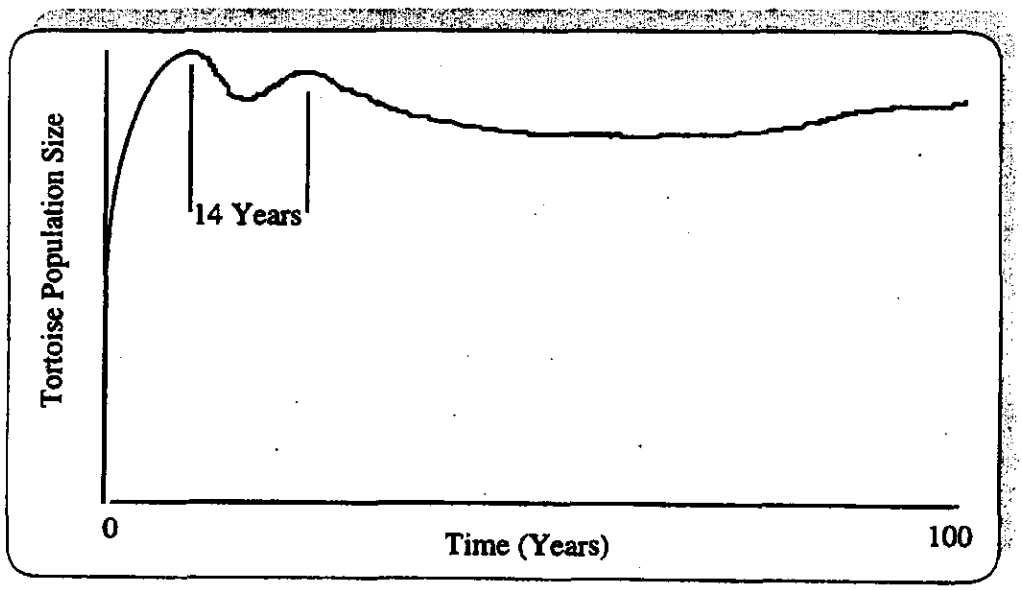


Figure C16. A projection of age structured growth for a desert tortoise population.

A simple discrete equation for stochastic growth is:

$$N_{t+1} = \{lambda\}\ N_t \qquad \text{if} \qquad N <= K$$
$$N_{t+1} = 1 \qquad \text{if} \qquad N > K$$

where N_t is the current population size and where N_{t+1} is the size of the next time period, and where {lambda} represents a random variable for discrete growth described below. If the current population is above K, the carrying capacity, the population size drops to K the next year. But if the population is below K, the new population size is determined by drawing a discrete growth rate, lambda, from a probability distribution with a known mean and variance. In most explorations of this model, it is assumed that the mean lambda is greater than 1, which corresponds to an r of greater than 0. The relationship between r and lambda is:

$$\rho = \log_e (\text{lambda}).$$

In more sophisticated models (e. g., Goodman 1987), the mean and variance of the distribution of lambda values may change with the size of the population; that is they may be functions of N. For populations in natural environments, it is almost impossible to determine the relationship of mean and variance of lambda to N, if for no other reason than the problem of obtaining a sufficiently large sample size. Thus, it will not always be the case that the variation of population growth will be modeled as independent of N.

Data for this model came from desert tortoise populations that had been sampled at 13 locations throughout the Mojave desert (Berry 1990, as amended, Nevada Department of Wildlife 1990; SWCA, Inc. 1990):

California:	Chemehuevi
	Chuckwalla Bench
	Goffs
	Ivanpah valley
	Upper Ward Valley
	Desert Tortoise Natural Area
	Fremont Valley
	Johnson Valley
	Kramer Hills
	Lucerne Valley
	Stoddard Valley
Nevada:	Piute Valley
Arizona:	Littlefield

Samples of adult desert tortoises were taken at these study locations at various years. From these samples, the discrete growth rate

lambdas can be computed. These lambdas are based on per year growth intervals. For samples on two successive years, the lambda is given by:

lambda = final_sample/initial_sample.

If the period is more than 1 year, the relationship is

lambda=(final_sample/initial_sample)^(1/no_of_years).

where the "^" sign indicates exponentiation. From these study locations, some of which had more than two samples, 27 different values of lambda can be determined, which define a probability distribution. The mean lambda is .985, with a standard deviation of 0.08. The probability distribution of lambdas is shown in Figure C17.

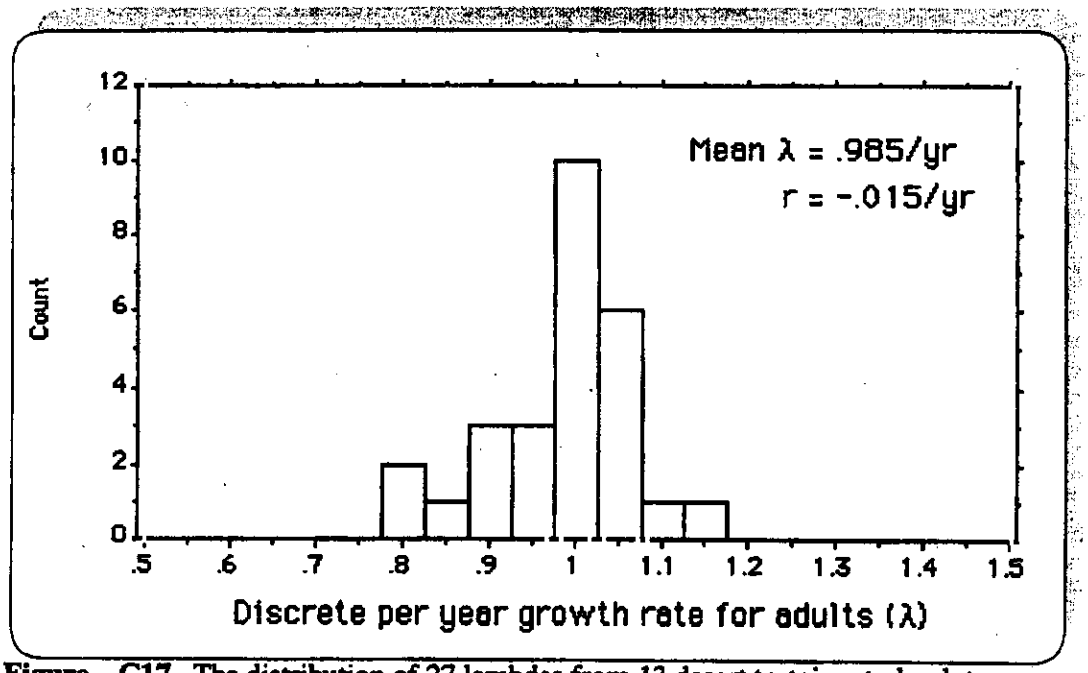


Figure C17. The distribution of 27 lambdas from 13 desert tortoise study plots.

The lowest lambda is 0.8 and the highest is 1.15. These correspond to per year changes of roughly -20% and +15%, with a mean of -1.5%/year. That the average growth rate from these sites is -1.5% does not mean that the entire desert tortoise population is only shrinking at this rate, for these study populations represent for the most part local populations in the centers of good habitat. The entire species population of desert tortoises could simultaneously be shrinking in its spatial extent, and this would not be represented in these figures. Furthermore, these are pre-URTD studies. Adult dieoff accelerates by as much as an order of magnitude not long after URTD is first identified in these populations. Also, the extreme growth rates of -20% and +15% probably correspond to cases where the age structure of the population is badly out of stable age distribution (see below), or where there is some form of animal movement into or out of the local population.

Nonetheless, the variance in lambda values possibly represents the variance that would be present in reserve systems with protected boundaries and which were free of URTD. Thus, these are good numbers to use in a first-pass simulation study of local extinction of desert tortoise populations on reserves. They may set one kind of lower limit to the scale of reserve units, suggesting that anything smaller is certain to be inadequate. They may also be a best-case scenario insofar as the consequences of disease are not reflected in the data.

To model time to extinction, N_{t+1} is calculated using the empirical distribution of lambdas in Figure C18. The first simulation assumed an initial N of 20,000 adult desert tortoises at equilibrium (i.e., K is the same value). An extinction threshold is taken as 2 individuals. The distribution of times (in years) to extinction is given in Figure C18.

From Table C3 it can be seen that, among other things, 90% of the populations will survive at least 350 years, and that the mean time to extinction is 505 years, with a standard deviation of 115 years.

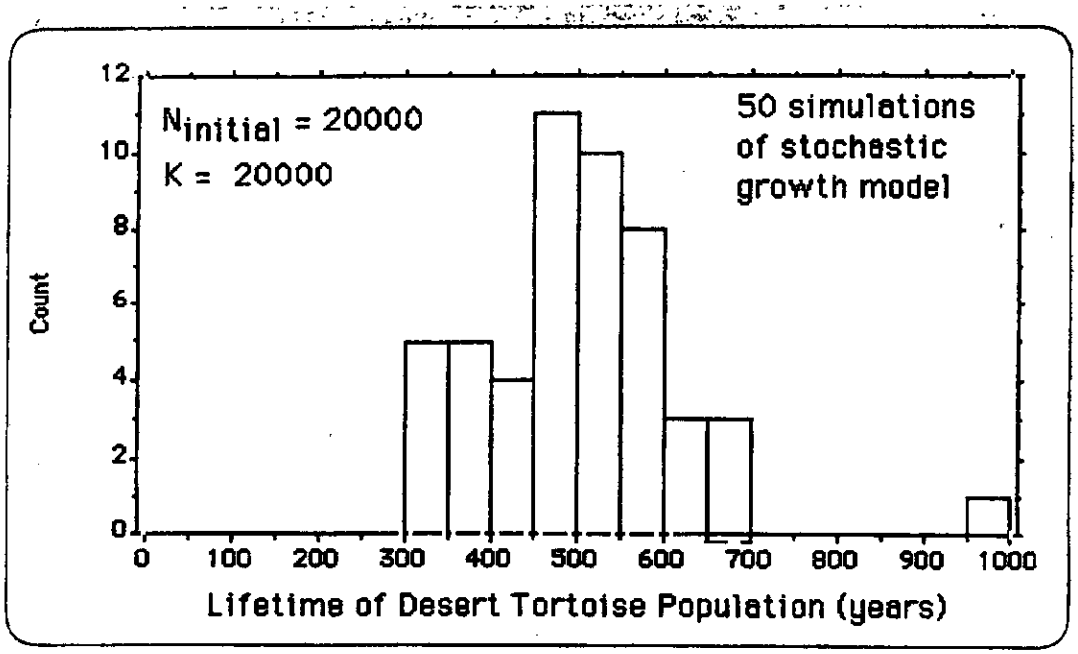


Figure C18. Time to extinction based on current best estimates of stochastic growth.

Table C3. Descriptive statistics for the distribution of times to extinction (Fig. C18).

Mean:	Std. Dev.:	Std. Error:	Variance:	Coef. Var.:	Count:
504.8	115.427	16.324	13323.429	22.866	50
Minimum:	**Maximum:**	**Range:**	**Sum:**	**Sum Squared:**	**# Missing:**
332	987	655	25240	13394000	0
# < 10th %:	**10th %:**	**25th %:**	**50th %:**	**75th %:**	**90th %:**
5	350	423	499.5	562	633.5
# > 90th %:					
5					

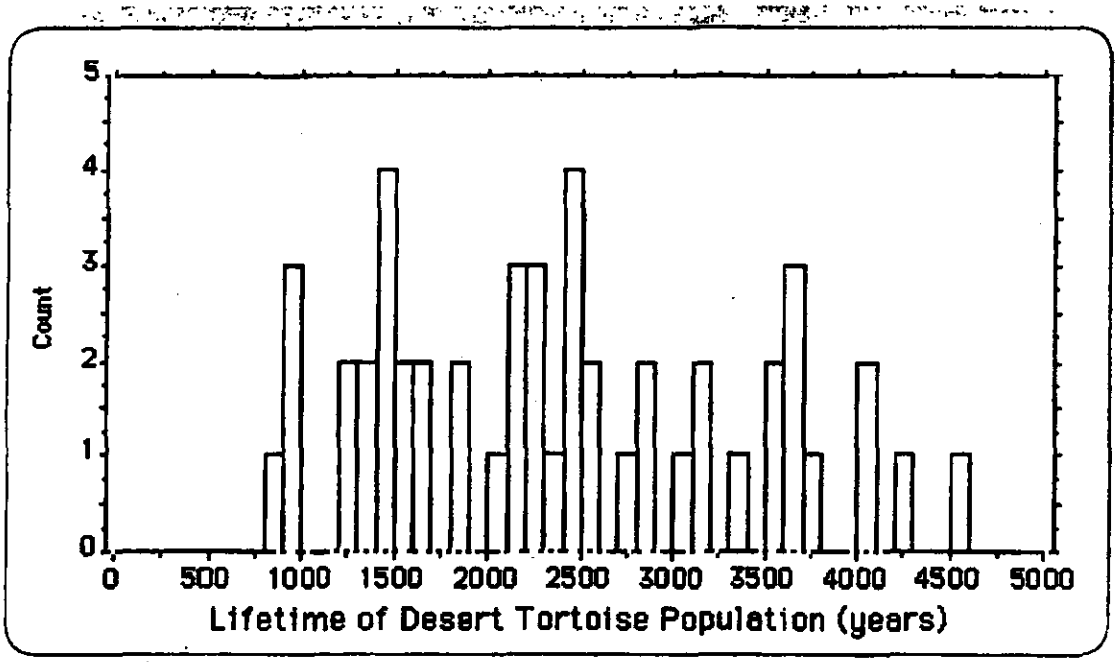


Figure C19. Extinction time under hypothesized management (see text).

These projections are based on a relatively simple model and on relatively limited data. One way to get a feeling for the reasonableness of "stability" of such projections is to change the model slightly. If the mean lambda is raised from 0.985 to 1.000 (a growth rate for maintaining stable population size), but the variance in growth remains the same; that is, that the histogram in Figure C18 is shifted rightwards by an amount 0.015, the mean tendency is for the population to remain stationary in size. However, it cannot increase above its K, while at the same time it has no lower bound other than extinction. If the model is now run with the slight increase in mean lambda, the growth distributions are as shown in Figure C19.

The mean time to extinction has now increased five fold to 2,474 years, with a standard deviation of 1,150 years. That is, given the hypothetical situation for growth now assumed for a desert tortoise population, a 1.5% elevation of the growth rate leads to a 500% increase in time to extinction. This suggests that a little management of tortoise habitat may go a long way to help local populations.

A second manipulation is also instructive. If the mean lambda is kept at 1.000, but the local population is made ten times smaller (i.e., $N_{initial} = 2000$ and $K = 200$), the mean time to extinction is

361 years(Figure C20). Thus, the size of the population (and hence the reserve) matters greatly given the observed fluctuation in growth rates. Thus, even with improved management, a reserve with a maximum population of 2,000 desert tortoises is too small to achieve a reasonable predicted time to extinction.

Even though tortoise populations declined (mean lambda = 0.985), the years 1979-1989 were relatively good ones for the desert tortoise compared to the next two. During 1990 and 1991 marked declines in numbers occurred. If the data from 1990-91 are added to the 1979-89 data, the mean lambda (i. e., the per year discrete growth rate) is so reduced that the model populations promptly go extinct. However, recovered populations, or populations on their way to recovery, should have the ability to rebound from bad years, once most of the extrinsic sources of mortality have been removed. Clearly, these years are not the first drought or disease episode experienced by desert tortoises over their long history of occupation of this region. In addition to bad years, there will also be some years of extraordinarily high lambdas associated with very good conditions. This implies that the average lambda from the 1979-89 data set will still be obtained--only its variance (or standard deviation) will be increased. The amount of the increase in the standard deviation will depend on the frequency of very good years and very bad years, whatever that may be.

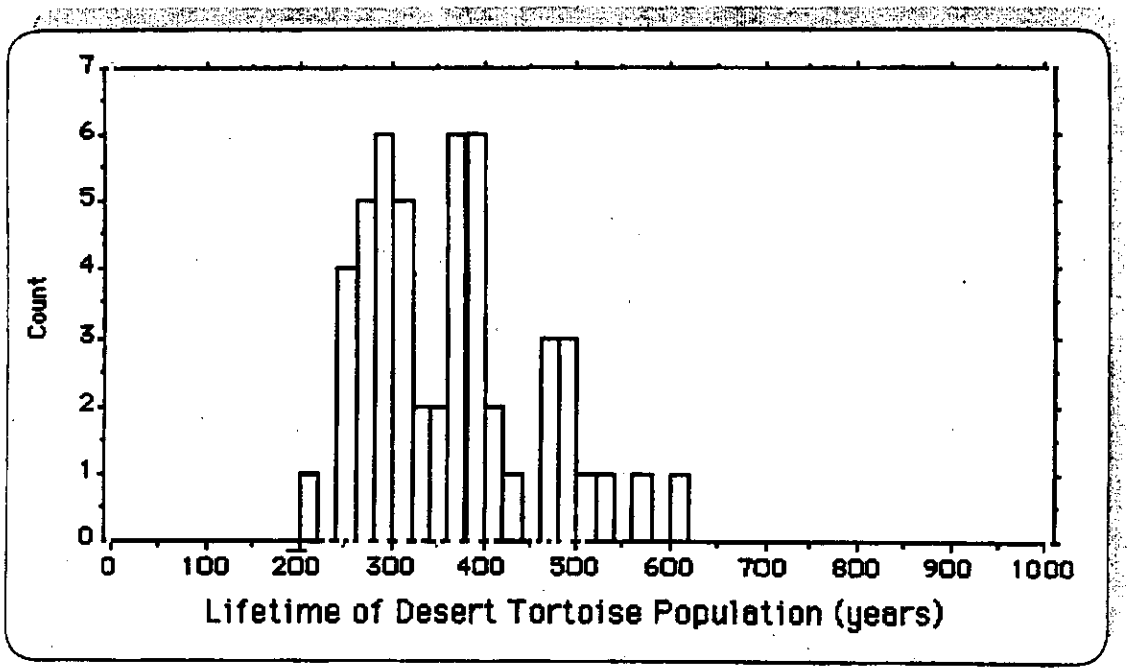


Figure C20. Extinction times in a small managed reserve.

This model can also be used to examine the time to extinction for various modifications to variation in lambdas. Population ceilings of 200, 2000 and 20,000 adult desert tortoise were used, and the variation in lambdas is increased by certain percentage amount while all else was kept constant. Fifty trials were performed for each case, and the median number of years of persistence is used as the estimator of time to extinction. The results are shown in Figure C21. Time to extinction increases linearly with the logarithm of population size, as is expected from standard theory. The highest line is for the 1979-1989 data. The 500 year time to extinction is reached with a population ceiling (K) of 20,000 adult desert tortoises. The three lower lines on the figure, based upon simulations using ceilings of 200, 2000 and 20,000 adult animals, show the effect of increasing the variance in lambda to 120%, 150% and 200% of its value in the 1979-1989 data set.

This experiment shows that the higher the variability of population growth, the larger the population size required for viability. For example, about 50,000 adult tortoises would be required for a median time to extinction of 500 years if the actual variance in lambda is 120% of the 1979-89 value. Since population size is a function of reserve size, a reserve large enough to support this number of adult tortoises would be necessary. That is, this model suggests that reserves large enough to support 50,000 adult desert tortoises would be advisable building blocks to achieve a median time to extinction of 500 years for recovered populations.

This model does not incorporate three important features. First, it ignores catastrophes. Second, it extrapolates from the last decade of desert tortoise history hundreds of years into the future. Many things, such as climate change, could invalidate these data considerably. Third, it does not account for spatial structure and the possible interactions of local populations. Nonetheless, this analysis does show that a reasonable reserve size for long-term protection of desert tortoises should be large enough to accommodate roughly 50,000 adult animals.

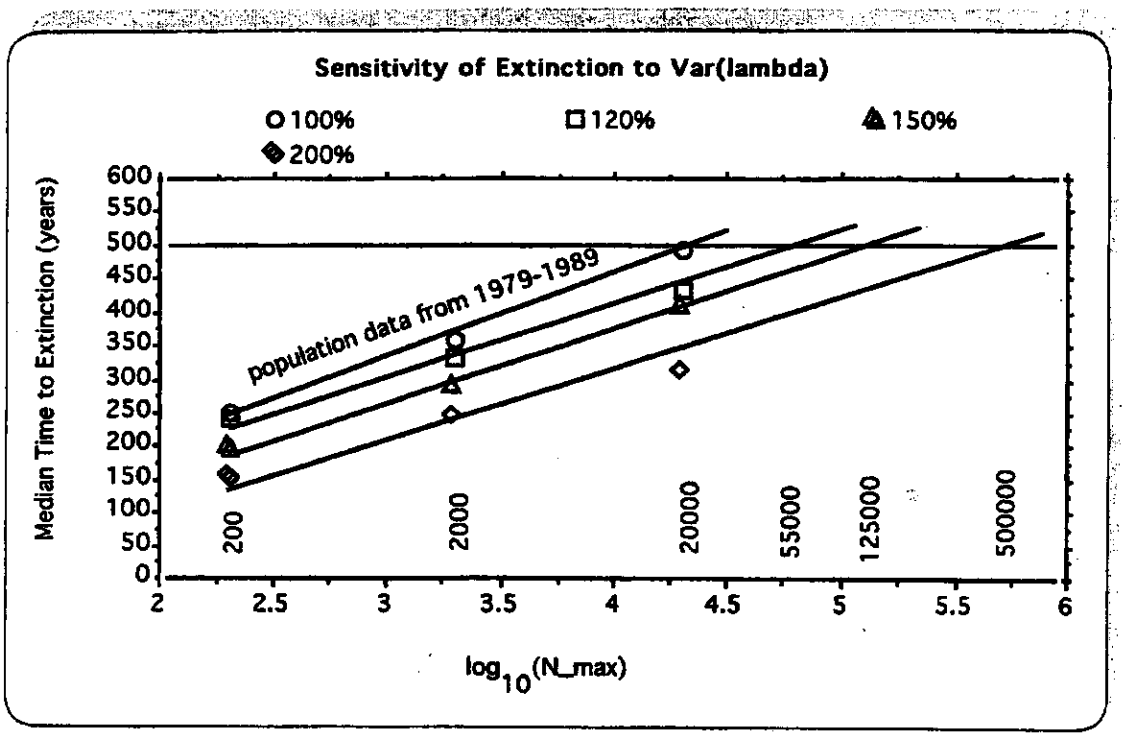


Figure C21. Median time to extinction as a function of population carrying capacity (denoted N_max) and of the variance of the discrete growth rate, lambda. The standard deviation of lambda is increased by 20%, 50% and 100% above the value used in the original report. The horizontal line is at 500 years, which is taken as the minimally acceptable time for a single reserve.

B. The Tracy Analysis

Matrix Population Model. - The only compilation of detailed demographic data for the desert tortoise comes from studies at the Goffs Site in California (Turner et al. 1987, Burnham et al. 1987). From these data it is straightforward to construct a stage-transition matrix (Caswell 1989). All tortoises were placed into five stage categories (Table C4), and these stages were incorporated into a five-stage demographic model (Figure C22).

The demographic flows modeled in Figure C22 are placed into a transition matrix:

$$\mathbf{A} = \begin{pmatrix} P_1 & F_2 & F_3 & F_4 & F_5 \\ G_1 & P_2 & 0 & 0 & 0 \\ 0 & G_2 & P_3 & 0 & 0 \\ 0 & 0 & G_3 & P_4 & 0 \\ 0 & 0 & 0 & G_4 & P_5 \end{pmatrix}$$

The G and P elements of this matrix model were estimated from the simulated survivorship curve (Figure C23) for the Goffs Site (Turner et al. 1987, Burnham et al. 1987). The F element (only "adults" produce eggs) was taken as a variable based upon population growth rates to be modeled.

Table C4. Description of the ages of desert tortoises included in the five stages for the stage-based demographic model of desert tortoise population growth.

Stage	Ages
1	hatchlings
2	1 to 5 years old
3	6 to 10 years old
4	subadults
5	adults

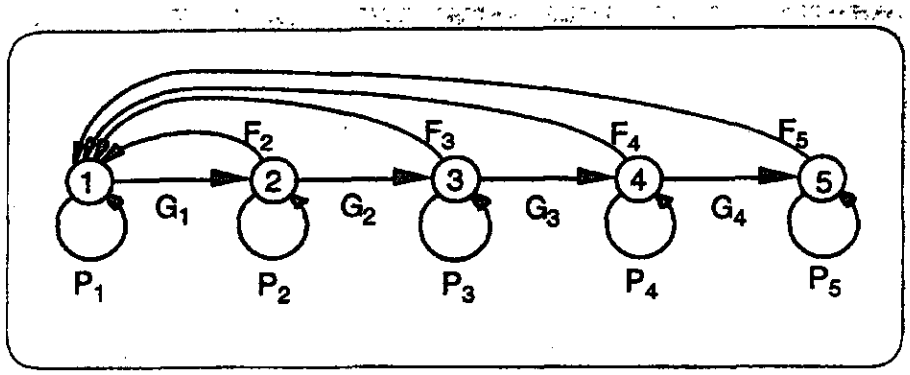


Figure C22. Conceptual model of the life cycle of desert tortoises in which individuals move among the five stages within the life cycle according to two probabilities of movement: P_X is the probability of an individual remaining in a particular stage x, G_X is the probability of an individual moving to the next older stage x, and F_X is the number of hatchlings produced by individuals surviving to the adult stage.

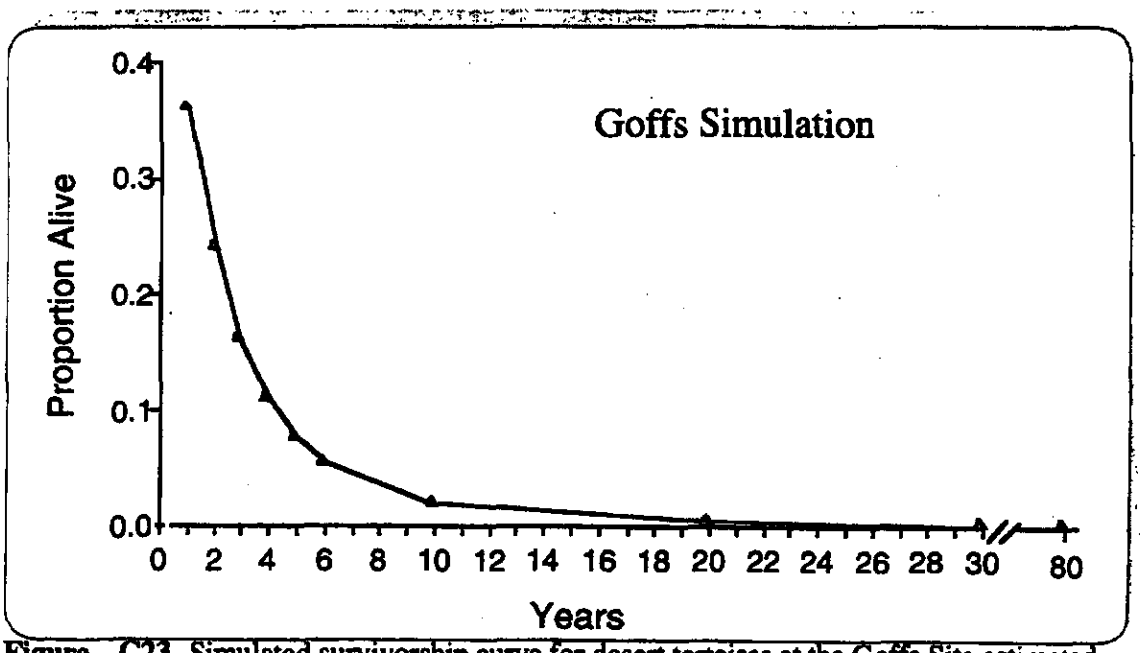


Figure C23. Simulated survivorship curve for desert tortoises at the Goffs Site estimated from data presented in Turner et al. (1984) and Burnham et al. (1987). Survivors are presented as proportion of the population still alive as a function of tortoise age.

Growth of Mojave Populations

Nineteen sites in California and Nevada have been monitored for desert tortoise population sizes since 1979 (Table C5). At all of these sites populations have been sampled more than once over a period of 13 years yielding a total of 39 estimates of the discrete growth rate (lambda, l) calculated as,

$$l = (N^*/N)^{(1/(t^*-t))}$$

where:

N^* = Population size at time = t^*

N = Population size at time = t

t^* = time of the initial sample

t = time of the second sample

The mean lambda for all monitoring sites was 0.975 (Figure C24A) with a standard deviation of 0.091. However, this standard deviation for the mean lambda includes variation attributable to several sources: (1) differences in lambda among sites, (2) differences in lambda due to temporal trends in population size, (3) year-to-year variation around the temporal trends, and (4) errors in the estimation of population sizes. An analysis of covariance was performed to partition these sources of variation around the mean lambda (Figure C25). The standard deviation for the mean lambda due only to year-to-year variation around the temporal trends, plus the estimation errors, was only 0.019 (Figure C24B). Until an analysis is performed to determine the errors in population estimation, it is not possible to sort out the year-to-year variation around the mean lambda completely.

Using the transition matrix from Goffs and the mean Lambda for the 39 sites in California and Nevada, the unknown F_x in the model can be solved for. This results in the transition matrix for the "average" population in the Mojave to be,

$$\mathbf{A} = \begin{pmatrix} .000 & .000 & .000 & .000 & .500 \\ .360 & .614 & .000 & .000 & .000 \\ .000 & .076 & .715 & .000 & .000 \\ .000 & .000 & .171 & .840 & .000 \\ .000 & .000 & .000 & .174 & .940 \end{pmatrix}$$

Table C5. Long-term monitoring sites at which population sizes of desert tortoises have been estimated between 1979 and 1992.

Sites Receiving Winter and Summer Rains

Chemehuevi Valley, California
Chuckwalla Bench, California
Chuckwalla Valley, California
Ivanpah Valley, California
Upper Ward Valley, California
Christmas Tree, Nevada
Coyote Springs, Nevada
Gold Butte, Nevada
Piute Valley, Nevada
Sheep Mountain, Nevada
Trout Mountain, Nevada

Sites Receiving Winter Rains Only

Desert Tortoise Natural Area (Interior), California
Desert Tortoise Natural Area (Visitors Center), California
Fremont Valley, California
Fremont Peak, California
Johnson Valley, California
Kramer Mountains, California
Lucerne Valley, California
Stoddard Valley, California

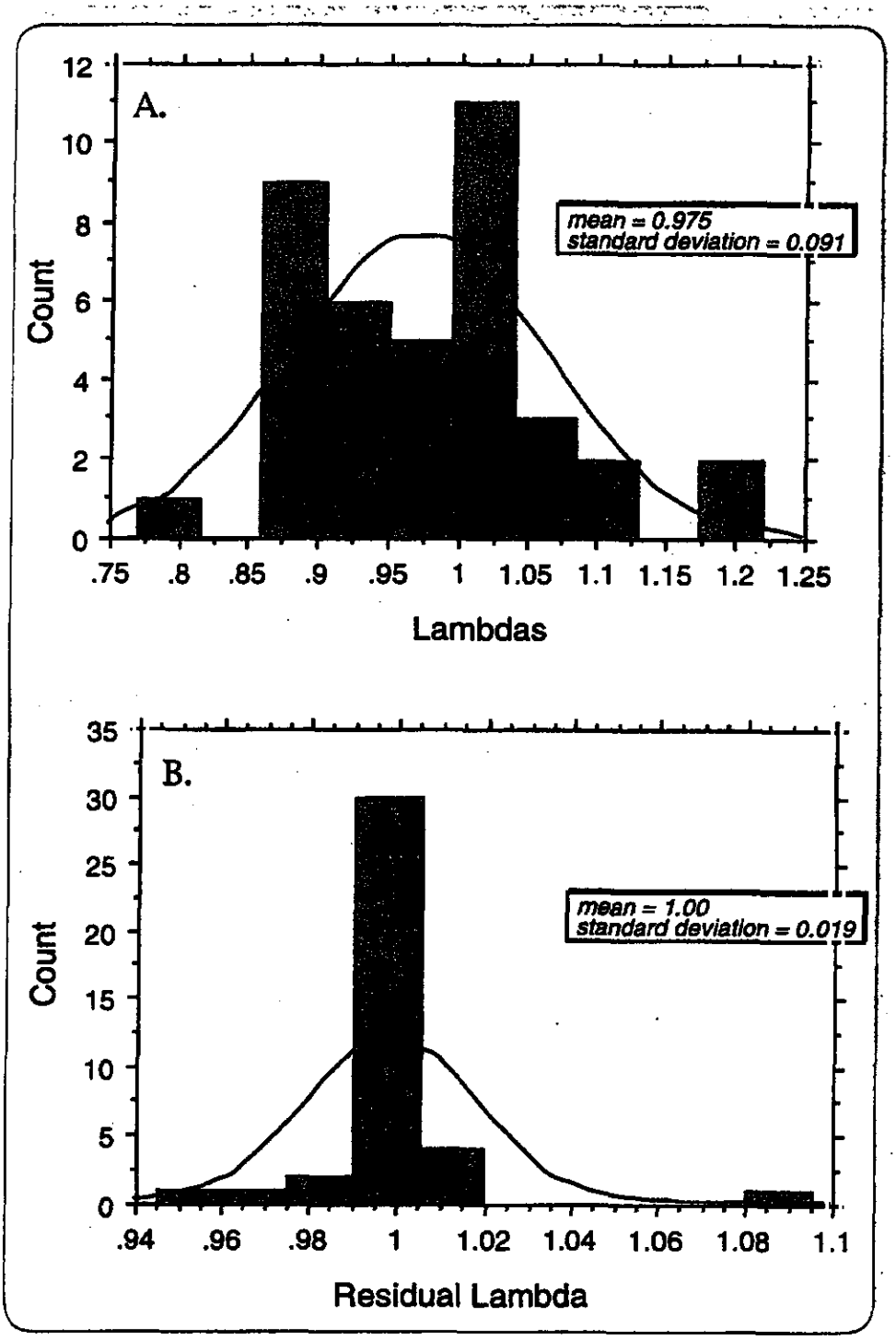


Figure C24. Frequency distribution of Lambdas for (A) all 39 Lambda estimations, and (B) for the residuals after variation due to site, time, and site * time interaction are removed.

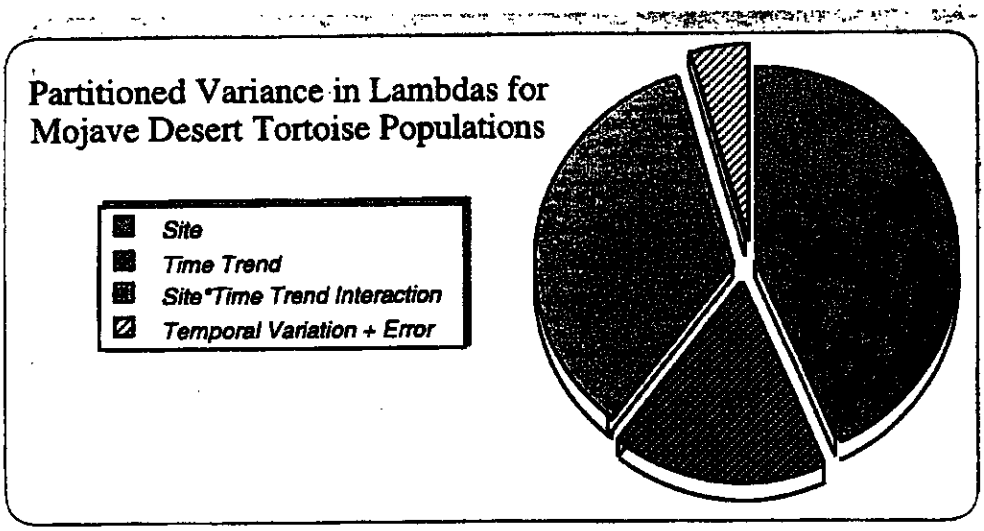


Figure C25. Proportions of variance around the mean lambda for 39 sites in California and Nevada.

When the "A" matrix (the transition matrix) is multiplied times a vector containing the number of tortoises in each of the five stages, the result is a new vector containing the numbers of tortoises in each stage one time step (one year) into the future. After many repeated time steps, the relative proportions of tortoises in each stage remains a constant, and the population is said to have reached a stable-age distribution. The stable-age distribution for an idealized population with the growth and survival characteristics of the Goffs population and the Lambda of the average population from the monitored sites is given in Figure C26. This stable-age distribution is similar to a collective size distribution assembled from data at several study sites in the Mojave and Sonoran desert tortoise populations (Figure C27). Moreover, when the data in Figure C27 are collapsed to a stage distribution and compared to the stage-based distribution assembled for the Goffs population (Turner et al. 1987, Burnham et al. 1987), it would appear that the Goffs population is typical of other desert tortoise populations (Figure C28).

The principal difference between the stage distributions in Figure C26 (simulated) and Figure C28 (observed in the field) is that the modeled distribution has a greater proportion of individuals in the hatchling and 1-5 year age classes than do the distributions from Goffs and the multi-site aggregate. While it is true that there are high levels of mortality at the younger ages (with only approximately 7% of all hatchlings surviving to the age of six years), the low proportions of young tortoises in the empirical distributions (Figure C28) more likely reflect the difficulties with locating very small tortoises in the field. Regardless, the proportion of individuals that are adults is very high: 42% in the simulated population and 60% in the empirical data sets.

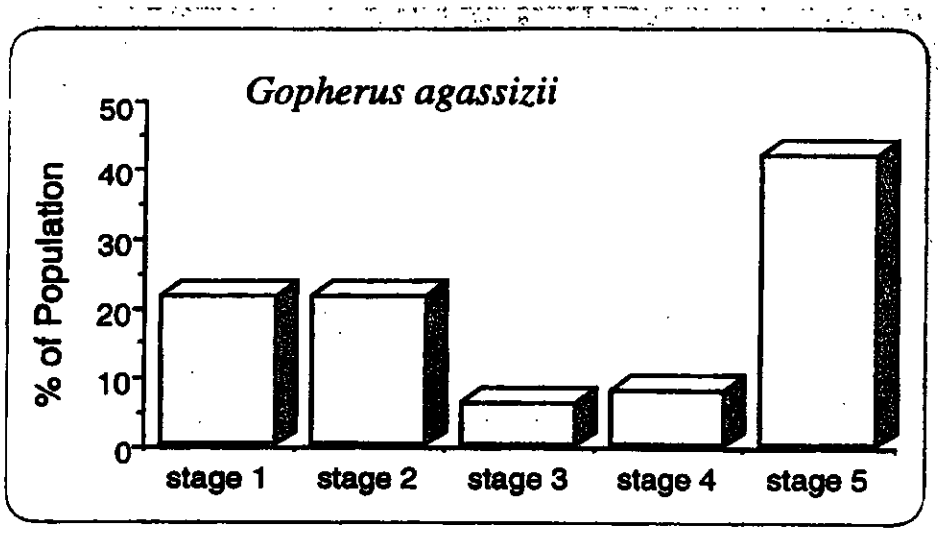


Figure C26. The proportion of individuals in each age stage of the modeled population when the population is in stable-age distribution.

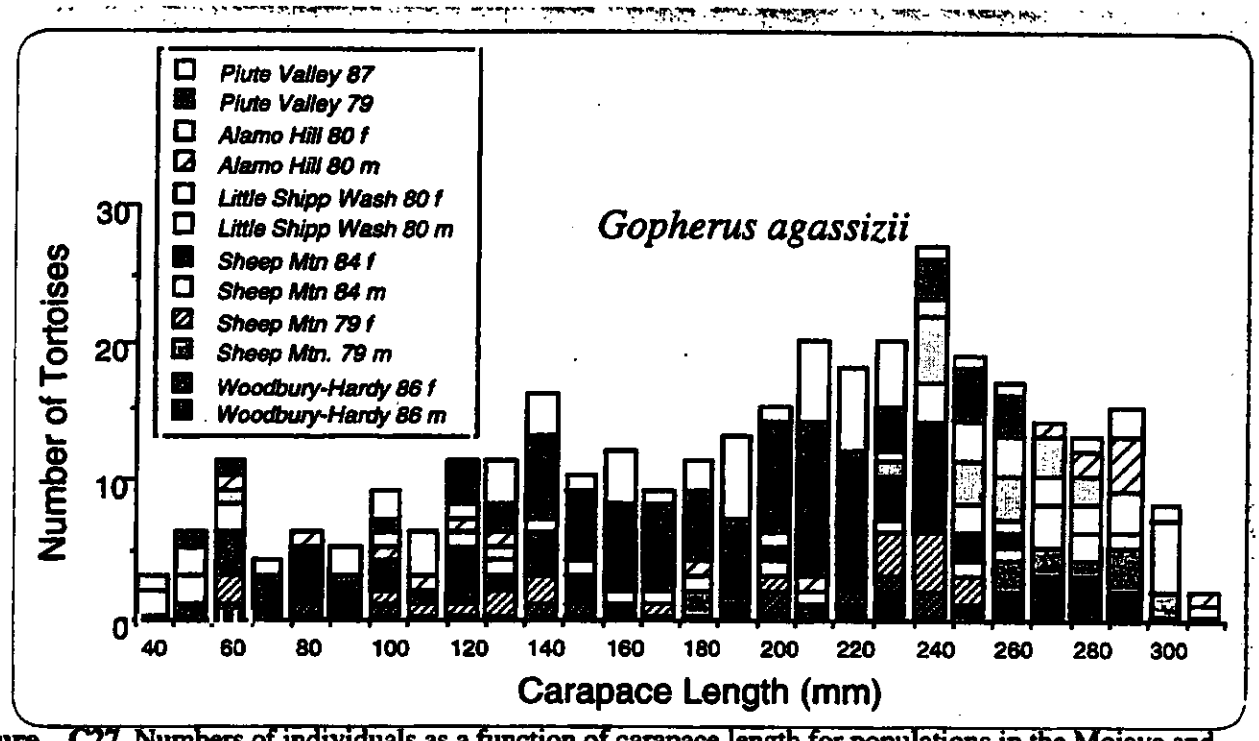


Figure C27. Numbers of individuals as a function of carapace length for populations in the Mojave and Sonoran deserts.

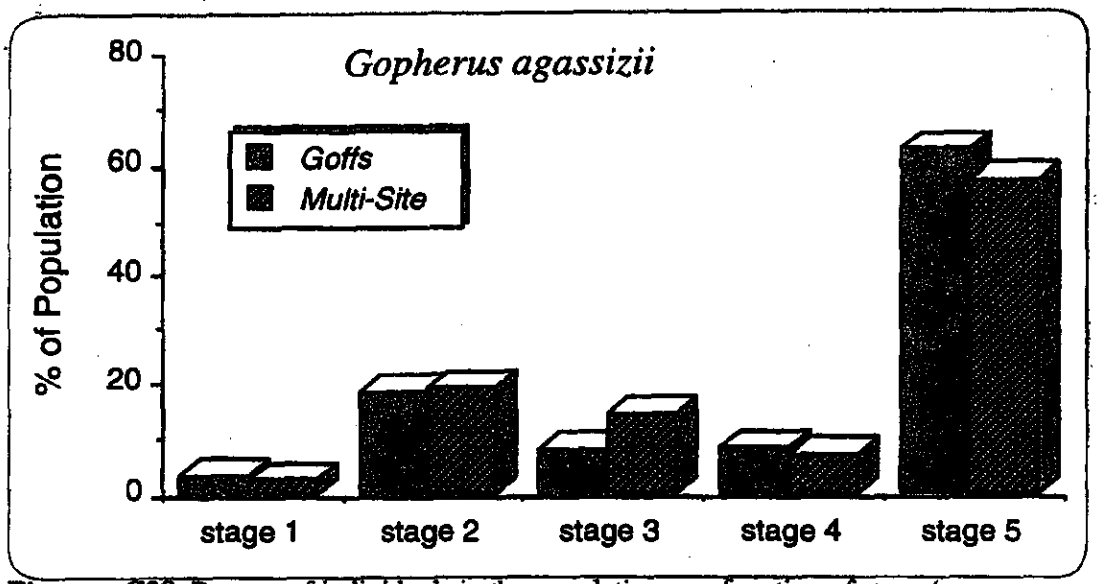


Figure C28. Percent of individuals in the population as a function of stage (age categories) for (a) the Goffs population (Turner et al. 1987, Burnham 1987), and (b) an aggregate of populations in the Mojave and Sonoran deserts.

Effects of Environmental Stochasticity. - Environmental stochasticity can cause population growth rates to vary from time to time and from locality to locality, and variable population growth rates can increase the probability of extinction. For example, a population could have a run of years with stochastic drops in population size until its density drops below a recovery threshold and it subsequently goes extinct.

Stochastic population growth was simulated with a "Monte Carlo" simulation, with lambda being drawn from a probability distribution with different means (all below 1.0 and including the observed mean of 0.975), and a standard deviation of 0.19 (the standard deviation due to random variation around population trends calculated from sampled populations; see Figure C24). An additional simulation was performed holding the mean lambda at 0.975 and using two different standard deviations around lambda (0.019 and 0.038). All simulated populations were started with different numbers of tortoises to assess the effect of mean lambda, standard deviation of lambda, and starting population size on the computed time to extinction (extinction was assumed to occur when the population reached two individuals).

Of course, all simulations with lambdas below 1.0 eventually go extinct. The time required to reach extinction theoretically is affected by both lambda and the stochastic variation around lambda (Figure

C29). However, the effect of the mean lambda was considerably greater than was the standard deviation around those means. The model's prediction that a population with a mean lambda of 0.975 (the observed mean of sampled populations in California and Nevada) could never persist for more than approximately 390 years (approximately 15 tortoise generations), regardless of the initial population size, was particularly disturbing.

Partitioning the variance in lambdas into its components was also instructive. The importance of within-population environmental stochasticity is trivial unless lambdas are close to 1.0. Even then, such populations are predicted to persist for a long time.

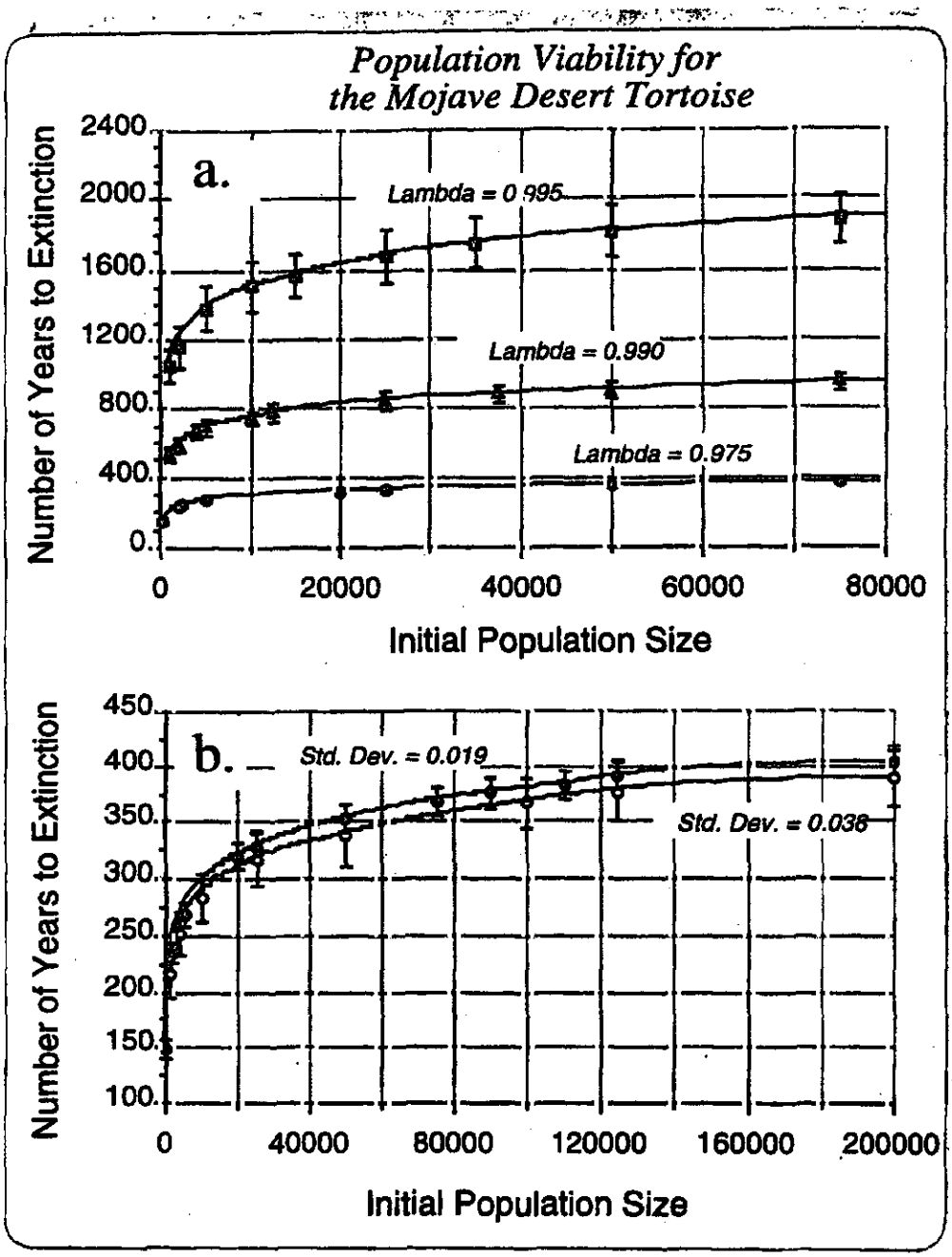


Figure C29. Results of a Monte Carlo simulation of the mean time to extinction for desert tortoise populations (a) as a function of lambda all with a standard deviation of 0.019, and (b) as a function of two different standard deviations at a lambda of 0.975 for populations starting at different initial sizes.

C. *The Peacock Model*

Projection Model. - Demographic data for the desert tortoise was entered into RAMAS/Stage, a single-species, stage-based model developed by Applied Biomathematics (Ferson, 1990). RAMAS simulates discrete-time stage-structured population dynamics. This model is used to predict the behavior of population trajectories (probability of extinction or population explosion) as influenced by demographic parameters and stochastic environmental variables. RAMAS is a modeling environment which allows the user to build a species-specific model using mathematical expressions based upon stage modeling theory (Lefkovitch 1965).

The effect of environmental variability on demographic processes was not measured independently for the desert tortoise; thus, the effect of stochastic environmental variation on population dynamics could not be modeled separately from demographic variation. Five life history stages were defined as in the Gilpin Analysis (see above) and the Tracy Analysis (see above): 1) hatchlings, 2) 1-5 year olds, 3) 6-10 year olds, 4) subadults, 5) adults or 17-100 year olds. Transition matrix variables: P_X (probability of remaining in a stage), G_X (probability of moving to the next older stage) and F_X (number of hatchlings produced by individuals surviving to the adult stage) were then used to simulate population growth over a 600-year period,

$$\mathbf{A} = \begin{pmatrix} P_1 & F_2 & F_3 & F_4 & F_5 \\ G_1 & P_2 & 0 & 0 & 0 \\ 0 & G_2 & P_3 & 0 & 0 \\ 0 & 0 & G_3 & P_4 & 0 \\ 0 & 0 & 0 & G_4 & P_5 \end{pmatrix}$$

Survival probabilities estimated from demographic data (Turner et al. 1987) were used to construct a transition matrix (Table C6). Because data on survivorship from the egg to hatchling stage are unavailable, F_5 was defined as the average number of eggs produced per adult female per year. (More properly, F_5 should be the number of hatchlings--which will always be lower than the number of eggs because not all eggs live to become hatchlings--but reliable data were not available.) Initial population size was modeled as 20,000 individuals; additional simulations were also conducted using starting populations of 40,000, 60,000, and 100,000 individuals. The initial stage distribution used for all simulations was based upon stable-age distribution generation by The Tracy Analysis (Figure C26).

Simulation Results. - The simulation of population dynamics over a 600-year period predicts a steady decline in the population

(Figure C30). With a starting population of 20,000, the total declines to 100 individuals by 327 years, 24 individuals by 400 years, and goes extinct (at one individual) at 553 years. Lambda averaged over the first 400 years of the simulation was 0.979. Abundances in each stage at 200, 400, and 600 years show a preponderance of individuals in stages 1 and 2 (Figure C31) with very low recruitment from stage 2 to 3 (although this result is likely due to the overestimation of recruitment of hatchlings into the population). A stable-stage distribution generated at the end of 200 years indicates that the adult breeding population would be reduced to 100 individuals. Although the total population was still relatively high (N=1400) after 200 years, a small breeding population (based upon the number of adults present) due to primarily to the low recruitment of individuals from stage 2 to 3, results in a potentially unstable population.

Population projections using starting populations of 40,000, 60,000, and 100,000 individuals show that after 200 years populations would be 200, 300, and 400 individuals respectively. By 400 years, all simulations, regardless of starting population size, produced populations of less than 100 total individuals and breeding adult populations of less than 10 individuals (Table C7). Given the current survival probabilities, desert tortoises would be extinct (fewer than one individual) in less than 600 years (Figure C32).

Table C6. The transition matrix used in population simulations, calculated using survival probabilities from Turner et al. 1987.

	Hatchlings	1-5	6-10	11-16	Adults
Hatchlings	0	0	0	0	5.8
1-5-year olds	0.36	0.619	0	0	0
6-10-year olds	0	0.057	0.6	0	0
11-16-year olds	0	0	0.085	0.806	0
Adults	0	0	0	0.126	0.925

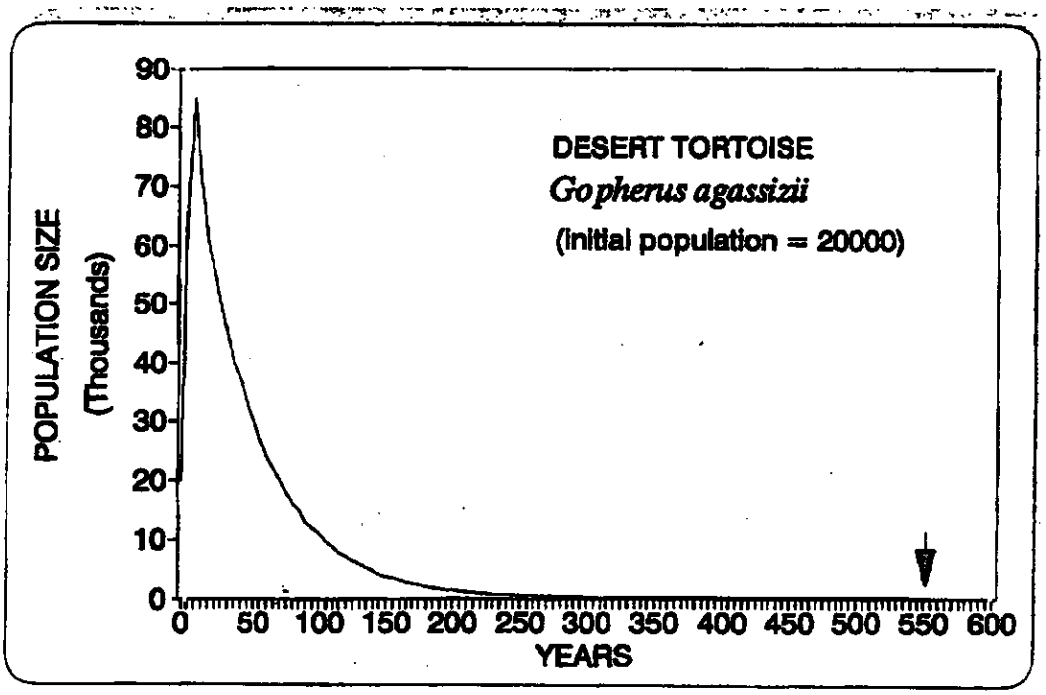


Figure C30. Population projection based upon survival probabilities for each stage (Turner et al. 1987). The starting population size was 20,000 individuals. The population goes extinct (at 1 individual) at 553 years.

Table C7. The total number of individuals remaining in the population given current survival probabilities after 200, 400, and 600 years of simulation. Simulations were conducted for populations with initial sizes of 20,000, 40,000, and 60,000, and 100,000 individuals.

Initial Size	200 y	400 y	600 y
20,000	1,400	24	0
40,000	2,900	48	0
60,000	4,300	72	1
100,000	5,700	96	1

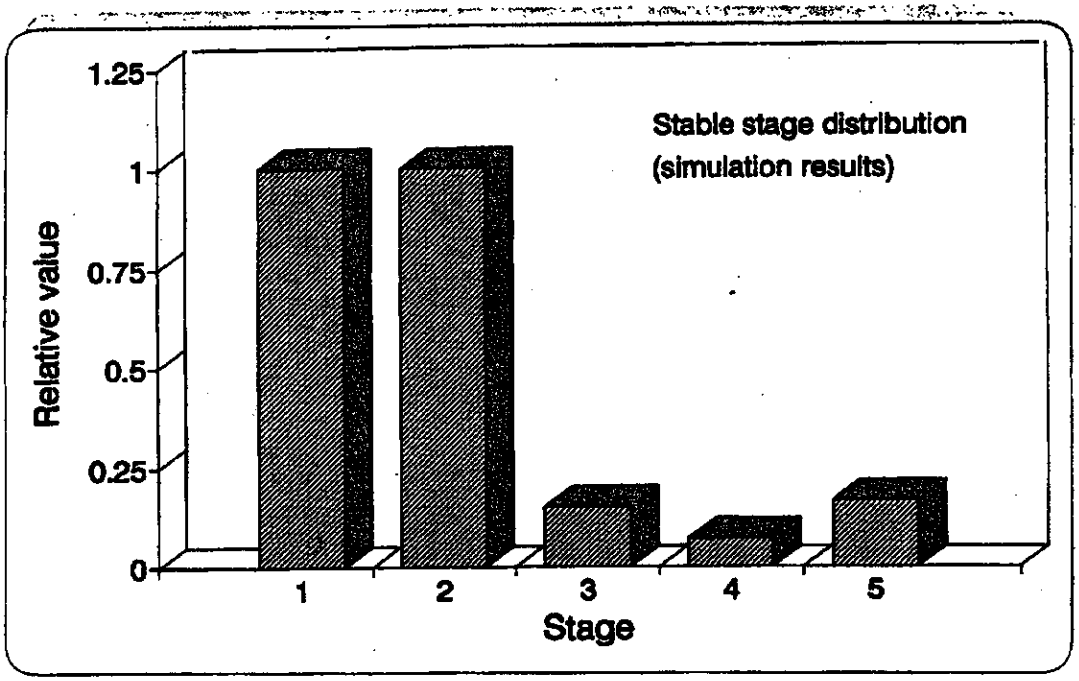


Figure C31. The stable stage distribution generated by the simulations.

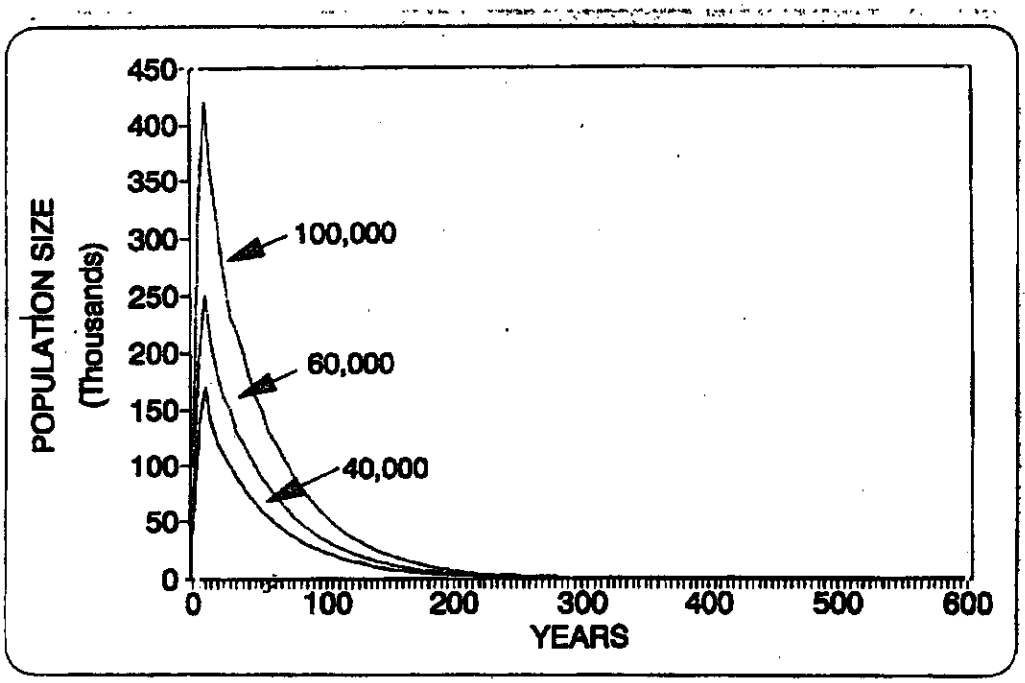


Figure C32. Population projections with starting populations of 40,000, 60,000, and 100,000 individuals. Regardless of starting size, all populations go extinct at the same time.

VII. Viability of the Mojave Desert Tortoise Population

Several criteria important to recovery and long-term persistence for the desert tortoise have been reviewed in this appendix. These include avoiding conditions for extinction (CFE) which are (1) demographic stochasticity, (2) social dysfunction, and (3) genetic deterioration. These CFEs are closely related to population density and population size. Therefore, the vulnerability of a population to these CFEs can be directly affected by two conditions: (1) extrinsic sources of mortality, and (2) the area occupied by the population. Any plan to recover the desert tortoise through the establishment of reserves must consider both the sizes of the reserves and controlling levels of mortality on the reserves.

Population Density and Size of Reserves

In Section 5 of this appendix it was shown that a minimum population density for desert tortoises is approximately 10 adults per square mile. Below this density there will be a high probability of demographic stochasticity, social dysfunction, and genetic deterioration. Section 4 of this appendix shows that a population of at least 5,000 tortoises (all age classes) is necessary to maintain sufficient genetic diversity for long-term evolutionary potential. Taken together, these two analyses indicate that an area of at least 500 square miles is necessary to maintain evolutionary potential at minimum density (Figure C32). In practice, reserves should be larger than this because acceptable tortoise habitat is patchy and not all areas are occupied. Thus, 1,000 square miles should be taken as the minimum size for a viable reserve based on these criteria.

Population Numbers and Size of Reserves

In Section VI. of this appendix it was shown that desert tortoise populations are extremely vulnerable when lambda decreases to low levels. For example, a population with a lambda of 0.975 will decrease to half its starting size in only 25 years. However, the time it takes a population with a lambda of 0.975 to decline to extinction depends most upon the size of the population before it begins its decline. For all populations with lambdas less than 1.0 there is a curvilinear relationship between mean time to extinction and initial population size (Figure C29). At population sizes exceeding 10,000 to 20,000 individuals, any further increases in population size do not greatly increase the time to extinction. That is, if variances in lambda due to year-to-year variation in population trends are small, very large populations do not have a much lower risk of extinction than do populations of approximately 10,000 to 20,000 individuals. However, the time to extinction for very small populations is strongly related to population size. If desert tortoise populations become smaller than 10,000 to 20,000 individuals, strict

management of extrinsic sources of mortality is required to prevent the populational lambda from falling much below 1.0. If this management is ineffective, the population will rapidly progress to extinction.

Taken together, these characteristics of desert tortoise population dynamics indicate two themes of major importance for recovery: (1) Reserves should be large enough to contain at least 20,000 individuals to buffer the population adequately from extinction vulnerability due to small size. (2) Populations must be managed to prevent lambdas from falling below 1.0 on average; otherwise the populations become extremely vulnerable to extinction. These themes translate directly to two management prescriptions: (1) Assuming that most current population declines will not be reversed until minimal viable density is reached (10 adults per square mile, Figure C33), reserves should be no smaller than 1000 square miles. (2) Sources of extrinsic mortality, i.e., the threats listed in Appendix D, should be reduced to the point that lambdas can reach at least 1.0. The precise means by which this can be achieved are given in the Recovery Plan section called, "Desert Wildlife Management Areas: Descriptions and Specific Management Recommendations."

Reserve Sizes in Relation to both Population Density and Size

Considerations of both minimum population densities and minimum population numbers indicate that reserves, or DWMAs, should be at least 1,000 square miles. When populations are well above minimum viable density (e.g., 30 or more adult tortoises per square mile) and lambdas can be maintained, on average, at 1.0 or greater through elimination of extrinsic sources of mortality, smaller reserves that provide high-quality, secure habitat for 10,000 to 20,000 tortoises should provide comfortable persistence probabilities for the species well into the future.

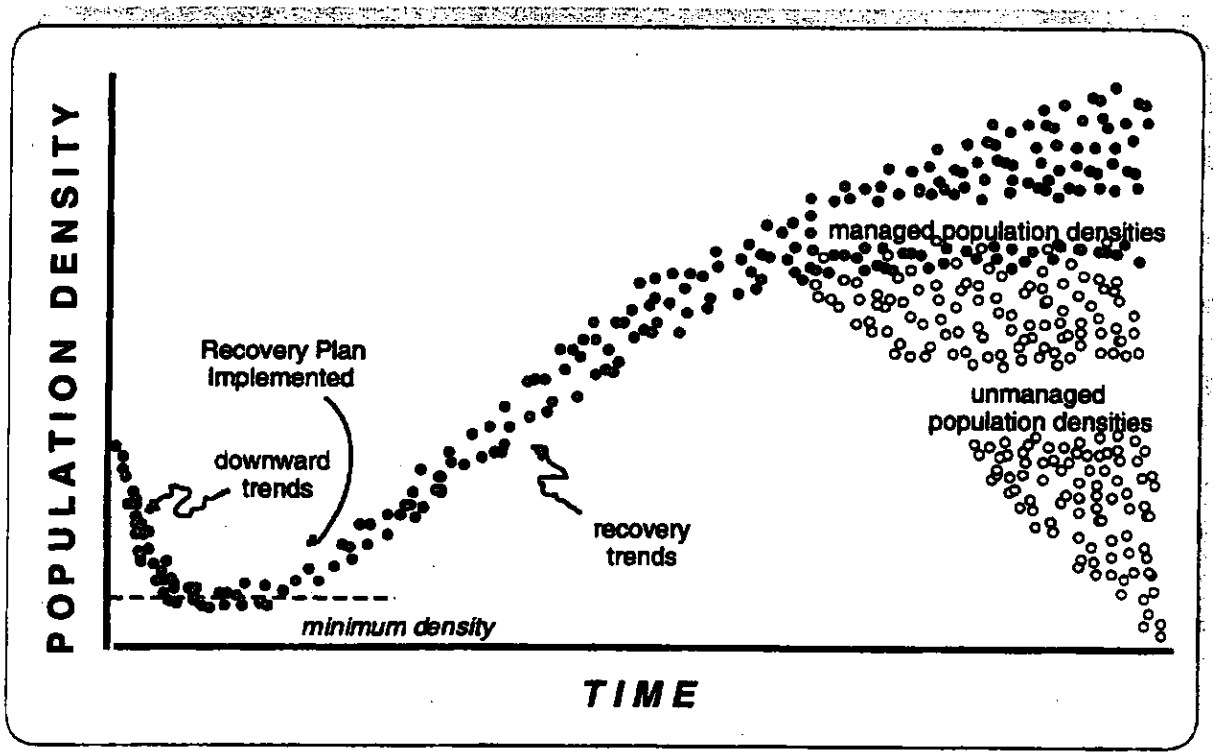
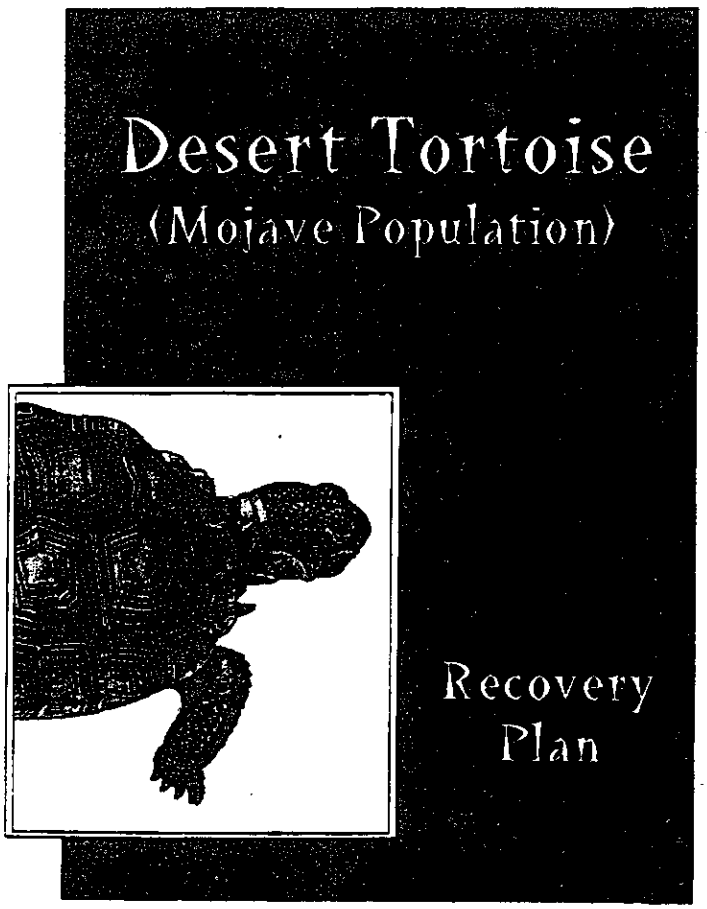


Figure C33. Idealized population densities as a function of time shown before, during, and after recovery. Downward trends are reversed at or near minimum viable density. Subsequently, the population "recovers" by growing significantly for 25 years. At that time, the population could continue to grow in response to good conditions created by proper management until (or if) the population reaches a "carrying capacity". After the population has become dense, the population might continue to grow, fluctuate around a high density, or, if management is relaxed, it may again decrease slowly.

Appendix D



Appendix D: Human Activities Which Directly or Indirectly Threaten Naturally-Occurring Populations of Desert Tortoises and Their Habitats in the 1990's

I. Introduction

The purpose of this appendix is to review, update, document, and summarize human-induced pressures operating on naturally occurring populations of desert tortoises in the Mojave and Colorado deserts. The appendix begins with a brief overview of prehistoric and historic trends in human-desert tortoise interactions both globally--relative to the entire tortoise family (Testudinidae), and regionally--relative to desert tortoises. This document focuses on demonstrated and probable threats to desert tortoise recovery areas. Where appropriate, records of specific threats to other chelonians are incorporated to establish their potential impact to desert tortoises. The collective, synergistic, and cumulative nature of threats is illustrated with a case study of progressive extirpation of desert tortoises in the Antelope Valley, California of the western Mojave recovery unit.

II. Methods and Sources of Data

The following resources were used, in descending order of confidence: (1) peer-reviewed journal articles; (2) published symposia and professional texts; (3) government agency reports and data; (4) environmental impact statements and related documents; (5) reports and commentaries of private consultants; and (6) properly attributed personal communications of qualified professionals and lay people.

We have drawn particularly on the following published or released surveys of human threats to desert tortoises: (1) California Statewide Desert Tortoise Management Policy (BLM and California Department of Fish and Game 1990); (2) Chapters 3, 4, 6, 8, and 10 of Berry (1984); (3) (Final) Cumulative Impacts Study on the Desert Tortoise in the Western Mojave Desert (Chambers Group, Inc. 1990b); and (4) "Assessment of Biological Information for Listing the Desert Tortoise as an Endangered Species in the Mojave Desert, A Predecision Document" (Fish and Wildlife Service

1990b). Also of interest were locally focused supplemental reports, e.g., Desert Tortoise Impacts Analysis (Lamb 1991) and the Short-Term Habitat Conservation Plan for the Desert Tortoise in Las Vegas, Clark County, Nevada (RECON 1991).

III. History of Human-Desert Tortoise Interactions

A. Prehistoric Accounts.

Prehistoric human predation on desert tortoises in California and Nevada was vigorous and widespread (Schneider and Everson 1989). Aboriginal groups that used desert tortoises included the Chemehuevi, California; Owens Valley Paiute and Mono, Tubatulabal, and Panamint Shoshoni, California; the Cahuilla in California; and Southern Paiute of Ash Meadows and Shoshoni of Beatty, Nevada. However, some aboriginal groups such as the Mohave had a "great aversion to eating desert tortoise and spoke in a derogatory manner about groups that did eat the animal" (Schneider and Everson 1989).

Human predation often involved well-developed techniques for hunting (Schneider and Everson 1989). For example, in Mexico, Seri Indians used dogs to locate desert tortoises, water to induce them to emerge from their burrows, and hooked probes for extracting them from their burrows. Papago Indians even developed protocols for roasting desert tortoise flesh (removing the plastron and inserting hot rocks). Hunting practices varied with both the location and chronology of the site.

Morafka (1988) reviewed the Late Quaternary prehistory of human-desert tortoise interactions globally, emphasizing data on the progressive extirpation of the bolson tortoise, *Gopherus flavomarginatus*. Human predation, which is still ongoing, appears to have had a pivotal role in reducing bolson tortoise distribution over the last 20,000 years.

B. Human-Tortoise Interactions and Human Cultures.

Globally, tortoises are preyed upon for a variety of reasons (Swingland and Klemens 1989). Swingland (1989) stated:

> In economic terms, the tortoise is an important part of rural dynamics, being used for food in most parts of the world, as a musical instrument (maracas and banjo), as a scoop or water bail in boats, and canned as meat in parts of the Mediterranean. The adults are often kept in village pens for food and as a source of hatchlings, which are becoming a new economic product of this traditional habit.

The traditions of developing countries may seem tangential to a review of threats to desert tortoises posed by human actions in the southwestern United States, but in fact many former residents of these areas are bringing their traditional practices with them as they immigrate to the pluralistic societies of Los Angeles, Las Vegas, and elsewhere in the West.

Highway mortalities and habitat modification and fragmentation have critical negative impacts on terrestrial turtles in the more industrial societies (Swingland and Klemens 1989). Most authors of species accounts in Swingland and Klemens' book described similar threats. For example, Klemens (1989) described problems faced by emydid turtles in New England, a region subject to the kinds of development which now increasingly characterize Mojave Desert landscapes.

Nowhere are the correlations with human influences more pronounced than in the history of the insular tortoises of Madagascar and the adjacent western Indian Ocean. More than a dozen putative taxa of giant tortoises once occurred in this region (Arnold 1979). Of these, all but a single population of the species *Geochelone gigantea* were apparently driven to extinction by the direct or indirect impact of abrupt human colonization. The chronology of these human colonizations and resulting tortoise extinctions were strikingly correlated. Interestingly, similar extinctions were not observed on the adjacent African mainland where more than half a dozen tortoise taxa of varying sizes have occurred sympatrically with hominoids for tens of millions of years. Perhaps the continued existence of the mainland tortoise species can be explained by long-term associations with hunter-gatherers in complex and relatively stable relationships. In contrast, the sudden appearance of humans, especially in the simplified and isolated ecosystems of oceanic islands, had a much more catastrophic impact on tortoises and their habitats.

IV. Human-Induced Threats to Desert Tortoises

A. Deliberate Removal of Desert Tortoises by Humans.

1. Predation for food. The use of tortoises for food was historically the primary motive for collections on a global scale (Swingland and Klemens 1989) and regionally for desert tortoises in the Great Basin and southwestern deserts (Schneider and Everson 1989). Many cultures have engaged in both individual and commercial exploitation of desert tortoises as food items (Berry and Nicholson 1984b). Commercial exploitation has included export of desert tortoises from the Mojave Desert to restaurants in Los Angeles, the Central Valley, and elsewhere in the West. Such practices continue today. Meat markets which offer live aquatic turtles still exist in some areas of metropolitan Los Angeles--Monterey Park for example. Asian nationals were arrested in two separate incidents for taking over one dozen desert tortoises from the Western Mojave Desert for food and ceremonial purposes in 1991 and 1993 (Ditzler 1991, BLM files).

2. Collection and commercial trade for pets. This threat is similar to, and may not be clearly separable from, collecting desert tortoises for food or other purposes. Collections for pets and the commercial trade were undoubtedly of importance in the past (Berry and Nicholson 1984b). Commercial collecting of desert tortoises continued to be significant into the 1970's, even though full legal protection was extended to the species in California by 1961 (St. Amant 1984). Intense collecting of desert tortoises occurred well into the 1960's in the Jawbone Canyon region of Kern County, California (David J. Morafka, pers. comm.). Dr. A. D. Stock (University of Nevada, pers. comm. to D.J. Morafka) similarly recalled fairly intense commercial collecting of desert tortoises and Gila monsters (*Heloderma suspectum*) in the Beaver Dam Slope region of southwestern Utah. Two instances of commercial collecting in Nevada were documented in 1982 and 1983 (Berry and Burge 1984). In one case, more than 30 wild desert tortoises were taken to Alabama.

In spite of Federal and State listings, commercial collecting still occurs. Felicia Probert, a BLM District Ranger in Riverside, California, described an ongoing case involving the attempted sale of desert tortoises in 1990, at a Barstow gas station. An arrest warrant was issued, but the suspect apparently fled the country to avoid prosecution. Other cases provide circumstantial evidence of large-scale take. For example, a substantial decline in subadult and adult desert tortoises occurred between 1982 and 1987 at the Kramer Hills study site in California, without any evidence of mortality (Berry 1990, as amended). Within the same time frame, signs of human excavation of desert tortoises burrows were observed near the study site (A.P. Woodman pers. comm.), and a sheepherder reported to a BLM employee that he saw a truck containing over a

dozen desert tortoises at nearby Kramer Junction (Berry 1990, as amended).

Families and individuals still collect desert tortoises for personal pets, especially when they are found on roads. This threat is serious in areas with high visitor use and is, surprisingly, even operative in remote desert areas. Three examples of desert tortoises taken from research sites (and, in some cases later recovered) provide an indication of the extent of the threat. During studies conducted from 1987 to 1991 near Kramer Junction in the western Mojave Desert, two of 16 desert tortoises with radio transmitters were lost to poaching; five others may have also been poached (Stewart 1991). This area experiences human traffic of more than 500 visitors/mi^2 per year. In another example, one of a few dozen desert tortoises with transmitters was removed from a study site in the Ward Valley, California in summer of 1990 (A. Karl pers. comm.). The site is in an area with fewer than 100 visitor-use days/mi^2 per year. The transmittered desert tortoise was recovered at a motel parking lot in Bullhead City, Arizona. In Nevada, one of 78 desert tortoises (1.3%) marked in 1986 at the BLM's Coyote Spring Valley study site was found as a captive in the Las Vegas Valley a few years later (Betty L. Burge, per. comm.). This site is in a relatively remote part of Nevada and has few human visitors.

Naturalists at the Desert Tortoise Natural Area in eastern Kern County, California described probable illegal take during spring (Howland 1989, Ginn 1990, Jennings 1991). Additional information is also available from personal discussions between agency biologists and the public by phone, at meetings, or in government offices. Each year, Berry (pers. comm.) receives several accounts from individuals who describe "saving" desert tortoises from traffic on highways. Most such desert tortoises are either inappropriately released or retained in captivity.

The threat of collections should not be underestimated and will continue to remain high for three reasons. First, most new arrivals to the Southwest are unaware that desert tortoises are protected. Second, the presence of law enforcement officers in open desert lands is inadequate. And third, commercial poaching of rare, threatened, and endangered species is well documented, and in some cases, a lucrative business (Reisner 1991, Poten 1991). Reisner (1991), who presented a powerful documentary of the effects of poaching on alligators, pointed out that many wildlife biologists tend to attribute population declines to habitat loss, when illegal collections are a major factor.

B. Vandalism.

Shooting and vandalism play a major role in losses of desert tortoises in many areas, particularly where human visitation is high (measured in visitor-use days/unit area per year). Deliberate

shooting of desert tortoises or crushing them with vehicles has been documented (Berry 1986a, Berry and Nicholson 1984b; Michael Coffeen, BLM, Glenallen, Alaska, pers. comm.). Acts of vandalism have also included beheading, severing of body parts, and overturning. At the BLM's western Mojave Desert study plots, 14.6% to 28.9% of all desert tortoise carcasses bore evidence of gunshots, whereas carcasses from the less-visited eastern Mojave Desert yielded gunshot frequencies of 0% to 3.1% (Berry 1986a). Fencing the Desert Tortoise Natural Area did not effectively reduce the frequency with which carcasses bearing gunshot holes were encountered, at least in the vicinity of the interpretive center (Berry and Shields et al. 1986). The highest rate of vandalism was recorded in the Fremont Valley, where 40.7% of desert tortoises found dead between 1981 and 1987 showed signs of gunshots and other vandalism (Berry 1990, as amended).

In 1991, local residents of Mesquite, Nevada, and St. George, Utah, threatened to undertake "reprisal" killings of desert tortoises in response to the recent Federal listing, economic hardships, and perceived loss of local self-government (Tim Duck, BLM, St. George, Utah; pers. comm. to David J. Morafka). Residents threatened to shoot desert tortoises or flip them over to immobilize them.

Desert visitors also harass desert tortoises. Three incidents of harassment occurred at the Desert Tortoise Natural Area in the spring of 1990 when visitors handled wild desert tortoises (Ginn 1990). In one case, a group of adults from France poked a desert tortoise with a stick. Jennings (1991) described the trampling of a burrow by a visitor.

People who vandalize desert tortoises are difficult to identify and classify, thus increasing the problem of apprehending and educating them. Some who are suspected of shooting desert tortoises claim to be hunting rabbits, but such "hunters" are regarded as "plinkers" by legitimate hunters. In general, "...illegal hunters face little threat of arrest from the thinly spread force of ... federal and state wildlife enforcement officers" (Satchell 1990). While no law enforcement officer has caught a person in an act of vandalism to desert tortoises since the species was federally listed in August of 1989, the threats and actual mortalities from such acts remain high in many areas.

C. Deliberate Manipulation of Desert Tortoises by Humans.

1. Relocation and translocation. Relocation can be defined as "... moving an animal or population of animals away from an area where they are immediately threatened...to an area where they would be less prone to habitat loss..." (Dodd and Siegel 1991). Past relocations of desert tortoises were frequently motivated by sincere attempts at conservation, but their results have been both

varied and disappointing, so much so that poorly planned and executed relocations should be treated as a threat.

Several factors are likely to contribute to low success rates of relocations: (1) the tendency of the released desert tortoises to travel or wander from the site or attempt to return home; (2) increased vulnerability to predators; and (3) the potential for agonistic responses from resident or host desert tortoises (Berry 1986b, Stewart 1991). Significantly higher mortality rates were recorded for relocated desert tortoises than in the host or control population in a 1990-1991 relocation project (Weinstein 1992). The higher mortality rates did not appear to be associated with higher rates of predation or availability of food and water.

The potential for introducing or spreading diseases must not be overlooked. Diseases such as URTD pose a grave threat to wild populations, especially because such a significant proportion of ill desert tortoises are asymptomatic (Brown et al. 1992, Jacobson 1994). Diseases such as URTD may be passed from mother to offspring through the eggs and from male to female through seminal fluid.

Illegal relocations by local desert residents and visitors occur frequently and must be treated as an ongoing threat. Such activities have been best documented at the Desert Tortoise Natural Area in eastern Kern County, California (Howland 1989, Ginn 1990, and Jennings 1991), but are by no means limited to that site. For example, illegal releases or attempted releases of six wild desert tortoises were recorded in 1990 elsewhere in California (Ginn 1990, Gilbert Goodlett, BLM files).

2. Release of captive desert tortoises. Captive releases pose numerous problems to their wild host populations, not to mention the inhumanity of placing animals which have been provided with water, food, and shelter on a regular basis into a hostile environment. Examples of areas of concern include genetic pollution, the potential for introducing or spreading disease, and disturbance to the social structure of the host population. In terms of genetics, the most potentially disruptive releases into the Mojave region would be the introduction of Sonoran Desert tortoises or Texas tortoises (Gopherus berlandieri), which are reported to hybridize with desert tortoises in captivity.

Release of captives has been, and continues to be, a problem (Jacobson 1993). The California Department of Fish and Game released thousands of captives and has formal records for over 800 releases undertaken in the 1960's and 1970's (Berry and Nicholson 1984a). In the 1970's, California Department of Fish and Game also set up a program to rehabilitate captive desert tortoises and prepare them for return to the wild through quarter-way and half-way house projects. Of more than 200 individuals exposed to the desert transitional pens, only 15% survived more than a few years. About 30 of the survivors, some of which were apparently ill with

URTD, were subsequently released in Antelope Valley (Cook 1983).

Information on the prevalence of released or former captive desert tortoises in wild populations can be derived from several sources. For example, a single captive release was found among 45 wild desert tortoises registered during a formal survey in the Black Mountains, Mojave County, Arizona (Hall 1991). In the Las Vegas Valley in 1990, 13 (1.5%) captive desert tortoises were found among a sample of 842 wild desert tortoises collected from private parcels of land (Hardenbrook and Tomlinson 1991). Ten of the 13 captives were found in close proximity to urban development. Naturalists at the Desert Tortoise Natural Area in California intercepted people in the process of releasing captives and discovered recently released captives (Howland 1989, Ginn 1990, and Jennings 1991). Howland (1989) reported illegal releases and an attempted release of five desert tortoises, three of which showed signs of URTD. Jennings (1991) recorded two such instances. Released captives may introduce infectious diseases, including URTD, to wild populations (e.g., see Berry and Slone 1989, Jacobson 1993). In the Mojave population, the outbreak and incidence of URTD appears to be closely correlated with known and suspected release sites for captives, as well as with the proximity to urban development and degree of human access (e.g., Hardenbrook and Tomlinson 1991, Jacobson 1993, and Tomlinson and Hardenbrook 1992).

V. *Human-Induced Habitat Alterations Coupled with Losses of Desert Tortoises*

A. *Urbanization.*

Many terrestrial chelonians are affected by habitat destruction and fragmentation resulting from urbanization (Swingland and Klemens 1989, Klemens 1989). In addition, populations of chelonians are often depressed in the vicinity of roads as a result of animals killed by vehicles or collected by visitors.

The portions of the desert Southwest occupied by desert tortoises have experienced episodic human settlements since the mid to late 1800's. A checkerboard or braided pattern of public and private lands has encouraged patchy development. Current areas of rapid development include, but are not limited to, the Antelope, Peerless, Fremont, Indian Wells, Lucerne, Yucca and Victor valleys of the western Mojave Desert; the Mojave River Valley of the western and central Mojave; Las Vegas and Virgin River valleys, and the towns of Mesquite, St. George, and Searchlight in the eastern Mojave Desert; Laughlin, Bullhead City, Lake Havasu City, Parker, and

Blythe along the Colorado River; and parts of the Chuckwalla Valley (Berry 1984a).

Tierra Madre (1991) provided careful documentation for the current status of desert tortoises for about 225 square miles in the City of Lancaster and surrounding areas. Surveyors walked transects and recorded desert tortoise sign on 90 square miles of undeveloped, nonagricultural lands. Three desert tortoise carcasses and a single live desert tortoise (observed in 1983) were the only remaining records of the presence of this once common species. Within the City limits and the general planning area, evidence of sheep grazing, shotgun shells and rifle cartridges, trash, litter, ORV tracks, domestic canines, unimproved roads, and ravens were recorded in over 50% of the transects. The lack of desert tortoise sign was attributed in part to these disturbances. Roughly a third of the area was found to be no longer suitable for desert tortoises (Tierra Madre 1991).

Desert tortoise populations have virtually been extirpated to the south of the City of Lancaster (Judy Hohman, Fish and Wildlife Service, Ventura, California, pers. comm.). Occasional desert tortoise sign is still observed east of Palmdale, but not in Palmdale west of Hwy 14 (Palmdale Freeway) or south of Hwy 138 (Pearblossom Highway). No signs of desert tortoises were found in a survey of 68 square miles of northeastern Palmdale and at Saddleback Butte State Park (Feldmuth and Clements 1990).

Las Vegas illustrates regional trends for future growth in the eastern Mojave Desert. The City is projected to increase in population by more than 100%, from 674,000 in 1988 to 1,400,000 in 2030 (Clement Associates, Inc. 1990). Numbers of visitors are expected to similarly increase. The City of St. George, Utah, may increase in population by as much as 1000% in the next 35 years. In addition, the Southern California megalopolis is spreading north and east from metropolitan Los Angeles into the deserts of Kern, Los Angeles, San Bernardino, and Riverside counties. The desert portion of San Bernardino County, with a 1984 population of 192,100, is projected to reach 441,800 (a 230% increase) by the year 2010.

In the Colorado Desert, the Coachella and Imperial valleys are centers for continuing urban and agricultural growth, a process which dates back to the turn of the century (Berry and Nicholson 1984b). Here, most development does not impinge directly on important desert tortoise habitats. However, the proposed transfer of urban-generated wastes to desert landfills via rail through the Chuckwalla Bench Area of Critical Environmental Concern (RECON 1991) and the new prison in the Chuckwalla Valley bring urban threats to portions of the Colorado Desert.

Urban environments have indirect impacts on desert tortoise populations and habitat at their interface with the desert (Berry and Nicholson 1984b, Berry and Burge 1984, Lamb 1991). Dogs range

into the desert, often for several miles (see Predators: Non-natives). Unauthorized collecting of desert tortoises, dumping of trash, and removal of vegetation are common near urban development. Children and adults shoot firearms and use ORVs indiscriminately adjacent to towns. For example, Lamb (1991), in discussing ORV/off-highway-vehicle use in the eastern Mojave, reported that the "...greatest amount of unauthorized off-highway vehicle use occurs around urbanized areas such as Beaver Dam, Windy Acres, and Mesquite, Nevada."

B. Agriculture.

Agricultural development yields disturbance patterns similar in distribution and extent to urban development. However, no future projections for agricultural growth can rival the rates for urban centers. As of 1980, about 3,000 square miles of desert tortoise habitat had been developed for agricultural use in California, especially in the Antelope, Victor, Lucerne, Coachella and Imperial valleys, and around the Cantil-Koehn Dry Lake region (Berry and Nicholson 1984b). Other areas that have experienced additional development since 1980 include the Cadiz and Chuckwalla valleys and parts of the Colorado River Valley near Blythe in California (Berry and Nicholson 1984b); and Mesquite and the Virgin River Valley in Nevada, Arizona, and Utah (Lamb 1991).

Most agricultural developments, such as alfalfa farming, draw water from local or regional ground water aquifers and require clearing of native vegetation, plowing of previously undisturbed soils, and applications of pesticides and/or fertilizers. All such activities either kill desert tortoises directly, obliterate their habitats, lower primary productivity, or otherwise negatively impact wildlands. Even fields long fallow contain pesticides and fertilizers, along with compacted and disturbed soils. Old fields are often invaded by Mediterranean and Asian weeds and become sources of seeds. For example, Russian thistles blow from adjacent agricultural fields at Cantil into the Desert Tortoise Natural Area in eastern Kern County, California, where they are becoming established (BLM and California Department of Fish and Game 1988).

Desert tortoise deaths occurred as a result of jackrabbit poisoning in the Cantil, California, farming area in 1952 and 1953 (Berry and Nicholson 1984b). Populations of the marginate tortoise (*Testudo marginata*) are adversely affected in agricultural areas in Greece, where they are killed by machinery and herbicides (Stubbs 1989a). The Egyptian tortoise (*T. kleinmanni*) is also threatened by agriculture, related human settlements, dogs, and corvids (Mendelssohn 1990).

Pumping of ground water for agricultural and urban developments has caused local and widespread depression of the water table in numerous valleys and basins within desert tortoise habitat (see Berry

and Nicholson 1984b). For example, in the western Mojave Desert, depressions in the water table at Koehn Dry Lake and adjacent Fremont Valley were evident from the 1950's to the 1970's due to pumping of ground water from deep-water wells for cotton and alfalfa farming (Koehler 1977). Depression of the water table resulted in the death of mesquite trees along the edge of Koehn dry lake. By 1983, large fissures, which can function as giant pit-fall traps, formed in the earth. One such fissure was a mile-long, 15- to 20-feet deep, and varied from 6 inches to 50 feet in width. Similar fissures occurred at Rogers Dry Lake on Edwards Air Force Base in 1990-1991.

C. Garbage, Trash, and Balloons.

Turtles and tortoises are known to eat foreign objects, such as rocks, balloons, plastic, and other garbage (John Behler, Chairman of the Freshwater Turtle and Tortoise Group, Species Survival Commission, International Union for the Conservation of Nature, and New York Zoological Society, pers. comm; Karen Bjorndahl, pers. comm.). Such objects can become lodged in the gastrointestinal tract or entangle heads and legs, causing death. A desert tortoise was observed consuming trash from an abandoned campsite and fire ring adjacent to the Desert Tortoise Natural Area in 1991 (BLM files for Site 4, Desert Tortoise Natural Area Interpretive Center). Burge (1989) has found metal foil and glass chips in scat of wild desert tortoises. She also discovered a desert tortoise entangled by a rubber band caught in the mouth and around the forelegs. In still another case, string, which was caught around a desert tortoise's leg, resulted in the eventual amputation of the limb.

Unauthorized deposition of refuse occurs close to towns, cities, and settlements in remote, inaccessible areas. Remnants of 130 balloons were found on a square-mile study plot in the Lucerne Valley in 1990 (southern Mojave Desert, California), which is about 9 miles from the nearest town. Only one of the 130 balloons was a weather balloon; four were message balloons; and the remaining 125 were individual balloons, possibly released by children at schools during fairs or other celebrations. Balloons are found on study plots in remote parts of the eastern Mojave and Sonoran deserts also. Burge (1989) described how she answered letters and notes attached to balloons and learned that some balloons were released 100 to 200 miles from landing sites. Refuse such as bicycle tires, chains, lawn clippings, sheet rock, and more recently, plastic bottles with toxic wastes are not unusual sights. On the Ward Valley study plot in the northern Colorado Desert, California, bags of garbage apparently dropped from an airplane were found (Burge - BLM field notes).

D. Mortality and Collections Associated with Freeways, Highways, Paved and Dirt Roads, and Railroads.

Impacts of roads on desert tortoise populations are well documented in California and can be assumed to similarly affect desert tortoises elsewhere. Desert tortoises are frequently killed or collected on freeways, paved highways and roads, and dirt roads, resulting in depletion of adjacent populations (e.g., Boarman et al. 1992). A significant and parallel pattern of loss in terrestrial wood turtles (*Clemmys insculpta*) and box turtles (*Terrepene carolina*) was noted in southwest New England where a growing number of roads and highways have fragmented wood turtle habitat (Klemens 1989).

Desert tortoise populations are depleted up to a mile or more on either side of roads when average daily traffic is greater than 180 vehicles (Nicholson 1978a, 1978b). Numbers of juvenile desert tortoises on permanent study plots in California were significantly lower adjacent to well-used dirt and paved roads (Berry and Turner 1984). Significant differences in desert tortoise densities were also documented adjacent to Highway 58 in San Bernardino County, California (Boarman et al. 1992). Based on desert tortoise sign, a similar situation occurs along Highway 395 (LaRue 1992). The breeding cohort of desert tortoises was severely depressed on a U.S. Ecology study plot about 2 miles from Interstate 40 in eastern San Bernardino County, California (Karl 1989, and in Dames and Moore 1991). Even dirt roads with relatively low vehicle use can contribute to depressions in local desert tortoise densities (Berry et al. 1986a).

Railroads are similar sources of mortality for desert tortoises and other chelonians (U.S. Ecology 1989, Dames and Moore 1991, Mount 1986). Desert tortoises can get caught between the tracks, overheat, and die or be crushed on the tracks by trains. Railroad workers have reported finding dead desert tortoises between the tracks (U.S. Ecology 1989). Desert tortoise populations adjacent to railroads are probably depleted in the same way that desert tortoise populations are diminished adjacent to well-used dirt or paved roads. The effects of railroads on desert tortoises was examined at the U.S. Ecology study plot; however, the effects of the railroad could not be separated from the effects of the adjacent Goffs Road (Dames and Moore 1991).

E. Mining, Minerals, and Energy Development.

Exploration and extraction of locatable minerals, fossil fuels, geothermal resources, and other types of mineral resources occur in most desert tortoise habitats. The potential for fragmenting DWMAs with small and large disturbances from mining and mineral exploration and extraction is high for some areas and moderate to low for others. The types of impacts are numerous, including: (1)

cross-country travel by vehicles during the exploration phase; (2) construction of roads; (3) disturbance of the soil surface and vegetation for access to the mineral resources (shafts, mill sites, open pits, placer diggings, tailings, leach pits, etc.); (4) production of toxic products or byproducts; (5) development of small towns and settlements to support large mines; and (6) temporary (short- or long-term oil and gas leases) or permanent transfer of title of public lands to the private sector, and (7) refuse of stakes and wire from seismic testing.

Examples of the above-listed problems, including large-scale destruction of desert tortoise habitat, are obvious in the western Mojave Desert with the mining of gold, tungsten, and borax in the Rand Mountains, Atolia, and Boron, respectively. The new cyanide heap-leach process for obtaining gold has initiated a new era in surface disturbance throughout the Mojave region.

As of 1991, leasing for oil and natural gas exploration and development was less common in the Mojave region than development of hard-rock minerals. However, it is nonetheless a substantial threat. Major exploration in the 1970's in the Ivanpah Valley left behind an uncapped well, peripheral unmitigated damage to the habitat, and an unauthorized road (Berry and Nicholson 1984b). During the 1980's, several areas of 0.5 to a few acres were cleared and/or damaged by exploratory oil and gas wells in the proposed Fremont-Kramer DWMA. At one site, an ORV trail was established, mud was dumped from the well over several hundred square feet, and additional surface area was cleared and compacted to construct temporary living quarters (BLM files).

F. Utility and Energy Facilities and Corridors.

Most proposed DWMAs have one or more pole or power lines, natural gas pipelines, fiberoptic cables, and/or communication sites. In some States, the localities for utility and energy corridors are specified in land-use plans (e.g., BLM 1980). Construction, operation, and maintenance of facilities usually involves clearing of land, creation of access routes, and generally large-scale disturbances. Vegetation is removed or degraded, soils are disturbed, and trenches are dug. Disturbances are usually linear in nature and are similar to those described above for urbanization, agricultural uses, and roads.

The zone of disturbance in utility corridors can gradually increase from 50 to 100 feet to several hundred yards as the number of transmission lines increases. Natural gas pipelines are similar: the area of disturbed soils devoid of vegetation can be 125 feet or more in width.

The potential for utility lines and energy corridors to fragment habitat is obvious; less obvious are impacts that occur during

construction and from long-term maintenance. For example, the temporary opening of deep trenches for pipelines can form significant "pit traps" into which desert tortoises may fall (Olson et al. 1992, S. Hale, pers. comm.). Towers supporting transmission lines also provide predatory birds with new perching and nesting sites which are otherwise scarce in the generally treeless habitat of the Mojave region (see Predators: Native, below).

G. Military Operations.

Impacts to desert tortoises and their habitats caused by military activities fall into at least four categories: (1) construction, operation, and maintenance of bases and support facilities (air strips, roads, etc.); (2) development of local support communities, including urban, industrial, and commercial facilities; (3) field maneuvers; including tank traffic, air to ground bombing, static testing of explosives, littering with unexploded ordnance, shell casings, and ration cans; and (4) distribution of chemicals. The several military bases and test ranges in the Mojave Desert include Edwards, and George Air Force bases, Twentynine Palms Marine Air-Ground Combat Center, Fort Irwin National Training Center, China Lake Naval Air Weapons Station, the Mojave B and Randsburg Wash Test Ranges, and Cuddeback Aerial Gunnery Range. The Chocolate Mountains Aerial Gunnery Range is the primary base affecting desert tortoise habitat in the Colorado Desert.

Some military activities occurred outside the above designated bases during World War II and later. General Patton conducted extensive maneuvers using tanks in Nevada, California, and Arizona to prepare troops for the North African campaigns in the 1940's (e.g., see Berry and Nicholson 1984b, Prose 1986). Additional maneuvers occurred in 1964 in California as part of Desert Strike (Berry and Nicholson 1984b). Even today some military activities overflow base boundaries, damaging or destroying adjacent habitats.

Hundreds of square miles of the Ivanpah, Fenner, Chemehuevi, and Chuckwalla DWMAs were affected by tank maneuvers during the early 1940's. Desert tortoise populations and habitat are still recovering from these impacts that occurred almost 50 years ago. The effects of tank maneuvers on soil compaction are significant, as are changes in composition, abundance, and distribution of perennial plants (Prose 1985, Prose and Metzger 1985, Prose et al. 1987). In general, areas with intense disturbance (camps, roads, and parking lots) probably will require additional decades or centuries for recovery.

The construction of military bases, test facilities, and supporting civilian communities have substantially affected desert tortoise populations and habitat in entire valleys since about 1940. For example, with development of the Naval Ordnance Test Station

(presently the Naval Air Weapons Station) at China Lake in the 1940's and 1950's, human populations rapidly grew to about 20,000 people in Indian Wells Valley. Desert tortoise populations correspondingly declined to low levels by the late 1970's (Berry and Nicholson 1984a). Similar patterns were observed at Edwards Air Force Base and Twentynine Palms. At Edwards Air Force Base, the civilian population of about 13,000 people affected desert tortoise populations for more than 30 miles in any direction. Large numbers of desert tortoises were collected on the base, especially on runways, and relocated north of base boundaries (Berry and Nicholson 1984b).

Detailed reports on impacts to tortoises from military maneuvers are available primarily for the National Training Center at Fort Irwin (Krzysik 1985, Krzysik and Woodman 1991, Woodman et al. 1986) and to a lesser extent the Naval Air Warfare Center at China Lake (Kiva Biological Consulting and McClenahan and Hopkins Assoc. 1991).

Dramatic reductions in shrubs (especially cover of creosote), pulverization of soils, and high frequencies of weedy annuals were observed at Fort Irwin in areas heavily used by tanks (Krzysik 1985, Krzysik and Woodman 1991, Woodman et al. 1986). The most recent assessment of tank traffic and the impact of ordnance directly on desert tortoises was summarized by Krzysik and Woodman (1991):

> In 1983, desert tortoise density was low in the two main valleys used for training exercises, but by 1989 tortoise density decreased by an additional 62%. Training scenarios have increased dramatically in the northwest portion of the fort since 1985, and in this area tortoises have declined by 81%.

Military ORV use results in some habitat damage. However, little habitat damage from ORVs was reported on the Naval Air Weapons Station except during retrieval of ordnance with ORVs (Kiva Biological Consulting and McClenahan and Hopkins Associates 1991).

Military maneuvers, installations, and camps can encourage congregations of desert tortoise predators such as the common raven (see Predator: Natives, below). Stubbs (1989b), in describing threats to Egyptian tortoise populations in Israel and North Africa, stated that the brown-necked raven (Corvus ruficollis) was a predator of concern and that: "Army camps in the desert also serve to increase the raven population."

Explosions of ordnance, static tests, and air-to-ground bombing on or adjacent to military installations may affect desert tortoise habitat and populations. For example, a new bomb crater, phosphorus flares, and parachutes were discovered on the Chuckwalla Bench study plot in California during 1988 (Berry 1990, as amended).

Military activities associated with the Chocolate Mountains Aerial Gunnery Range were probably responsible. Nearby, two student pilots released twelve 500-pound bombs near a campsite with 10 civilians (Bernstein 1989, Coleman 1989, Hurst and Healy 1989, Katoaka 1989). The bombs left foot-deep craters 10- to 12-feet wide and set fire to yuccas, palo verdes, and creosotebushes.

Damage is also incurred by collectors of scrap metal from military operations and utility lines. On the Chuckwalla Bench, Milpitas Wash drainage, and on the Chocolate Mountains Aerial Gunnery Range, California, scrap collectors illegally travel off-road in search of metal to sell. In 1989, unauthorized travel caused so much habitat damage that the BLM closed some areas of the Chuckwalla Bench (BLM 1989b).

H. Off-Highway (OHV) or ORV - Recreation.

ORV use takes many forms: organized events such as the Fast Camel Cruise in the southeastern Colorado Desert, California; large- or small-scale competitive races involving up to thousands of motorcycles (e.g., the Barstow to Las Vegas motorcycle competition); and casual family activities. ORV activities are among the most destructive, widespread, and best documented of threats to the survival of desert tortoises and other vertebrates, and to the integrity of their habitats (Adams et al. 1982ga and b, 1984; Berry and Nicholson 1984b; Brattstrom and Bondello 1983; Bury 1987, Bury and Luckenbach 1983, 1986; Bury et al. 1977; Busack and Bury 1974; Luckenbach 1975; Sheridan 1979; Stebbins 1974, 1975; Webb and Wilshire 1983).

The list of impacts from ORV use is extensive, including: mortality of desert tortoises on the surface and below ground; collapsing of desert tortoise burrows; damage or destruction of plants used for food, water, and thermoregulation; damage or destruction of the mosaic of cover provided by vegetation; adverse effects to the general well-being of desert tortoises through water balance, thermoregulation, and energy requirements; noise pollution; impact, damage or destruction of soil crusts; soil erosion; proliferation of weeds; and increases in numbers and locations of wild fires.

ORV use in the desert has increased and proliferated since the 1960's (Adams et al. 1982a, Stebbins 1974). As of 1980, ORV activities affected approximately 25% of all desert tortoise habitat in California and 67% of habitat which supported densities estimated at more than 100 individuals/mi^2 (Berry and Nicholson 1984b). Substantial portions of desert tortoise habitat in southern Nevada are also affected (Berry and Burge 1984, Burge 1986).

Government documents provide ample evidence of severe declines in biomass of plants and vertebrates as well as desert tortoise densities in the western and southern Mojave deserts due to

OHV/ORV-related activities (Busack and Bury 1974, Bury et al. 1977, Berry and Nicholson 1984b, Berry 1990, as amended). Bury (1987) demonstrated that desert tortoise densities and health (measured by length-scaled body weight) also deteriorated as a result of ORV activities when contrasted to values from appropriate control areas.

In the Southwest, the BLM and some other governmental agencies have been (and continue to be) ineffective in preventing ORV competitive events and casual use from causing more habitat damage and loss in important desert tortoise habitats (Burge 1983, 1986, Woodman 1983, BLM 1989a, 1990a, Fish and Wildlife Service 1989a, 1989b, 1989c). For example, when competitive events are held, old routes are widened, new routes are formed, race participants and observers camp and park in unauthorized areas, race monitors are unable to prevent unauthorized activities, and garbage is not appropriately handled. In general, more habitat is damaged or destroyed with each new event. In 1989, the BLM and Fish and Wildlife Service monitored the annual Barstow-to-Vegas race and reported that motorcycles and other vehicles strayed beyond the designated course by an average of 30 feet, causing damage or loss of hundreds of acres of desert tortoise habitat in the eastern Mojave Desert (BLM 1989a, 1990a).

The BLM has been unable to protect important habitats in the Rand Mountains and Fremont Valley of eastern Kern County, California from damage by casual recreational vehicle users (Goodlett and Goodlett 1991, 1992). This area, which is part of the proposed Fremont-Kramer DWMA and adjacent to the Desert Tortoise Natural Area, has experienced intensive ORV-oriented recreation since 1973, and has the highest rate (40.7%) of vandalism to desert tortoises (Berry 1990, as amended). Between 1989 and 1990, BLM closed much of the area to recreational use on an emergency basis to protect desert tortoises, but then reopened a network of "designated routes" in November of 1990. After route designation, vehicle-oriented recreationists traveled on closed routes and vandalized signs marking closed routes. Motorcyclists illegally traveled parallel to designated routes, creating new tracks and trails and widening existing routes. Just prior to, during, and after the Thanksgiving holiday in 1991, the level of unauthorized use was extremely high (Goodlett and Goodlett 1992). For example, of 65 vehicles observed in a 4-hour period, only 38% were following regulations and traveling on authorized routes, whereas 62% traveled cross-county or were on closed routes. In a second experiment, 39 transects (each of which was 500 feet long) were established perpendicular to designated, open routes, and data were recorded on numbers of trails and tracks crossing the transects. Eighty-five trails and 553 recent, unauthorized tracks were recorded. An average of 16 unauthorized trails or tracks crossed each transect, or one track every 31 feet. In a third experiment, 17 trails signed as "closed" were raked to remove tracks before Thanksgiving and then re-visited a week later. There were 195 new tracks or 11.5 unauthorized tracks per closed route.

I. Livestock Grazing.

Negative interactions between grazing and desert tortoises are not restricted to the American Southwest. In the habitat of *Testudo kleinmanni* in North Africa and Israel, livestock grazing changes the composition of desert vegetation and the altered vegetation is less favorable to rodents (Stubbs 1989b). Rodent burrows are vital to the survival of the species during summer. Livestock grazing has also contributed to declines in *Chelonoidis chilensis* (Waller et al. 1989, pers. comm.). In reference to a proposed nature preserve in Israel, Mendelssohn (1990) stated that "...areas were badly affected or even destroyed by overgrazing." Mendelssohn (1983) adds:

> The...Egyptian tortoise...is endangered by much of its habitats being turned into agricultural land, and, in the remaining areas, by overgrazing by Bedouin herds which destroys the protective vegetation and exposes the turtles to predation by ravens.

Sheep, cattle, burros, and horses can affect desert tortoises and their habitats directly and indirectly. The degree of impact depends on a number of factors including, but not limited to: resiliency of soil and vegetation types, type of stock, stocking rates, season of use, and years of use with and without rest. Other factors which interact with livestock grazing and can affect the degree and extent of impacts include: introduction and spread of weeds, previous grazing-induced changes in vegetation, fire, drought, and other land uses.

Livestock can trample, injure, or kill desert tortoises either above ground or while in burrows. Trampling of live desert tortoises by cattle has been observed in the eastern Mojave Desert (M. Coffeen pers. comm., T. Duck pers. comm) and juvenile desert tortoises have been trampled in the western Mojave Desert (Berry 1978a, Berry and Shields et al. 1986, Nicholson and Humphreys 1981; Craig Knowles, BLM field notes for Stoddard Valley). Livestock can also trample desert tortoise nests. Feral burros damaged nests of giant tortoises in the Galapagos, thereby reducing nesting success (Fowler de Neira and Roe 1984).

Livestock can also trample burrows and other cover sites. BLM study plot files (journal notes, 35-mm slides) for desert tortoises contain numerous examples of burrows trampled by cattle and sheep. For example, sheep damaged 10% and destroyed 4% of 164 freshly-used desert tortoise burrows on a study plot in the western Mojave Desert during less than 2 weeks of grazing (Nicholson and Humphreys 1981). Juvenile desert tortoise burrows are particularly vulnerable to trampling because of their locations and the shallow soil covering protecting the tunnels.

Livestock also trample shrubs (e.g., creosote) used as sites for desert tortoise burrows and pallets, and which provide protection from predators and temperature extremes. Cattle and sheep have been observed breaking apart large creosote bushes while feeding on annual plants in coppice mounds and when seeking shade and bedding sites (Berry 1978, Jeff Aardahl, pers. comm.). Cattle have also been observed swinging their heads/horns back and forth in creosote bushes, breaking apart the branches (Harold Avery, BLM, Riverside, pers. comm.). Once the branches were broken, the cattle then ate the annual plants in coppice mounds at the base of the creosote. The overall result was a loss of shrub biomass and canopy cover and reduction in shade-giving properties, etc. Burge (1977) and Berry and Turner (1984, 1986) described the importance of shrubs in providing cover for burrows and shade for desert tortoises. For example, most juvenile burrows (80%) were sheltered by shrubs, particularly creosote and burro bush, (*Ambrosia dumosa*).

Grazing can cause soil erosion and soil compaction similar to vehicle-induced compaction (Arndt 1966, Ellison 1960, Klemmedson 1956). Data from 25 grazing studies showed that filtration rates decrease by about 25% in areas of light to moderate grazing, and about 50% in areas of heavy grazing (Gifford and Hawkins 1978). Runoff of precipitation in heavily grazed areas was 150% greater than in areas of moderate grazing and 1000% greater than in areas of light grazing (Sharp et al. 1964). When grasses were continually grazed, their root systems shrink, and their capacity to hold soil from erosion was reduced (Johnson 1983). Livestock grazing also has negative impacts on soil crusts and cryptogams (e.g., Avery et al. 1992).

Livestock grazing can and has altered perennial vegetation in a number of ways. Livestock grazing has caused, or contributed substantially to, the reduction and loss of native perennial grasses (e.g., members of the genera *Bouteloua*, *Hilaria*, *Stipa*, *Oryzopsis*, *Poa*, *Muhlenbergia*, *Sporobolus*) in the desert as well as in other parts of the western United States (e.g., Bentley 1898; Frenkel 1970; Humphrey 1958, 1987; Rowlands, unpubl.; BLM 1980). Perennial grasses in many areas have been replaced by woody shrubs, often with an understory of non-native annual grasses introduced from Europe and Asia. Livestock play an important role in proliferation of non-native weeds such as *Erodium cicutarium*, *Schismus barbatus*, *S. arabicus*, *Bromus*, and *Salsola iberica* (Kay, Meyers, and Webb 1988). This profound change in structure of vegetation has contributed to invasion of weeds and an increase in fire (see below).

Livestock grazing has affected composition of shrubs used for cover by desert tortoises. For example, sheep reduced some perennial shrubs by 65 to 68% in volume and by 16 to 29% in cover (Webb and Stielstra 1979). In areas consistently and heavily grazed by sheep, cover of many species of shrubs was substantially reduced and creosote and weeds were often the predominant vegetation

(Webb and Stielstra 1979). The following shrubs can be reduced in numbers and vigor in such grazed sites: burro bush, goldenhead (*Acamptopappus sphaerocephalus*), Anderson thornbush (*Lycium andersoni*), spiny hop sage (*Grayia spinosa*), winter fat (*Ceratoides lanata*), and Mojave aster (*Machaeranthera tortifolia*).

Livestock grazing can affect quality and quantity of plant foods available to desert tortoises, and thereby affect nutritional intake. Data gathered through spring of 1992 indicate that desert tortoises are generally quite selective in their choices of foods (Burge 1977, Nagy and Medica 1986, Turner et al. 1987, Avery 1992, Esque 1992, 1994, Henen 1992, Jennings 1992, 1993). Desert tortoises may have individual preferences and seek out particular species to eat. In some areas, the preferences are clearly for native plants over the weedy non-natives. Food preferences may vary by age, sex, and locality.

The relation between food availability and growth, reproduction, and general well-being of desert tortoises has been the discussion of many published papers (e.g., Tracy 1992). For example, juvenile desert tortoises exhibit increased growth in years when rainfall and forage are abundant (Medica et al. 1975). Desert tortoises also produce more eggs when more food and water are available than when these resources are scarce (due to drought or grazing pressure) (Turner et al. 1986, 1987, Henen 1992).

Juvenile desert tortoises may be at greatest risk in grazed areas, because they are likely to be too small to reach remaining food items concealed within shrubs after livestock have used an area. Juveniles are less likely to travel the distances necessary to locate remaining patches of forage. If soils have been churned by trampling, juveniles may not be able to travel easily across the landscape. In addition, juveniles may require diets with more protein than adults (see Adest et al. 1989 for the bolson tortoise, also Troyer 1984).

The most substantial impacts to vegetation, soils, and desert tortoises likely occur at and in the vicinity of heavy-use sites where livestock are watered, bedded down, or trailed. The loss of cover and changes in vegetation are often evident for many acres around each cattle watering trough or tank. Biologists have observed trails leading to stock-watering sites miles from the actual waters. Sheep bedding and watering areas also receive substantial impacts (Nicholson and Humphreys 1981). Loss of cover can increase vulnerability of desert tortoises to predation (see below).

J. Invasion and Establishment of Weedy and Non-Native Plants.

The relationships among livestock grazing, invasion of non-native plants, and fire are complex. From a global perspective, invasions by non-native grasses are most severe in the arid and semi-arid western United States (D'Antonio and Vitousek 1992). Cheatgrass

(*Bromus tectorum*) for example, spread throughout the Great Basin in conjunction with the introduction of sheep and cattle.

Many species of non-native plants from Europe and Asia have invaded desert tortoise habitats in the Mojave and Colorado deserts and have become common to abundant in some areas, particularly where disturbance has occurred and is ongoing. Some of the more common non-native or native weedy species found within the Mojave region include: bassia (*Bassia hyssopifolia*), sand bur (*Ambrosia acanthicarpa*), western ragweed (*Ambrosia psilostachya var. californica*), common spikeweed (*Hemizonia pungens*), pineapple weed (*Matricaria matricarioides*), fiddleneck (*Amsinckia intermedia, A. tessellata*), flixweed (*Descurania sophia*), tumble mustard (*Sisymbrium altissimum*), London rocket (*Sisymbrium irio*), Russian thistle (*Salsola iberica*), redstem filaree (*Erodium cicutarium*), turkey mullein (*Eremocarpus setigerus*), and horehound (*Marrabium vulgare*) (in part from Tierra Madre 1991, and BLM files). Several species of annual grasses are also important, including: foxtail chess or red brome (*Bromus rubens*), cheat grass or downy brome (*Bromus tectorum*), barley (*Hordeum glaucum, H. jubatum, H. leporinum*), Mediterranean or split grass (*Schismus barbatus*), and Arab grass (*S. arabicus*).

The above weeds--particularly filaree, foxtail chess, and cheat grass--thrive in many open deserts which have been or are (1) grazed by livestock, particularly sheep; (2) disturbed by OHV/ORVs and cross-country travel; (3) used for military maneuvers; and (4) used for settlements, townsites, or air-strips. Weedy species, which lack adaptations for germinating in thickly crusted desert soils, gain entry when crusts are broken. Certain soil types, such as aeolian sands, are particularly vulnerable to such invasions.

As non-native plant species become established in some areas, some native perennial and annual plant species decrease, diminish, or die out (D'Antonio and Vitousek 1992). For example, under pressure from livestock grazing, many native perennial bunch grasses have declined, died out, and been replaced with such species as foxtail chess (Robbins et al. 1951). The native bunch grasses include, but are not limited to: desert needle grass (*Stipa speciosa*), Indian rice grass (*Oryzopsis hymenoides*), bush muhly (*Muhlenbergia porteri*), the grama grasses (*Bouteloua sp.*), fluffgrass (*Erioneuron pulchellum*), and members of the genera Poa and Sporobolus. Many areas formerly occupied by the native grasses have been filled by annual grasses and weeds from Europe and Asia.

Some botanists view non-native species as aggressive competitors capable of replacing native species (Frank Vasek, pers. comm., Webb and Stielstra 1979, D'Antonio and Vitousek 1992). Loss of native plants and replacement by weedy, non-native plants has resulted in what some call disclimax vegetation (Vasek, pers. comm.). Native plant populations in disturbed habitats have been in a weakened condition for decades, and are more vulnerable to competition than at any other time in the historic past (Vasek, pers.

comm.). Drought conditions in the last few years have placed additional pressures on native plant populations.

Few quantitative data are available to document patterns of successful invasion of non-native plants in the northern Mojave; however, vegetation samples from Rock Valley, Nevada, clearly show a remarkable increase in abundance of foxtail chess (Figure D1). Furthermore, expansion of foxtail chess does not correlate with population sizes of native plants (Figure D2), suggesting that foxtail chess is successfully invading the Mojave, but may not be competitively displacing native plants. In some areas, the bromes have become so abundant that they are capable of fueling fires that threaten the very structure of the desert as a shrubland (see Section 5.K. below). A prime example is the Pakoon Basin in northern Arizona (Lamb 1991).

K. Fire.

Fire has the potential to be an important force governing habitat quality and persistence of desert tortoises. Impacts of fire on desert tortoises have not been well documented; however, a few accounts provide some evidence that animals are injured or killed by fire (e.g., Woodbury and Hardy 1948, Richard Franklin pers. comm.). Remains of 14 desert tortoises thought to have been killed by a fire 2 years earlier were found near Bunkerville, Nevada, in December 1942 (Woodbury and Hardy 1948). Stubbs (1981a, 1981b, 1984) provided substantial evidence of the serious impacts of fire on a population of *Testudo hermanni* in Greece in alyki heaths, which is similar in appearance to the saltbush or alkali sink communities in California deserts. Fires maim or kill tortoises in Greece as surely as they do in the United States if the tortoises are above ground or exposed in shallow burrows.

With the help of Richard Franklin (BLM, Riverside, California), data were assembled from BLM files in areas where desert tortoises occur in Utah, Arizona, Nevada, and California. In excess of 5,000 fires occurred in the four-state region, burning more than 1 million acres (Table D1).

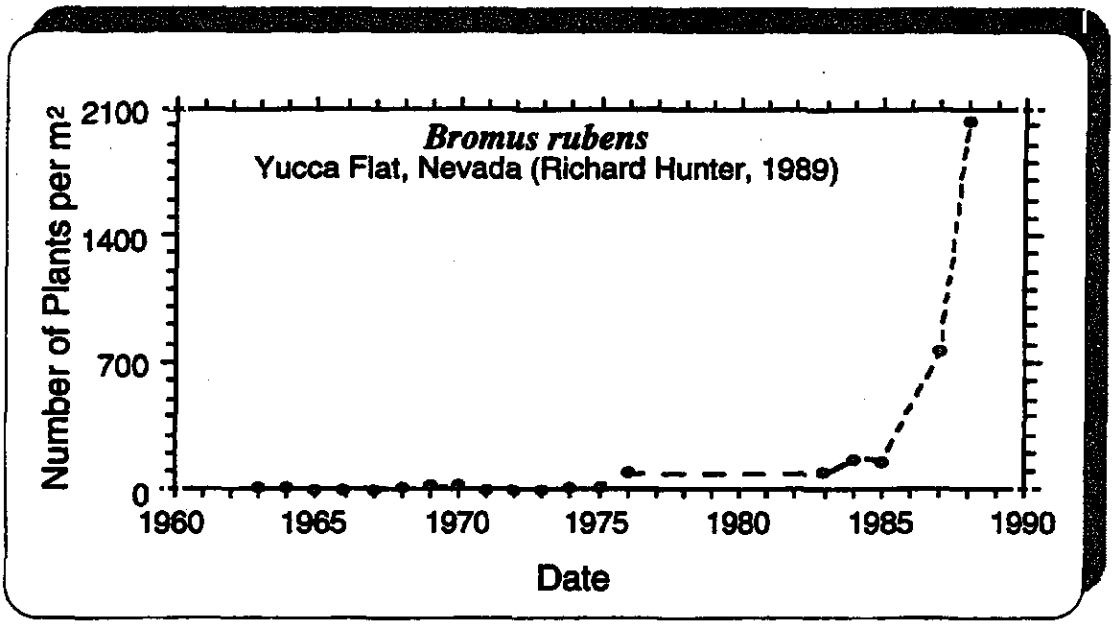


Figure D1. Historical increase in Bromus rubens in Yucca Flat, Nevada as a function of time (Hunter 1989).

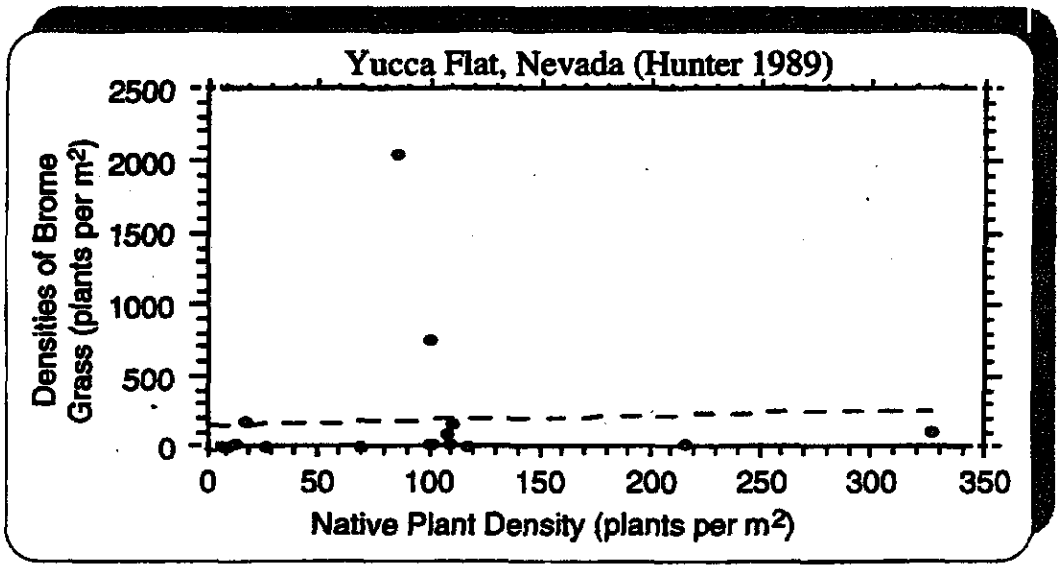


Figure D2. Relationship of densities of brome grass to native plant densities at Yucca Flat, Nevada.

Table D1. Number of fires and areas burned from 1980 to 1990 in the Mojave Desert.

State	No. of fires	No. of acres
Utah	830	49,944.6
Arizona	745	102,031.8
Nevada	2,114	159,275.8
California	1,437	243,316.9
Total	5,126	554,569.1

Most fires during the 1980's occurred in Nevada, but more habitat was burned in California (Figure D3). During the 1980's, the trend was towards an increasing number of fires in California, compared with a downward trend in the number of fires in Nevada (Figure D3, Tables D2 and D3). These trends were not due to lightning, and there was no significant trend in the number of fires caused by lightning in California or Nevada (Figures D3 and D4). Thus, fires directly caused by humans explain trends in both California and Nevada. The frequency of fires in California is significantly related to winter rainfall (Table D3). In years when winter rainfall exceeded eight centimeters, more fires occurred in the subsequent spring and summer seasons (Figure D5, Table D4). Rainfall is responsible for increased plant production, which in turn can produce more fuel for fire (Figure D5, see section on invasion of non-native weeds, above). Fires are more prevalent in areas where European and Asian weeds are successfully established. Ironically, in years with high rainfall that could produce greater amounts of potential food for desert tortoises, more fires occur which directly endanger desert tortoises and destroy shrub cover necessary for suitable desert tortoise habitat. Fires are associated with changes in annual and perennial desert vegetation not necessarily associated with changes in climate (Brown and Minnich 1986; Humphrey 1963, 1974; O'Leary and Minnich 1981, Reynolds and Bohning 1956). The relations among fire, disturbance, and changes in annual plant composition are complex. Biomass of weedy species has increased remarkably in deserts and desert tortoise habitat due to disturbance from vehicles, grazing, agriculture, and urbanization, etc. (Figure 5, see transect data in Berry 1990 as amended). Weedy, non-native grasses such as red brome, cheat grass, and split grass; and forbs increasingly blanket the desert floor, resist decomposition, and provide flammable fuel for fires. Once fires occur, they may improve opportunities for invasion and increases in the weeds. For example, Brown and Minnich (1986) reported that "...postfire herb cover was 23% greater in burned than unburned stands ...[and]...most cover was of exotic European annuals..."

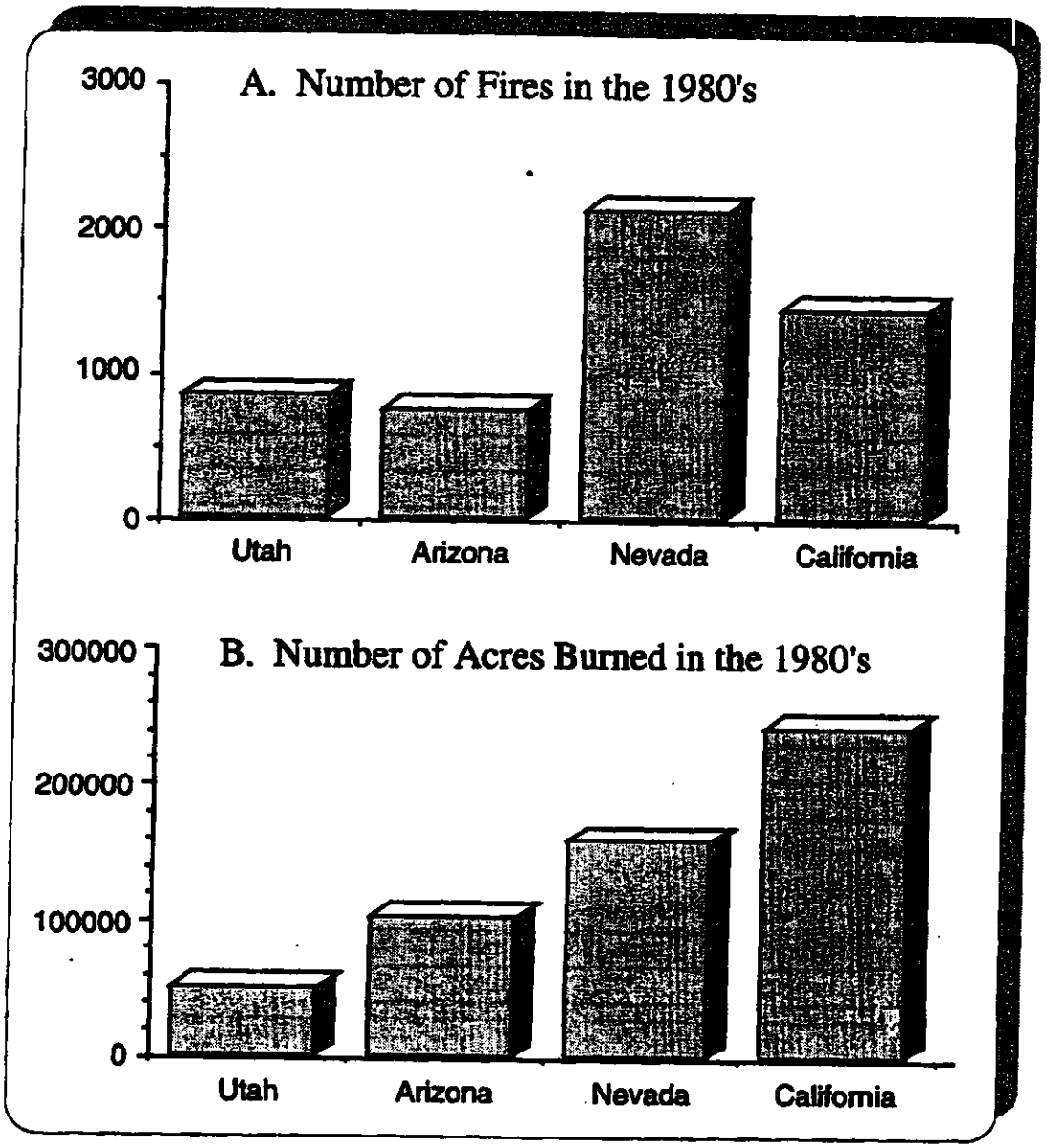


Figure D3. Number of fires and acres burned in the Mojave Desert between 1980 and 1990.

Table D2. Results of a regression analysis of the number of fires occurring in the Las Vegas District as a function of time (year in which the fire occurred).

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
Intercept	1	34285.461	34285.461		
year	1	23476.809	23476.809	9.356	.0136
Residual	9	22584.100	2509.344		

Dependent: no. of fires

Model Summary
Dependent: no. of fires

R-Squared	.510	Adj. R-Squared	.455	RMS Residual	50.093

	df	Sum of Squares	Mean Square	F-Value	P-Value
Model	1	23476.809	23476.809	9.356	.0136
Error	9	22584.100	2509.344		
Total	10	46060.909			

Model Coefficient Table
Dependent: fires

	Beta	Std. Error	t-Test	P-Value
Intercept	1501.682	406.259	3.696	.0049
year	-14.609	4.776	-3.059	.0136

Table D3. Results of a regression analysis of the number of fires occurring in the California Desert District as a function of time (year in which the fire occurred) and whether or not winter rainfall was above or below eight centimeters (rainfall category).

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
year	1	20384.861	20384.861	14.561	.0051
rain category	1	8055.276	8055.276	5.754	.0433
Residual	8	11199.806	1399.976		

Dependent: No. of Fires

Model Summary
Dependent: No. of Fires

R-Squared	.649	Adj. R-Squared	.582	RMS Residual	37.416

	df	Sum of Squares	Mean Square	F-Value	P-Value
Model	2	20734.921	10367.461	7.405	.0151
Error	8	11199.806	1399.976		
Total	10	31934.727			

Model Coefficient Table
Dependent: No. of Fires

		Beta	Std. Error	t-Test	P-Value
Intercept		-1201.322	350.189	-3.430	.0089
year		15.897	4.166	3.816	.0051
rain category	below 8	-70.955	29.580	-2.399	.0433
	above 8	0.000	•	•	•

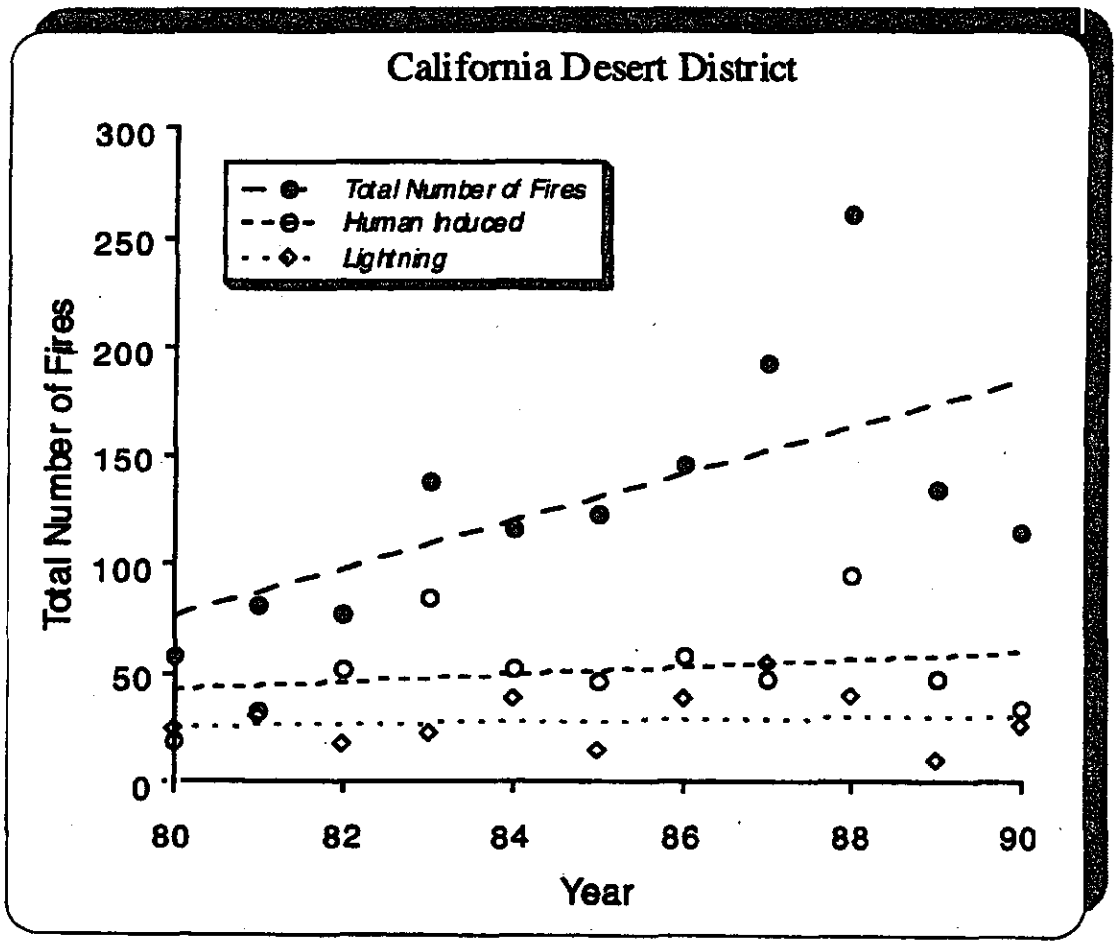


Figure D4. Number of fires occurring between 1980 and 1990 in the California Desert District of the BLM. Fires are presented as those produced by lightning, humans, and the total of lightning and human-induced fires.

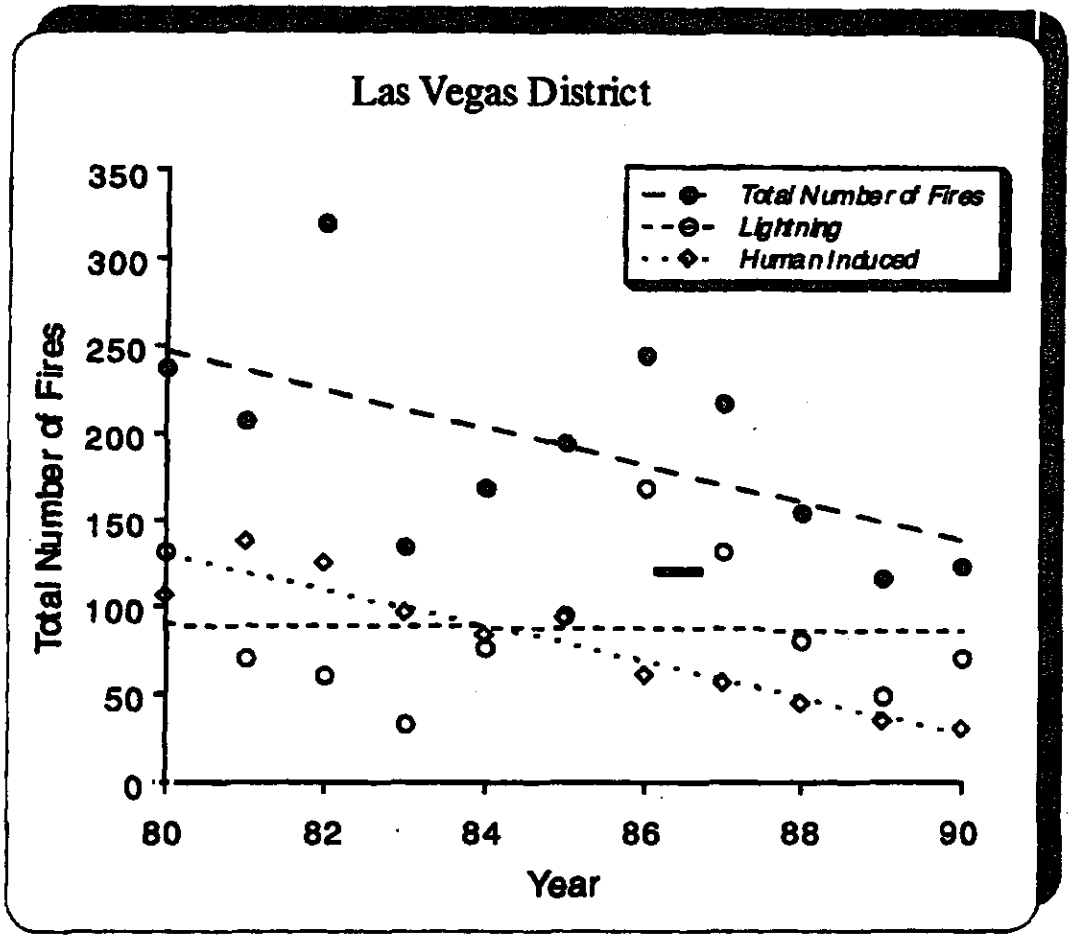


Figure D5. Number of fires occurring between 1980 and 1990 in the Las Vegas District of the BLM. Fires are presented as those produced by lightning, humans, and the total of lightning and human-induced fires.

Table D4. Results of a regression analysis of the number of fires occurring in the Las Vegas District as a function of time (year in which the fire occurred).

Type III Sums of Squares

Source	df	Sum of Squares	Mean Square	F-Value	P-Value
year	1	20384.861	20384.861	14.561	.0051
rain category	1	8055.276	8055.276	5.754	.0433
Residual	8	11199.806	1399.976		

Dependent: No. of Fires

Model Summary
Dependent: No. of Fires

R-Squared	.649	Adj. R-Squared	.562	RMS Residual	37.416

	df	Sum of Squares	Mean Square	F-Value	P-Value
Model	2	20734.921	10367.461	7.405	.0151
Error	8	11199.806	1399.976		
Total	10	31934.727			

Model Coefficient Table
Dependent: No. of Fires

		Beta	Std. Error	t-Test	P-Value
Intercept		-1201.322	350.189	-3.430	.0089
year		15.897	4.166	3.816	.0051
rain category	below 8	-70.955	29.580	-2.399	.0433
	above 8	0.000	•	•	•

Desert perennials are poorly adapted to burning and are poor colonizers (Tratz and Vogl 1977, Tratz 1978). Creosote, for example, can require hundreds of years to recolonize and recover (Vasek 1980, 1983). Fuel loads provided by canopies of split grass and brome make it more likely for fire to become hot enough to damage shrubs. Ultimately, fire can change the character of desert shrublands into Mediterranean grass and weedlands. Some shrublands have already been converted to annual grasslands in parts of the Apple, Stoddard, and Victor valleys in the southern Mojave Desert (R. Franklin, pers. comm.) and in the Pakoon Basin of northwestern Arizona (Lamb 1991). In the latter area, 88,152 acres of habitat burned from 1980 to 1990. Conversion of shrublands to annual grasslands can be devastating for desert tortoises, which depend upon shrubs for cover.

Relations among fire, rain, domestic grazing, proliferation of weeds, and destruction of desert tortoise habitats are complex; but understanding these relations is essential to promoting long-term habitat recovery. Grazing can promote invasion of weeds, which can enhance the destructive forces of fires. For example, grazing of sheep in California deserts is authorized by the BLM when winter rains produce sufficient poundage of winter annuals. Thus, rainfall simultaneously provides opportunities for sheep grazing, which in turn encourages proliferation of weeds and provides fuel for fires. Rainfall, especially when above the norm, virtually always encourages fires in disturbed habitats. Many desert fires are ignited by humans, thereby turning a "bounty" of potential desert tortoise foods into a season with higher potential for fires and habitat destruction.

L. Harvest and Vandalism of Vegetation.

Cacti and tree yuccas (*Yucca brevifolia, Y. schidigera*) are the primary targets of both legal and illegal harvesters. Harvesting operations impose much the same negative impacts as ORV activities: crushing of desert tortoises and their burrows, removal of vegetative cover, compaction of soils, and inhibition of annual and grass germination (Berry and Nicholson 1984b). Harvesting of yuccas can be viewed as a form of desertification because of the loss of cover and structure in the plant communities and the long period required for recovery.

Berry and Nicholson (1984b) summarized the data on yucca harvesting in California through the early 1980's. In recent years, San Bernardino County has modified the permitting process to enhance protection of the environment, but has continued to issue permits for yucca harvests on private lands in the eastern Mojave and northern Colorado deserts; notably in the Fenner, northern Ward, and Chemehuevi valleys. Several dozen square miles of private lands have recently been harvested both legally and illegally, and some illegal harvests occurred on public lands (U.S. Ecology 1989).

Vandalism of vegetation is common in some parts of the desert. Tree yuccas and cacti are frequent targets and are shot or set on fire, sometimes setting off wild fires (R. Franklin, pers. comm.). For example, use of semi-automatic and automatic weapons to vandalize vegetation is increasingly frequent in the southern parts of the Needles Resource Area (Chemehuevi DWMA) and "a...pipe bombing was associated with more shooting of structures and cactus in the Turtle Mountain area" (BLM 1991b).

M. Predation.

1. Native predators. Many species of predators prey on desert tortoises at different stages of their life cycle, including predation on eggs by Gila monsters (Beck 1990), destruction (and probably consumption of eggs) by kit foxes and coyotes (Turner et al. 1987), predation of juvenile and immature desert tortoise by ravens (Berry 1985, Woodman and Juarez 1988, Farrell 1989), and predation of immature and adult desert tortoises by golden eagles (Berry 1985). Many authors have reported predation by ophidians, felids, canids, and mustelids.

Natural predation in undisturbed, healthy ecosystems is generally not an issue of concern. Under certain situations, however, the level and type of predation becomes a management issue, and action must be taken to control the predator(s). The most obvious example is when numbers of desert tortoises become precariously low in local areas or regions, and any loss of individuals is likely to threaten that population. Predation rates may be altered when natural habitats are disturbed or modified. For example, densities of predators may increase, food habits of predators may be altered so that desert tortoises become more frequent components in the diets, and predators may be able to prey upon desert tortoises more easily when cover has been reduced.

The most important predators of desert tortoises at this time are the common raven (*Corvus corax*) and the coyote (*Canis latrans*). Based on data from over 1,000 remains, ravens generally kill juvenile desert tortoises with a carapace length of less than 110 mm (Campbell 1983, Berry 1985, Woodman and Juarez 1988). The evidence that ravens are preying upon and not scavenging juvenile desert tortoises is three-fold. First, ravens have been observed killing juvenile desert tortoises (Tom Campbell, Jim Farrell, Ted Rado, and others, pers. comm.). In contrast, scavenging of juveniles has not been observed (although scavenging of larger road-killed desert tortoises has been documented).

Second, large numbers of young desert tortoise remains show signs consistent with raven predation. Many remains show puncture wounds made by ravens' beaks or have entry wounds on the carapaces or plastrons where ravens pecked through the shells and

withdrew the organs (Berry 1985). The patterns of damage to the shell and removal of heads, legs, and girdles are consistent from one geographic region to another and from one species of tortoise to another (see Geffen 1990, for *Testudo kleinmanni*). The puncture wounds and openings in the shell must have been made when the tortoise was alive or within minutes of death, when the shell was soft and pliable and could be opened without fracturing it. Third, large numbers of young desert tortoise remains are found in and at the base of raven nests, as well as near perches. Concentrations of shells have been discovered along fence posts (Campbell 1983), at the bases of known raven perches and nests (Woodman and Juarez 1988), and along transmission line towers (Farrell 1989). For example, between 1987 and 1990, 564 shells of carapace length less than 110 mm were collected in California from 1987 to 1990 on study plots, along powerlines, and at raven nests and perch sites. Of this total, 215 (38%) were found on study plots and 349 (62%) were found associated with raven perch or nest sites, most of which were along powerlines.

In spring 1991, a case of probable raven predation occurred at a research site on the National Training Center, Ft. Irwin, California (D. Morafka, pers. comm.). In early 1990, two contiguous predator-proof enclosures were established for neonate desert tortoises. One enclosure had a roof of chicken-wire screen to prevent avian predation, and the other did not. In late summer and autumn 1990, approximately 30 juveniles hatched inside the roofed enclosure, 18 in the outside enclosure, and another 12 were free ranging. During a 2-week period in spring 1991 (29 April to 9 May), an avian predator, presumably a raven, preyed upon and killed the 18 desert tortoises in the open enclosure. Of the 12 free-roaming desert tortoises (each with a radio transmitter) outside the enclosures, 8 were found dead. All shells had punctures either through the carapace or plastron or both in patterns consistent with raven predation (Campbell 1983, Berry 1985, and others). The shells were within a few hundred feet of the sites where desert tortoises were last seen alive.

Raven predation on juveniles can be a threat to the long-term persistence of desert tortoise populations. In California, desert tortoise study sites that show high percentages of raven-killed juveniles also show significant changes in size-age class structure of populations from the 1970's to the 1980's (Berry et al. 1986a and b). The data show significant declines in percentages of live juveniles desert tortoises as well as declines in recruitment of juvenile and immature desert tortoises into the young adult size-age classes. Ray et al. (1992) developed a simple model to evaluate spatially structured raven predation on juvenile tortoises. This model predicts that ravens must increase mortality of juveniles 5 years old by 25% before a discrete reduction in population growth from 1.02 to 1.00 can occur.

The extent of raven predation varies regionally and appears to be correlated with densities of raven populations. Berry (1985)

demonstrated that the proportion of juvenile shells showing evidence of raven predation was significantly higher in the western Mojave than the eastern Mojave and southern Colorado deserts. This pattern is consistent with raven surveys in which large numbers of raven sightings were recorded in the western Mojave, intermediate numbers in the eastern Mojave, and relatively few in the southern Colorado deserts (Knowles et al. 1989a, 1989b). Considerable predation also occurs in the eastern Mojave Desert. For instance, most of the 248 desert tortoise remains collected in 1988 at or near three active raven nests and one foraging site in the eastern Mojave were estimated to have died that year (Farrell 1989).

Populations of common ravens apparently have been increasing for many decades. Numbers of ravens observed during Fish and Wildlife Service breeding bird surveys in the Mojave Desert increased by 1528% between 1968 (the year the surveys were initiated) and 1988 (Fish and Wildlife Service, Laurel, MD; cited in BLM 1989). Increases of 474% were also documented for the Colorado Desert during the same time period. Probable causes for population increases are increased availability of foods (e.g., landfills, sewage ponds, dumpsters, highways, cities) and water (e.g., sewage ponds, agricultural fields, golf courses). Artificial sources of food and water help sustain more individuals during times of low natural resource availability, such as winter and summer. Such artificial food sources also probably facilitate larger clutch sizes or increased frequencies of clutches and greater fledgling success for the common raven. In addition, human-made structures have increased numbers and distribution of perches and nest sites (power and telephone poles, bridges, bill boards, freeway overpasses, etc.). The presence of human refuse in almost a quarter of 226 raven pellets collected from the eastern Mojave Desert in May 1991 demonstrates the close relationship between humans and ravens (Camp et al. 1992). In another example, ravens spent 51% of non-flight time along transmission towers, railroads, telephone poles, and non-native tamarisk shrubs in the eastern Mojave (Sherman and Knight 1992).

A parallel issue involves Egyptian tortoises, which are preyed upon by the hooded crow (*Corvus corone sardonius*) and the brown-necked raven (*C. corax ruficollis*) in Israel, Egypt, and elsewhere in North Africa (Geffen and Mendelssohn 1989, Mendelssohn 1990, Stubbs 1989b):

> When I came to Palestine in 1933 the brown-necked raven was not a rare, but neither was it a common, desert bird. Each pair has a territory of about 100 kilometers^2 and there were small nomadic flocks of immatures and non-breeding adults. After the foundation of the State of Israel, when large scale immigration, agricultural, and settlement development began, the brown-necked raven became synanthropic and started a population explosion.

> Formerly a cliff-nesting species, it now began to nest on trees, on power line pylons, and on and in large buildings (hangars, etc.). ...The hooded crow has recently been removed from the list of protected species because of its population explosion and damage to agriculture. Brown-necked ravens are still on the list of protected species but in case of damage are controlled by rangers of the Nature Reserves Authority.
>
> [The hooded crow] was formerly distributed only in areas close to the Mediterranean, where human settlements were quite dense and high trees for nesting were available. Predation on young *Testudo graeca floweri* (a semi-desert subspecies) has been observed several times. Following human settlements they advanced eastwards penetrating into the area of *T. kleinmanni* and recently reaching Beer Sheva, 50 kilometers from their former distribution area. This synanthropic species can reach very high densities, notwithstanding that breeding pairs are territorial, but feed also outside their territory, as do the flocks of immatures and non-breeding adults. Recent research carried out not far from Tel Aviv, has shown that there can be up to 17 breeding pairs in 1 kilometer^2!
>
> [The brown-necked raven]...became also synanthropic and invaded the areas of *T. kleinmanni* from the east, so that now both species are sympatric there. Lack of trees so far prevents these corvids from exploiting much of the area, but I have seen even the hooded crow, not such a good flyer as the brown-necked raven, flying several kilometers from the next settlement over the *T. kleinmanni* habitat, apparently foraging (Mendelssohn 1990).
>
> Shells of young tortoises of both species, some still bloody from predation, are often reported. The disappearance of *T. graeca floweri* from some areas is likely due to crow predation, and there is increased concern about the impact of brown-necked ravens on Egyptian tortoises (Mendelssohn 1990).

The above documentation is sufficient to demonstrate that corvids in general are extremely efficient and demanding predators on young or small tortoises throughout the world. Their impact, relative to other predators and to tortoise population growth and general survivorship, is likely to vary from site to site.

Coyotes have been implicated in heavy levels of predation on desert tortoises at the Desert Tortoise Natural Area, Rand Mountains, and

Fremont Valley since 1988. Coyotes dug up and ate several adult desert tortoises which were fitted with radio transmitters (Charles Peterson, UCLA, pers. comm.). However, desert tortoises may have been ill (with URTD) or dead and then scavenged by coyotes, or coyotes may have been attracted to the area by large numbers of dying and dead desert tortoises. Feral dogs may have also been responsible for some of the predation.

2. Domestic and feral predators. Domestic and feral dogs are documented threats to captive and wild tortoises alike, not only for desert tortoises but for other species as well (Swingland and Klemens 1989). With the growing number and sizes of cities, towns, and settlements in the desert, this type of threat is increasing and will be difficult to control. Dogs singly, and in packs, often roam miles from home, dig up desert tortoises and injure them beyond recovery. For example, in 1971 and 1972, many burrows destroyed or damaged by dogs and two severely injured desert tortoises were found near scattered homes along Highway 58 in Kern County, California (K. Berry pers. comm.). Dog tracks and scats were unambiguously identified (size and shape of print; size and composition of scat).

Dogs have also attacked desert tortoises on BLM's permanent study plots in California. Judging from gnawed and chewed scutes and bones, a large proportion of desert tortoises observed at the Lucerne Valley study plot in 1986 and 1990 appeared to have been attacked by dogs. Numerous dog packs were observed at the same time (BLM files, Riverside, California).

At the Desert Tortoise Natural Area in California, two dogs were observed harassing a desert tortoise (Jennings 1991). Also at the Desert Tortoise Natural Area, George Moncsko of the Desert Tortoise Preserve Committee (pers. comm. to Kristin Berry) chased a pack of dogs from a desert tortoise. In the adjacent Fremont Valley permanent study plot, dog packs were observed on three occasions in spring of 1991, and dogs had apparently excavated desert tortoise burrows and probably killed desert tortoises there (Craig Knowles and Paul Frank, pers. comm.). On one occasion, the dogs charged a fieldworker. In each case, the nearest human habitation was 2- to 3-miles away.

N. Diseases and Toxicosis.

In this section, diseases related to toxicosis are discussed. Information on other diseases may be found in Jacobson (1994).

Evidence is mounting that desert tortoises are experiencing toxic effects and higher rates of mortality from one or more elements or compounds, such as selenium, heavy metals, chlorinated hydrocarbons, organophosphates, as well as nitro compounds and alkaloids in plants. In some cases, such chemicals occur naturally

or result from distribution or concentration through human-induced activities. While research on the aforementioned subjects in desert tortoises is in preliminary stages, existing data are sufficient to suggest that these sources of mortality may be important, especially when coupled with drought.

Levels of mercury in the livers of desert tortoises ill with URTD at the Desert Tortoise Natural Area were significantly higher than in desert tortoises from the Ivanpah Valley (eastern Mojave Desert) (Jacobson et al. 1991). The mercury levels in livers of Desert Tortoise Natural Area desert tortoises could be higher for natural reasons, e.g., naturally higher levels in soils and plants, or perhaps higher levels as a result of mining:

Many attribute mercury levels to emissions from industrial activity in the area. However, most of the area is within an epithermal alteration area due to, and within acid volcanic rocks. These rocks, and the saprolites and soils mantling these rocks, contain anomalous levels of mercury. Many of the deposits currently being mined...were defined in part by using mercury geochemical tracing. There may be naturally high levels of mercury in plants, and those animals that graze these plants. In addition, considerable smelting of ores has occurred in the early part of this century that could have resulted in emissions and deposition of elemental mercury in the surrounding soils (e.g., Tropico Mill) (Robert Waiwood, BLM geologist, pers. comm.).

Jacobson et al. (1991), in summarizing the potential effects of mercury on desert tortoises, stated:

> ...several investigators have reported altered host resistance to pathogens...depressed antibody responses to mitogen stimulation..., and thymic cortex and splenic follicular atrophy with concomitant depression of ... antibody response to *mitigen stimulation...*

Between 1982 and 1988, desert tortoise populations on the Chuckwalla Bench permanent study plot (Riverside County, California) sustained about a 70% decline in numbers (Berry 1990, as amended). Dead desert tortoises and a high proportion of the remaining live animals showed signs of shell disease (Berry 1990 as amended). These animals had experienced dyskeratosis and metabolic disorders typical of toxicosis from such elements or compounds as selenium; mercury, lead, and other heavy metals; chlorinated hydrocarbons; and/or organophosphate (Jacobson et al. 1991). The exact cause(s) of the shell disease has not been determined, but it is widespread in the California deserts, and most common in the eastern Mojave, northern Colorado, and southern Colorado deserts (K. Berry, pers. comm.).

During spring 1991, two partially paralyzed, dying desert tortoises were discovered in the eastern Mojave Desert of California and

southern Nevada. A necropsy of one of these animals showed it had been suffering from lymphangiectasia of the gastrointestinal tract; focal ulceration and heterophilic inflammation of the nasal sinuses; marked denervation atrophy and edema of skeletal muscle; and myelomalacia, liquefaction necrosis, and degeneration of the spinal cord (etiology unknown) (James Klaassen, APL Veterinary Labs, Las Vegas, NV, pers. comm.). The paralysis and some other symptoms were typical of selenium toxicosis in swine (E.R. Jacobson pers. comm., Casteel et al. 1985). Sheep and cattle also experience similar symptoms, not only from selenium, but from poisoning by some species of locoweed (*Astragalus sp.*). Poisoning from locoweed can occur in four ways: as selenium converter plants; through poisoning by aliphatic nitro compounds; by locoine (the toxic principle is not yet known); and with congenital defects and abortion. Some locoweeds may also reduce cell-mediated immune responses. Selenium toxicosis can occur in ranges where the nonselenium accumulating forage is depleted by livestock and selenium-accumulating plants remain (Blood et al. 1989, Fuller and McClintock 1986). Desert tortoises in some parts of the Mojave region consume locoweed, including species known to have properties toxic to livestock (e.g., *A. layneae*; see Fuller and McClintock 1986).

Many other species of desert plants besides locoweed are toxic to livestock (Keeler et al. 1978) and could affect desert tortoises. The levels of lead in plants and soils should also be explored, especially along roadways and adjacent to mines (Robert Waiwood, pers. comm.).

O. Noise and Vibration.

Anthropogenic noise has several potential impacts on desert tortoises, including disruption of communication and damage to the auditory system. Background noise has been shown to mask vocal signals essential for individual survival and reproductive success in other animals (e.g., bushcrickets, Conocephalus brevipennis, Bailey and Morris 1986; green treefrogs, Hyla cinerea, Ehret and Gerhardt 1980). Desert tortoises are known to have hierarchical social interactions (Brattstrom 1974), are capable of hearing (Adrian et al. 1938; Patterson, 1971, 1976), and communicate vocally (Campbell and Evans 1967; Patterson, 1971, 1976). Desert tortoises use eleven different classes of vocalizations in a variety of social encounters (Patterson 1971, 1976). The signals are relatively low in amplitude, have fundamental frequencies as low as 0.2 kHz or lower, and harmonics as high as 4.5 kHz (Patterson 1976).

Many human-induced sources of noises, such as automobiles, jets, and trains, cover a wide frequency bandwidth. When such sounds propagate through the environment, the high frequencies rapidly attenuate, but the low frequencies may travel great distances (Lyon, 1973). The dominant frequencies that remain after propagation

correspond closely to the frequency bandwidth characteristic of desert tortoise vocalizations. The masking effect of these sounds may significantly alter an individual's ability to effectively communicate or respond in appropriate ways. The same holds true for incidental sounds made by approaching predators; masking of these sounds may reduce a desert tortoise's ability to avoid capture by a predator. The degree to which masking affects desert tortoise survival and reproduction probably depends on the physical characteristics (i.e., frequency, amplitude, and short- and long-term timing) of the noise and the animal signal, the propagation characteristics of the sounds in the particular environment, the auditory acuities of desert tortoises, and importance of the signal in mediating social or predator interactions.

Loud noises (and associated vibrations) may damage the hearing apparatus of desert tortoises. Sources of noise and vibration include, but are not limited to: cars, trucks, and other vehicles on paved highways, dirt roads, and test tracks; trains; recreation vehicles traveling on or off road; terrestrial military vehicles; commercial and military aircraft; equipment associated with exploration for and development of hard-rock minerals and saleable and leasable minerals; explosions from military ordnance; air to ground bombing or release of missiles; mining; road construction; and nuclear tests. Little research has been performed on desert tortoise ears, but it is clear that they are able to hear, and the relatively complex vocal repertoires demonstrated by desert tortoises suggests that their hearing acuity is similarly complex. Brattstrom and Bondello (1983) experimentally demonstrated that ORV noise can reduce hearing thresholds of Mojave fringe-toed lizards (Uma scoparia). Relatively short bursts (500 sec) of loud sounds (95 decibels at 5 meters) caused hearing damage to seven test lizards. Comparable results were obtained when desert iguanas (Dipsosaurus dorsalis) were exposed to 1 to 10 hours of motorcycle noise (Brattstrom and Bondello 1983). Repeated or continuous exposure to damaging noises is likely to cause an even greater reduction in auditory response of these lizards. It is not unreasonable to expect loud noises to similarly impact the auditory performance of desert tortoises.

Ground vibrations can cause desert tortoises to emerge from their burrows; slapping the ground several times within a few feet of a desert tortoise burrow entrance will often cause a desert tortoise to emerge (C. Peterson, pers. comm., and others). Research is needed to determine what kinds of vibrations and noise cause a desert tortoise to emerge from its burrow.

P. Other Potential Impacts.

Impacts to desert tortoise populations and their habitats described above are well documented or established. While chelonian experts and conservation biologists may not agree on the importance of each

particular impact or the degree of effect, they generally have concluded that such impacts should be substantially reduced or eliminated.

Another group of impacts which can be categorized as "potential impacts" includes air pollution, acid rain, acid precipitation, electromagnetic fields, electromagnetism, global warming, and greenhouse effects. The role of these factors in the status and recovery of desert tortoise populations should become apparent as more information becomes available.

VI. Cumulative and Synergistic Effects of Human Uses on Desert Tortoise Populations and Habitats

A. Interface between the Desert and Developed Areas.

Overall, desert tortoise habitats most susceptible to negative impacts are those at the interfaces between developed lands and open desert. At this interface, many, if not all, threats described above may be present. For example, deserts adjacent to urban and agricultural areas are exposed to deliberate take or removal of desert tortoises, vandalism, release of captives, translocation of wild desert tortoises, unauthorized or authorized deposition of trash, dumping of toxic or hazardous waste, vehicle kills on and off road, proliferation of trails and roads, clearing of land for utility lines and corridors, casual ORV use and general recreation, invasions of weedy and non-native plants, human-caused fires, harvest and vandalism of vegetation, predation by domestic animals, and noise. Even near small settlements, isolated tracts, and ranches, the same factors are present, and the cumulative impacts can spread in a radius of several miles from such areas. Dog packs, for example, can be found digging up and killing desert tortoises miles from home. Ravens can use resources available at human settlement, such as perches, nest sites, water, and food, as a springboard for preying on wild animals nearby. Examples of existing problem areas include but are not limited to the Antelope, Indian Wells, Fremont, Apple, Victor, Lucerne, Johnson, Chuckwalla, and northern Ivanpah valleys in California; Las Vegas, Laughlin, Piute and Mesquite in Nevada; and the Virgin River Valley and St. George in northern Arizona and Utah.

B. Human Access.

The density of paved and dirt roads, routes, trails, and ways in desert tortoise habitat has a direct effect on mortality rates and losses of desert tortoises. The status of desert tortoise populations is directly linked to access, because access allows people to penetrate

into remote parts of the desert, and people cause or contribute to mortality of desert tortoises and habitat loss (Nicholson 1978, Berry 1986, 1992, see discussion above). As mileage of roads, trails, and tracks increased on BLM study plots in California, desert tortoise population declines occurred at greater rates (Berry 1990, as amended, 1992).

The types of human activities recorded on or near access routes in remote parts of the desert include, but are not limited to: take or removal of desert tortoises (predation for food, collections for pets, and commercial trade), vandalism, translocation and release of captive desert tortoises, dumping of trash and other wastes, vehicle kills on and off roads, proliferation of roads and trails, invasion of weedy, non-native plants, fire, harvest of and vandalism to vegetation, and predation by dogs and ravens. Remote areas of the desert are also disturbed by mining, grazing, military use (past and current), and the access routes that permit such activities. The long list of threats to desert tortoises becomes a greater burden when each individual, vehicle, family, or event (e.g., vehicle race or tour) enters desert tortoise habitat. As numbers of visitor days increase, the potential for losses of desert tortoises and their habitats increases (e.g., Berry 1986a).

To ensure recovery of desert tortoises, mortality from human-related sources must be eliminated or reduced to very low levels. Because of the natural history characteristics of the species, losses of even a few adults can delay or prevent recovery (see Appendix C). Currently, acts of vandalism, collecting, release of captives, vehicle kills, etc. occur on all or nearly all desert tortoise study sites. Low rates of desert tortoise mortality from human causes have been documented for only a few relatively remote areas with low levels of human access, such as parts of Ivanpah, Ward, Fenner, Chemehuevi, and Piute valleys. Vandalism and vehicle kills occur at these sites but at relatively low rates. The level of human access in DWMAs, as measured in linear miles of access routes per square mile or township, should mirror road/route densities in areas where: (1) human-caused death rates are very low, and (2) stable or increasing desert tortoise populations exist. Route densities in DWMAs should be reduced where human-caused mortality of desert tortoises is a problem.

C. *Recovery Rates of Habitat.*

Natural recovery rates of soils and perennial vegetation in desert habitats from development of utility-line corridors, military activities, and human settlements may require decades, centuries, or even millennia (Lathrop 1983b, Lathrop and Archbold 1980, Vasek 1989, Vasek et al. 1975a, 1975b, Webb and Newman 1982, Webb et al. 1983). Recovery rates of native annual plants, a critical source of food for desert tortoises, has not been examined in depth and cannot be estimated. Potentially, recovery of native plant

communities could be hastened by revegetation. However, the science of restoration and revegetation of native ecosystems is in its infancy. In general, because of the uncertainties and costs associated with revegetation and the long periods required for natural recovery, the first priority in mitigation should be to minimize land disturbance (Kay et al. 1988).

VII. A Case Study in Extirpation of Desert Tortoise Populations: Antelope Valley in Los Angeles and Kern Counties, California

The Antelope Valley is currently the most broadly urbanized landscape within the Mojave region. Portions of this valley supported high densities of desert tortoises from 1920's to the 1950's (Berry 1984b), but a series of human activities gradually reduced desert tortoise populations and destroyed or damaged the habitat. Examples of causative factors include, but are not limited to: collection of desert tortoises for food, pets, and commercial purposes; agricultural and urban development; construction of roads, railroads, and utility corridors; mining and energy development; high native predator densities (ravens); and uncontrolled predation by domestic and feral pets (Berry 1984b, Luckenbach 1982). The Antelope Valley is now characterized by numerous cities and small towns, several major State highways, Edwards Air Force Base, several airports and airfields, light and heavy industry, and a burgeoning human population. Parts of the Valley have become suburbs of the greater Los Angeles area. The town of Rosamond was recently a toxic-waste disposal site and is now identified has having high rates of cancer in the human population. Alfalfa and other crops are supported with crop dusting, fertilizers, plowing, and irrigation. Skip development has left hundreds of acres of scattered lots covered by Asian and Mediterranean weeds (Tierra Madre Consultants, Inc. 1991), which fuel increasing numbers of wildfires.

The vast network of paved and dirt roads render most areas accessible to ORV-oriented recreationists and general recreationists. Power, communication, water, gas lines, and fiber-optic cables border many of these roads, creating broad corridors of disturbed and destroyed habitat. Telephone and power poles further contribute to pressures on desert tortoises because they have become perch sites for increasingly abundant raven populations.

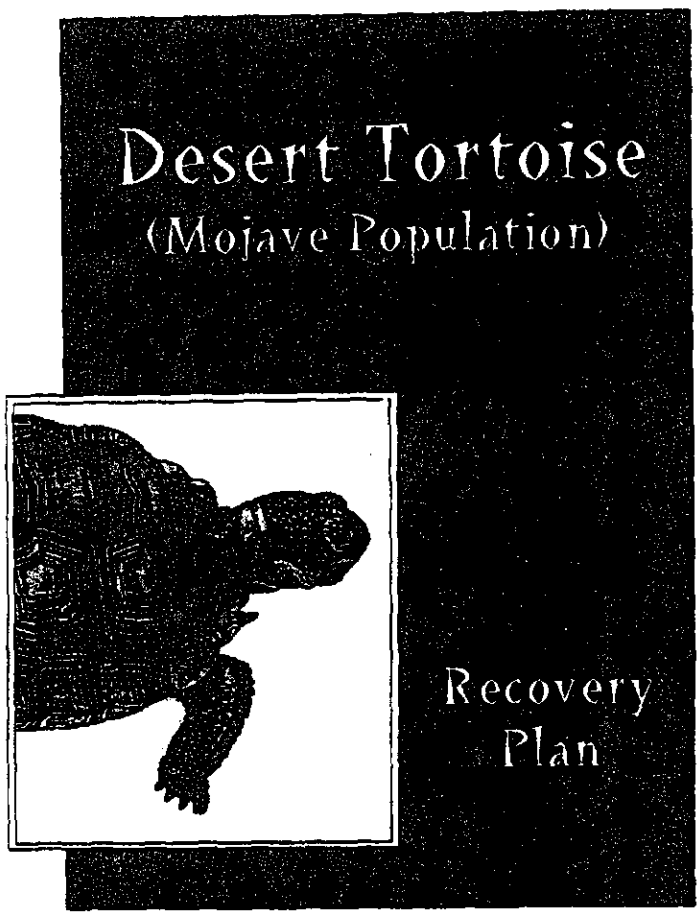
As of 1991, extirpation of desert tortoises from the Antelope Valley was nearly complete. Desert tortoise sign is occasionally observed east of Palmdale but not in Palmdale west of Highway 14 (Palmdale Freeway) or south of Highway 138 (Pearblossom Highway) (J. Hohman, pers. comm.). For instance, desert tortoise sign was observed recently in the vicinity of Lake Los Angeles (G.M. Groenendaal, Tehachapi, California, pers. comm. 1991). Desert

tortoise sign has also been reported in northeastern Palmdale (Feldmuth and Clements 1990), and desert tortoises have been observed recently at Saddleback Butte State Park by park naturalists.

Surveys for tortoises and habitat condition were conducted in a 225 square mile area, including the City of Lancaster and surrounding lands (Tierra Madre). Only 90 square miles of land were undeveloped, nonagricultural lands. The only remaining records of the presence of the once common desert tortoise were three desert tortoise carcasses and a single live desert tortoise (observed in 1983). An analysis of disturbance, which included types of impacts observed on each desert tortoise transect and from aerial photographs, was conducted in the same area (Tierra Madre 1991). Very high levels of disturbance were recorded in the city and surrounding lands, and lack of desert tortoise sign was attributed in part to this disturbance. Roughly a third of the area had been rendered unsuitable for desert tortoises.

Although we lack the data base and chronological history to resolve specific contributions to extirpation of desert tortoises, the Antelope Valley provides unambiguous evidence of the cumulative and synergistic effects of human activities on desert tortoises and how such trends have led to the demise of desert tortoise populations from a substantial portion of the historical range in the western Mojave Desert. Furthermore, these same patterns are operative nearby in the Indian Wells, Fremont, Victor, Mojave River, Apple, Lucerne, and Johnson valleys. Human activities are likely having the same impact in the Las Vegas, Colorado River, and Virgin River valleys.

Appendix E



Appendix E: Vegetation and Climate of the Mojave Region

I. Regional Setting

North America includes five desert regions (Jaeger, 1957): The Chihuahuan Desert of North Central Mexico and adjacent parts of Texas and New Mexico; the Sonoran Desert of northwest Mexico and parts of southern California and Arizona; the Mojave Desert in part of southeastern California, southern Nevada and adjacent parts of Utah and Arizona; the Great Basin Desert in the Great Basin region of Nevada, Utah, Oregon, Idaho, Wyoming and Colorado; and the Navahoan Desert of the four corners region of Utah, Colorado, Arizona and New Mexico.

The Desert Tortoise does not occur in the Great Basin or the Navahoan Deserts. It does occur in the other three deserts but our present interest is concerned with its range in the Mojave Desert and in that portion of the Sonoran Desert located west of the Colorado River, namely the Colorado Desert of California.

Mojave Desert

The Mojave Desert is located in southern California, southern Nevada, the northwest corner of Arizona, and the southwest corner of Utah. The Mojave Desert is bordered on the north by the Great Basin Desert, on the west by the Sierra Nevada, on the south by the San Gabriel and San Bernardino Mountains and by the Sonoran Desert, and on the east by the Hurricane Cliffs in Utah, and by Grand Wash Cliffs and the Peacock and Hualapai Mountains in Arizona.

The boundary between the Mojave Desert and the Great Basin Desert is basically defined, at low elevations, by a vegetational component, namely the creosote bush (*Larrea tridentata*) which occurs in the Mojave, but not in the Great Basin (Cronquist, et al., 1972). The boundary is thus an irregular line across southern Nevada extending roughly from Olancha (south of Bishop), in Inyo County, California to St. George, in the southwest corner of Washington County, Utah. The Mojave Desert includes all of Clark County as well as the southern parts of Esmeralda, Nye, and Lincoln Counties, Nevada.

Sonoran Desert

The greater Sonoran Desert includes seven geographical divisions (Shreve and Wiggins 1951). The lower Colorado Valley division of the Sonoran Desert occurs in western Arizona, in southeastern California, in northwestern Sonora, and in Baja California east of the Peninsular Ranges as far south as Bahia de Los Angeles. The other six divisions of the Sonoran Desert occur elsewhere in Arizona and in Mexico and do not concern us at present.

The Lower Colorado Valley Division was considered by Jaeger (1957) to consist of two parts: the Yuman desert in Arizona and Sonora; and the Colorado Desert in California, Baja California and a small part of Arizona near Needles, California. The Lower Colorado Valley Division in retained as a unit by Crosswhite and Crosswhite (1982) as the Lower Colorado-Gila Division, since it includes much of Arizona's Gila River drainage. Nevertheless, use of Colorado Desert for the California portion has gained widespread and consistent currency. We follow that custom and consider the Colorado Desert to be that part of the Colorado-Gila Division of the Sonoran Desert located west of the Colorado River.

The boundary between the Mojave Desert and the Colorado Desert has been subject to controversy. Toward the west, the Little San Bernardino and Cottonwood Mountains provide excellent boundary definition. Farther east, mountains seem less prominent and more widely spaced, and provide little definition. To the contrary, broad lowland areas provide north to south continuity, with Sonoran elements extending far to the north, and Mojavean elements extending far to the south. As a result, the boundary between the two deserts has variously been interpreted to be farther north or farther south (References in Vasek and Barbour, 1977) than the arbitrary line running from Indio to Needles as indicated by Crosswhite and Crosswhite (1982). Most interpretations extend the Colorado Desert northward along the Colorado River Valley to the vicinity of Needles, California.

A more northerly distribution of the Colorado Desert along the Colorado River Valley and also as far west as the Bristol Mountains, was proposed by Rowlands et al. (1982) after analysis of vegetation and climate. We basically adopt the definition of the Colorado Desert proposed by Rowlands with only minor modification. According, the boundary between the Mojave and Sonoran (Colorado) Deserts extends eastward along the Little San Bernardino and Cottonwood Mountains, then goes north from Cottonwood Pass along the eastern edge of the Hexie, Pinto, Sheephole and Bullion Mountains to Ludlow. It continues northward through Broadwell Lake and then loops around the northern end of the Bristol Mountains. The boundary returns southeast between the Granite and Old Dad Mountains, and then heads eastward along the northern edge of the Marble, Clipper, Piute and Dead Mountains before crossing the Colorado River about 20 miles north of Needles.

The boundary between the Mojave Desert and the Sonoran (Yuman) Desert extends eastward into Arizona, skirts around the southern end of the Black Mountains and proceeds eastward to the base of the Hualapai Mountains, approximately at the latitude of Yucca, Arizona.

The triangular portion of Mohave County, Arizona between Needles, Yucca and Parker Dam is included in the Colorado Desert on two maps by Jaeger (1957), but his discussion of the Yuman Desert clearly indicates its extension along the Colorado River to the north of Needles. We adopt the strict interpretation that the Colorado Desert occurs west of the Colorado River (and Gulf of California) in California and Baja California, and the Yuman Desert occurs east of the Colorado River and Gulf of California) in Arizona and Sonora.

The Mojave Desert includes most of San Bernardino County and parts of Inyo, Kern, Los Angeles and Riverside Counties, California, and the western part of Mohave County, Arizona. The Colorado Desert occurs west of the Colorado River in Imperial and parts of San Bernardino, Riverside, and San Diego Counties, California.

Subdivisions of the Mojave Desert

The Mojave Desert has been divided into five regions for the convenience of description (Rowland et al., 1982); namely the Northern, Eastern, Central, Southwestern and South Central regions. We agree that the five regions are defined on the basis of significant, large scale differences in soils and land forms, in climate, in plant ecology and vegetation, and in animal ecology. Accordingly, we accept the five Mojavean regions, but propose a slightly simpler nomenclature by shortening the last two regional names to the Western region and the Southern region respectively. We also propose some rather mind changes in the boundaries. Those boundaries are somewhat arbitrary and do not follow straight lines. Hence, the following descriptions of the five Mojavean regions must be considered approximate:

I - A Northern Mojave region has two sections: a California section roughly corresponding to the desert areas of Inyo County; and a Nevada section roughly corresponding to the desert portions of Esmeralda and Nye Counties.

II - An Eastern Mojave region has three sections: a Southern Nevada section in Clark County and the desert portion of Lincoln County; an Arizona section in western Mohave County, Arizona, and extending to St. George, Utah; and a California section from the Soda Lake Basin to the Nevada State Line.

III - A Southern Mojave region (the Southcentral region of the Rowlands, et al., 1982) occurs roughly from Victorville to Ludlow in San Bernardino County, California, and then southward to the Little San Bernardino and Cottonwood Mountains in Riverside County, California.

IV - A Central Mojave region includes the area around Barstow, and extends northward nearly to the Panamint Range, and eastward toward Baker and Ludlow, all in San Bernardino County, California.

V - A Western Mojave region (the Southwestern region of the Rowlands, et al., 1982) occurs in San Bernardino, Kern and Los Angeles Counties, California, roughly in the area from Trona to Victorville and west to the bordering mountains.

Subdivisions of the Colorado Desert

Subdivisions of the Colorado Desert. The Colorado Desert has informally been subdivided into eastern and western regions by Rowlands (unpubl.). Such subdivision is useful. However, we suggest three subdivisions of the Colorado Desert, based largely on general considerations of topography and vegetation.

I - The Northern Colorado Desert region includes the area from the Bristol Mountains to the Colorado River north of Needles, and southward to the Coxcomb Mountains and Vidal Wash.

II - An Eastern Colorado Desert region includes the area south from Pinto Basin and Vidal Wash between the Salton Trough and the Colorado River.

III - The Southwestern Colorado Desert region includes the Salton Trough and the desert to the south and west from the Little San Bernardino Mountains south into Baja California, Mexico (The peninsular strip of Colorado Desert along the Gulf of California coast may comprise a fourth subdivision.)

Boundaries between desert subdivisions

The boundary between Northern and Eastern Mojave regions comes southward from Emigrant Valley in Nye and Lincoln Counties, Nevada, to Indian Springs Valley and then around the western edge of the Spring Mountains where it crosses into California just east of the Resting Spring and Nopah Ranges. It skirts the west edge of Pahrump Valley and turns westward around the south edge of the Kingston Range. It then follows the north edge of Kingston wash to the north end of Silurian Valley, at the junction of Salt Creek with the Amargos River.

The boundary between the Northern and Central Mojave regions proceeds westward from Salt Creek through a low channel to Leach Lake and Pilot Knob Valley to the south end of the Slate Range. This boundary is south of the Owlshead and Quail Mountains, and north of the Avawatz and Granite Mountains.

The boundary between the Northern and Western Mojave regions goes north along the west edge of the Slate Range and turns westward at the north end of Searles Valley, passing just north of the Southern Argus Mountains and the Coso Basin, joining the Sierra Nevada just south of Little Lake.

The boundary between the Western and Central Mojave regions goes south from the south end of the Slate Range, skirting the west edge of Black Hills, to Fremont Peak, loops around Fremont Peak and cuts back to the south east, passing along the north edge of Harper Lake and then goes due south to Hinkley, joining the Mojave River near Hodge.

The boundary between the Western and Southern Mojave regions is the Mojave River, from Hodge southward through Victorville to the San Bernardino Mountains.

The boundary between the Central and Southern Mojave regions goes easterly from Hodge, passing south of Lenwood, to Daggett. It then follows Interstate Highway 40 to Ludlow.

The boundary between the Central Mojave and the Northern Colorado regions proceeds north from Ludlow through Broadwell Lake, and passes along the northwest edge of the Bristol Mountains to the northern tip of the Bristol Mountains.

The boundary between the Central and Eastern Mojave regions proceeds from the northern tip of the Bristol Mountains northward through Soda, Silver and Silurian Lakes to the junction of Salt Creek and the Amargosa River.

The boundary between the Eastern Mojave and the Northern Colorado regions proceeds southeast from the northern tip of the Bristol Mountains between the Old Dad Mountains and the Granite Mountains to the northern tip of the Marble Mountains. It proceeds eastward along the northern edge of the Clipper Mountains toward Goff and the northern end of the Dead Mountains. It crosses the southernmost couple of miles of Nevada before ending at the Colorado River.

The boundary between the Eastern Mojave region and the Yuman Desert of the Colorado-Gila Division of the Sonoran Desert goes from the Colorado River to the Black Mountains in Arizona and then around the southern end of the Black Mountains and proceeds eastward to the base of the Hualapai Mountains, approximately at the latitude of Yucca, Arizona.

The boundary between the Southern Mojave and the Northern Colorado regions goes south from Ludlow along the eastern edge of the Bullion Mountains and the eastern edge of the Sheephole Mountains to Clark's Pass.

The boundary between the Southern Mojave and the Eastern Colorado regions goes south from Clark's Pass in a sinuous path at the base of the Pinto and Hexie Mountains around Pinto Basin and Smoketree Wash to Cottonwood Pass at the eastern end of the Cottonwood Mountains. It continues westward to the southeast end of the Little San Bernardino Mountains near Cactus City.

The boundary between the Southern Mojave and the Southwest Colorado regions follows the scarp of the Little San Bernadino Mountains westward to Morongo Valley.

The boundary between the Eastern Colorado and the Southwest Colorado regions goes southwest from Cactus City around the Mecca Hills and then southeast along the edge of the Salton Trough to the Colorado River.

II. Major Topographic Features

The desert region under consideration varies extensively with regard to number, size and stature of mountains. Topographic diversity is greatest in the Northern Mojave Desert region with numerous high mountain ranges and large basins at low elevations. For example, the sink of the Amargosa River in Death Valley reaches 280 feet below sea level whereas Telescope Peak in the Panamint Range a few miles to the west reaches an altitude of 11,049 feet above sea level. Topographic diversity and the stature of mountains generally decreases southward. Concomitantly, the proportion of open desert consisting of broad plains and gentle alluvial fans also increases southward. Hence, each subdivision of the desert has its own characteristic array of landforms.

The Northern Mojave Desert region includes the Amargosa (8,738), Coso (8,160), Kingston (7,323), Last Chance (674), Nelson (7,701), Nopah (6,394), Panamint (11,049), Resting Springs (5,264), Saline (6,548), and northern Argus Ranges (8,839) as well as California, Chicago, Death, Eureka, Greenwater, Long, Panamint, and Saline Valleys in the California section. Features of the Nevada section include the Bare Mountains (6,316), Gold Mountain (7,565), the Sportted Range (6,254), and part of the Amargoas Range (8,738) as well as Sarcobatus Flat, the Amargosa Desert (Valley) and Ash Meadows.

The Eastern Mojave Desert region also has impressive mountains and Valleys. The Nevada section, including Arizona, includes the Black (5,456), Cerbat (6,900), Eldorado (5,060), Newberry

(5,639), Spring (11,919), and Virgin (8,056) Mountains and the Desert (6,540), Las Vegas (6,943), McCullough (7,026) and Pintwater (7,040) and Sheep (9,120) Ranges. It also includes Desert, Dry Lake, Eldorado, Hidden, Hualapai, Indian Spring, Las Vegas and parts of Ivanpah, Pahrump and Piute Valleys. The California section includes Table Mountain (6,176), and the Castle (5,120), Clark (7,929), Granite (6,786), Ivanpah (6,163), Mescal (6,493), Mesquite (5,160), New York (7,530, Old Dad (4,250), Pinto (6,144), Providence (7,040) Mountains or Ranges, as well as Clipper, Ivanpah, Lanfair, Mesquite, Pahrump, Piute, Silurian, and Valjean Valleys and the Soda Lake Basin and the Devil's Playground.

The Southern Mojave Desert region includes the Bullion (4,187), Cottonwood (4,375), Hexie (3,820), Little San Bernardino (5,814), Newberry (4,882), Ord (6,270), Pinto (3,963), Rodman (6,010), Sheephold (4,685), and Sidewinder (5,168) Mountains. It also includes Antelope, Apple, Johnson, Lucerne, Sidewinder, Stoddard, and Yucca Valleys as well as Dale, Emerson, Melville, Soggy, Rabbit and Lucerne Dry Lakes.

The Central Mojave Desert region includes the Avawatz Mountains (6,154), Calico Mountains (4,542), Eagle Crags (5,512), Granite Mountains (4,862), Pilot Knob (5,428), Slocum Mountains (5,124), Soda Mountains (3,617) and Tiefort Mountains (5,090). Important Basins are Goldstone, Harper, Coyote, Troy, Cronese, Soda and Superior Dry Lakes and the lower half of the Mojave River.

The Western Mojave Desert region includes the southern Argus Mountains (6,562), El Paso Mountains (5,244), Fremont Peak (4,584), Rand Mountains (4,755), Red Mountain (5,270), and numerous smaller mountains. Important Basins include Antelope, Fremont, Indian Wells, Searles and Victor (part) Valleys, as well as China, Cuddeback, Koehn, El Mirage, Rogers and Rosamond Dry Lakes.

The Northern Colorado Desert region includes the Bristol (3,422), Calumet (3,723), Chemehuevi (3,697), Clipper (4,604), Iron (3,296), Marble (3,842), Old Woman (6,326), Piute (4,165), Sacramento (3,308), Turtle (4,231), and Whipple Mountains (4,131). Important valleys are Cadiz, Chemuevi, Fenner, Vidal and Ward, together with Bristol and Cadiz Dry Lakes.

The Eastern Colorado Desert region includes the Arica (2,163), Big Maria (3,100), Cargo Muchacho (2,130), Chuckawalla (4,504), Chocolate (2,967), Coxcomb (4,416), Eagle (5,350), Granite (4,353), Little Chuckawalla (1,261), Little Maria (3,043), Little Mule (1,465), McCoy (2,835), Mule (1,801, Orocopia (3,815), Palen (2,443), Palo Verde (1,795), Riverside (2,252), and West Riverside (2,667) Mountains, and the Mecca Hills (1,642). It also includes Chuckawalla Valley, Ford Dry Lake, Hayfield Lake,

McCoy Wash, Milpitas Wash, Palen alley, Palo Verde Mesa, Palo Verde Valley, Pinto Basin and Rice Valley.

The Southwestern Colorado Desert includes the Algodones Dunes, Fish Creek Mountains (2,334), Indio Hills (1,739), and Superstition Mountains (759). Its main features are the Borrego, Coachella and Imperial Valleys and the Salton Sea.

Climate of the Mojave and Colorado Deserts

Weather recording stations are relatively few, especially in the mountainous Northern and Central Mojave regions and the remote lowland areas that experienced early agricultural development. The climatic data (Table E1) and the accompanying description are drawn largely from Rowlands (unpubl.), Huning (1978), and Rowlands et al. (1982). Temperatures are given in degrees Celsius; precipitation is given in mm rainfall.

The two major climatic factors, temperature and precipitation, are both extremely variable in both space and time. Temperature decreases with latitude and elevation, thus permitting a calculation of lapse rate. Temperature also shows extensive, but predictable seasonal variation and extreme, unpredictable yearly variation. Precipitation increases with elevation and also has marked seasonal variation and even more extreme yearly variation.

Temperature

The hottest places are in low elevation basins. Mean July maxima are nearly 47°C in Death Valley, 43 at Baker, 41 at Trona, 32 to 40 at other Mojave Desert stations and from 32 to 36 at neighboring Great Basin stations. Mean July maxima range from 41 to 43 over much of the Colorado Desert and from 39 to 43 in the Yuman Desert of Arizona, reflecting the slightly higher elevations of the latter.

The coldest places are at the higher elevations of the Northern and Eastern Mojave Desert. Mean January minima range from -6 to -10 C at Great Basin Stations, but -1 to +5 in the Northern Mojave, -6 to +3 in the Eastern Mojave, and -3 to +2 in the Western, Central and Southern Mojave. Mean January minima range from +2 to +5 in the Colorado Desert and from -1 to +5 in the Yuman Desert of Arizona, again reflecting slightly higher elevations of the latter.

The number of freezing days ranges above 144 at Great Basin stations, 3 to 127 in the Mojave Desert (plus 157 at Alamo on the Great Basin margin), 1 to 19 in the Colorado Desert, and 0 to 65 in the Yuman Desert.

Mean annual temperatures range roughly from 11 to 14 at neighboring Great Basin stations and 14 to 19 at Mojave Desert stations, except for two hotter stations in Death Valley at 22 and 25. Mean annual temperatures range from 21 to 23 in the Colorado Desert and 18 to 23 in the Yuman Desert.

Precipitation

Precipitation is delivered by storms which follow one of the three principal patterns: winter cyclonic storms; summer thunder storms; and erratic hurricanes (locally called "chubascos"). Winter storms bring moisture from the north Pacific. They are usually widespread, mostly of low intensity, and frequently deliver snow at the higher elevations. Their effects diminish toward the south and toward low elevations.

Summer thunder storms are usually intense, of fairly short duration and somewhat local. Chubascos are very large, violent, and may deliver very large amounts of rain, but they are quite sporadic. Both summer thunder storms and chubascos bring moist tropical air northward from the Gulf of California and up the Colorado River Valley into the Eastern Mojave Desert. These storms may diverge northwestward through the Salton Trough, or westward through Rice Valley, but their effects usually diminish award from the Colorado River Valley.

Total precipitation ranges from 90 to 203 mm at nearby Great Basin stations, 50 to 260 at stations in the Northern and Eastern Mojave Desert regions, and 80 to 170 mm in the Western, Central and Southern Mojave regions (plus recordings of 263 and 377 near mountains at the southern margin of the Western Mojave Desert). Total precipitation ranges from 49 to 139 mm in the Colorado Desert and from 77 to 281 in the Yuman Desert.

The percentage of summer precipitation ranges from 5 to 40 at Great Basin stations, 15 to 20 in the Northern Mojave, 20 to 40 in the Eastern Mojave, only 3 to 10 in the Western Majoave, but 6 to 36 in the Central and Southern Mojave. The percentage of summer precipitation ranges from 11 to 36 in the Colorado Desert and 35 to 59 in the Yuman Desert.

Precipitation during the spring is usually recorded on more than three days a year at stations in the Great Basin, the Eastern Mojave Desert, and Southern Mojave Desert, the Northern Colorado Desert, and the Yuman Desert, but on fewer than three days at Eastern Colorado and Southwest Colorado Deserts.

Vegetation of the Mojave and Colorado Deserts

Vegetation in the desert areas strongly reflects availability of water and evaporative demand for water. Consequently, vegetational biomass is very low at low elevations with their characteristic low precipitation and high temperatures. Vegetational biomass generally increases with elevation as precipitation increases and temperatures decrease. Vegetation structure follows a similar pattern with the predominant growth form being low shrubs at low elevations and in valley bottoms, larger shrubs at intermediate elevations, small trees at higher elevations and larger trees at high mountain elevations.

Vegetational species composition follows a similar elevational pattern and is further modified by regional climatic and other environmental factors.

Classification

The California desert vegetation has been described in detail and classified by Rowlands (unpubl.). We basically follow his classification with slight augmentation from included references (e.g. Thorne, 1982,1986, Vasek and Thorne, 1988). The entire desert area supports seven major vegetational complexes (Table E2). Each complex includes one to several subcomplexes, and each subcomplex includes one to several vegetation types. A vegetation type typically includes all the numerous, similar communities dominated by a given group of perennial plants.

Vegetation across the Mojave Desert is quite complicated,with much variation in species composition and much interdigitation between vegetation units. A range of variation in space and in time exists for each environmental parameter, and a range of variation in tolerance to each parameter exists in each species. Although exact correspondence between variation in species composition and variation in physical environmental factors does not exist, vegetational units must reflect good generalizations on species composition, biomass productivity, soils, climatic conditions and the water table.

Many of the common species may live in more than one vegetation type. Hence, Complex is an appropriate term for major vegetational units (Rowlands unpubl.). Furthermore, the occurrence of common species outside their primary vegetation unit leads to difficulty in delimitation and classification, and hence to differences of opinion regarding the correct classification of vegetation. In all probability, there is no such thing as a "correct classification" (Rowlands unpubl.). Any system of classification is only as good as its utilitarian value. We follow the system out lined by Rowlands based on the judgement that the vegetational units described are reasonable in terms of repetitive observation and useful in terms of management units.

Vegetation Types

I. Desert Scrub Complex

The Desert Scrub Complex includes three subcomplexes. This vegetation occurs on slopes, plains, and alluvial fans and in basins and valleys at low elevations over most of the desert area.

1. The Mojave-Colorado Desert Subcomplex is most common and widespread, occurring over more than 70% of the area of the Mojave and Colorado Deserts. Its three component vegetation types experience similar climatic conditions. This vegetation is limited by cold temperatures at

northern or upper elevational margins, and by high salt or extreme aridity at low elevations.

Creosote Bush Scrub is by far the most important and widespread desert vegetation type. It occurs on most terrain below about 1,500 meters, being common on alluvial fans and gentle slopes, becoming less common on steep, rocky slopes. It is dominated in various proportions by *Larrea tridentata* and *Ambrosia dumosa*, but a great many other species (see Table E3) also occur in various proportions at various places, and may even assume co-dominance.

The ratio of Potential Evaporation to Precipitation varies from 4 at upper elevations to 32 in Death Valley. Precipitation ranges from 40 to about 270 mm. Mean January minimum temperatures range from -6 to 6 degrees C, and mean July maxima range from 34 to 47 (Table E4).

Cheesebush Scrub occurs within the Creosote Bush Scrub zone on sandy, mobile substrate, usually in washes and drainage channels of the Mojave Desert which do not have an overstory microphyll woodland. Some components evidently play a role in secondary succession (Vasek 1975a, b). Plants in this vegetation seem to tolerate slightly lower winter temperatures than those in the Creosote Bush Scrub (Table E4).

Succulent Scrub occurs on upper slopes and bajadas within the Creosote Bush Scrub zone, thus experiencing the most favorableclimatic conditions of that zone. It is dominated by stem succulent species: mostly *Cactaceae*, but also *Yucca*, in the Mojave Desert; and mostly Agavaceae, but also Cactaceae and *Fouquieria*, in the Colorado Desert. Other species of the Creosote Bush Scrub also occur here, but the strong dominance of stem succulent plants, which undergo CAM metabolism, warrants recognition as a functional vegetation type.

2. The Saline-Alkali Scrub Subcomplex occupies mostly sinks and valley bottoms, and also some upland slopes with or without pronounced saline or alkaline conditions. The five vegetation types are dominated by chenopodiaceous shrubs and constitute what others have called `salt bush scrub'. The first three vegetation types are primarily xerophytic in nature and the last two types are halophytic.

Shadscale Scrub occurs on alkaline soils at low elevations in the Great Basin and the northern and eastern Mojave Desert. It also occurs on heavy soils on steep slopes in mountains of the Death Valley region. It tolerates both high salt levels and very arid conditions. Shadscale Scrub often occupies a position between Creosote bush Scrub and Sagebrush Scrub, similar to the position of Blackbush Scrub, and the climate is similar to that for Black bush Scrub (Table E4). Shadscale Scrub is dominated by *Atriplex confertifolia*, although several other species usually are also present (Table E3).

Desert Holly Scrub occupies extremely arid sites mostly in the northern and eastern Mojave Desert. In Death Valley, stands of Desert Holly occur at the foot of alluvial fans which contain a high percentage of carbonate rocks and a very salty substrate. Precipitation is very low but summer temperatures and the potential evaporation are very high (Table E4). *Atriplex hymenelytra* often occurs in pure, albeit sparse, stands, but sometimes *Atriplex polycarpa* or *Tidestromia oblongifolia* are also present.

Mojave Saltbush - Allscale Scrub occurs only in the southwest Mojave Desert near Kramer Junction and Fremont Peak. It occupies some upland areas and is rather similar to Shadscale Scrub. The dominant species are *Atriplex spinifera* and *A. polycarpa* but other components may also occur (Table E3).

Allscale - Alkali Scrub occurs in and around sinks and dry lakes where available ground water may contain up to 2.5% salts. This vegetation includes succulent or semi-succulent halophytes such as *Atriplex polycarpa* and several other species of *Atriplex*, *Kochia* spp., *Suaeda torreyana* and *Haplopappus acradenius*. The climate is hot and dry (Table E4), but the vegetation is mediated primarily by the salty water table.

Iodinebush - Alkali Scrub is similar to the preceding in habitat, climate and physiognomy, but occurs in sinks where available ground water may contain up to 6% salts. This vegetation is dominated by succulent halophytes, primarily *Allenrolfea occidentalis*. It may also include *Sarcobatus vermiculatus*, *Nitrophila occidentalis* and several others (Table E3).

3. The Great Basin Scrub Subcomplex occurs primarily in the Great Basin but is represented by significant occurrences of three vegetation types at upper elevations of the Desert Scrub Zone, in the eastern and northern Mojave Desert and to a lesser extent southward. It generally occurs at elevations below the Xeric Conifer Woodland (see below) and above the Creosote Bush Scrub and Succulent Scrub.

Sagebrush Scrub is the dominant scrub vegetation of the Great Basin region, but may be found at upland Mojave Desert sites, such as Round Valley north of the Providence Mountains. The climate is generally colder in winter and cooler in summer than for the two preceding subcomplexes, and the precipitation is a little higher (Table E4). Usually *Artemisia tridentata* dominates over extensive areas, but sometimes is replaced by *Artemisia nova*, especially on heavy, rocky soils. Many other species (Table E3) also occur in various combinations at different places. Sagebrush Scrub often forms an under story to Pinyon and Juniper Woodland types.

Blackbush Scrub occurs widely in the Mojave Desert on rocky, heavy soils at elevations of 1,000 to 2,000 meters. It occurs sparingly in the Colorado Desert. This vegetation is dominated by *Coleogyne ramosissima*. In addition, *Grayia spinosa*, *Ceratoideslanata*, *Thamnosma montana*, and species of *Ephedra*, *Yucca*, *Lycium*, *Haplopappus*, etc. (Table E3), may also occur but species diversity is usually low at any one locality. The climate is similar to that of Succulent Scrub, but a little cooler in summer (Table E4).

Hopsage Scrub is common in the eastern Mojave Desert, usually on sandy-loamy soils with only moderate rock content. Otherwise the habitat and climatic conditions are very similar to those of Blackbush scrub. *Grayia spinosa* is the usual dominant, often with any of several species of *Lycium* as a co-dominant. *Haplopappus cooperi* and several components of Creosote Bush Scrub may also be present.

Sometimes Joshua Trees (*Yucca brevifolia*) may occur in Hopsage Scrub, Blackbush Scrub, Shadscale Scrub, Creosote Bush Scrub, Succulent Scrub, and the Juniper - One-leaf Pinyon Woodlands. In these cases, Joshua Trees may appear as visual dominants, but they provide very minor fractions of ground cover or biomass. Hence, Joshua Trees are not dominant anywhere, despite

their conspicuity around the Mojave Desert, and do not provide consistent basis for recognizing a separate vegetation type (Rowlands 1978).

II. Desert Woodland Forest-Conifer Complex

A Conifer Woodland-Forest Complex, with two subcomplex components, occurs in mountains and high elevation desert areas.

1. The Xeric Conifer Woodland Subcomplex covers large areas between about 1,200 to 2,800 meters in elevation. It includes three vegetation types dominated by shrubs and small trees. This subcomplex is a highly productive and floristically diverse desert vegetation.

Utah Juniper - One-Leaf Pinyon Woodland is common in the Great Basin region and in the Northern and Eastern Mojave Desert. It occurs in the Providence Mountains and then has a major disjunction in the San Bernardino Mountains. The overstory trees are *Juniperus osteosperma* and *Pinus monophylla*, and sometimes a few Joshua Trees. Some arborescent shrubs are *Quercus turbinella* and *Cercocarpus ledifolius*. A rich assortment of other associated shrubs is partly listed in Table 3. The climate is similar to that of Sagebrush Scrub but is a little wetter and colder (Table E4).

California Juniper - One-Leaf Pinyon Woodland occurs on mountains bordering the Mojave Desert from just north of Walker Pass in Kern County, California southward to the mountains bordering the Colorado Desert in San Diego County, California. It also occurs on mountains of sufficient stature within the desert area such as the Granite Mountains and Granite Pass*, the Old Woman, Coxcomb, Eagle, Cottonwood and Little San Bernardino Mountains. This vegetation type is dominated by small trees (*Pinus monophylla*) and arborescent shrubs (*Juniperus californica*). Some of the other associated species are listed in Table E3. The more southern distribution makes for a warmer climate than for the preceding type (Table E4).

California Juniper - Four-Leaf Pinyon Woodland occurs in the peninsular ranges of California and Baja California at the western margin of the Colorado Desert. The dominant species are *Juniperus*

* The sudden change from a Utah Juniper Woodland in the Providence Mountains to a California Juniper Woodland in the Granite Mountains and Granite Pass may be strong biogeographical evidence in favor of including the Granite Mountains in the Colorado Desert rather than the Mojave Desert.

californica, *Pinus quadrifolia*, and *P. monophylla*. Some of the associated understory species (Table E3) include several found in Desert Chaparral and Redshanks Chaparral (Hanes, 1977). The climate is similar to that of the preceding (Table E4).

2. A Desert Mountain Forest Subcomplex occurs in the limited area at higher mountain elevations, and essentially represent sub-humid islands in an arid environment. Three vegetation types are included.

White Fir Forest elements occur in small pockets in the New York, Clark and Kingston Ranges. These small pockets of forest are essentially imbedded in the upper parts of Utah Juniper-Oneleaf Pinyon Woodland where local site characteristics mediate an evapotranspiration rate well below that expected for the region. Some of the associated species (Table E3) are found with White Fir in the Charleston (Spring) Mountains. These pockets represent the western most attenuation of the White fir-Douglas fir-Blue spruce zone of the Wasatch Series of the Great Basin vegetation (Vasek and Thorne, 1988). The dominant tree is *Abies concolor*.

Subalpine Woodland is found on upper slopes of high desert margin mountains from the Sweetwater Mountains to the Transverse and Peninsular Ranges of Southern California, and on the highest desert mountains, namely the Inyo, Panamint and White Mountains, at elevations of about 2,900 to 3,500 meters. The main trees are *Pinus flexilis* and sometimes *Acer glabrum* or *Juniperus occidentalis*. This woodland may overlap the upper Pinyon Woodland at its lower margin and may overlap the Bristlecone Pine Forest at the higher elevations. The trees are usually small and sparsely distributed. A few associated shrubs are listed in Table E3. The climate is characterized by low precipitation and cold winters.

Bristlecone Pine Forest is found on the highest mountains in the Mojave Desert and Great Basin From the Inyo, Panamint and White Mountains of California to Nevada and Utah. A few trees also occur in the Last Chance Mountains. The trees, primarily *Pinus longaeva*, are usually small and scattered. They sometimes form small forest-like stands in the Inyo and White Mountains, but more commonly are scattered in a `woodland'.

III. Desert Microphyll Woodland Complex

A Desert Microphyll Woodland Complex with two subcomplexes occurs in low desert areas with favorable, but often intermittent,soil moisture conditions.

1. A Paloverde Microphyll Woodland occurring in washes and on slopes with substantial regular summer rain (e.g. Whipple Mountains), includes two vegetation types.

Foothill Paloverde - Saguaro Woodland occurs in Sonoran Desert areas with substantial summer rain. It is sparsely represented in California, being found only near the Colorado River, primarily in the Whipple Mountains, but is far more important southward in Arizona. Similarly, the two most conspicuous components, *Cercidium microphyllum* and *Carnegiea gigantea*, are also rare in California.

Blue Paloverde - Ironwood - Smoketree Woodland is rather common in the Colorado Desert. It occurs throughout the Creosote Bush climatic zone, usually being concentrated in washes. The main components are *Cercidium floridum*, *Olneya tesota*, *Psorathamnus spinosa*, *Chilopsis linearis*, *Acacia greggii*, and a few others (Table E3). The understory is drawn from species also found in Creosote Bush Scrub and Cheesebush Scrub.

2. A Mesquite Microphyll Woodland with only one vegetation type is found in basins near and around seeps and sinks, or on sand sheets over a shallow, salty water table.

Mesquite Thicket is dominated by *Prosopis glandulosa* and *Prosopis pubescens*. The understory associates are commonly halophytic species found in the Allscale - Alkali Scrub and the Iodinebush - Alkali Scrub. The climate is hot and arid (Table E4). This vegetation type is controlled mostly by the occurrence of water near the surface.

IV. Streamside (Riparian) and Woodland Complex

A Riparian and Oasis Woodland Complex, with two subcomplexes, is found in areas near running water.

1. Streamside Woodland Subcomplex, with two vegetation types, is found along rivers and streams. This vegetation reflects azonal humid conditions within an arid zone, being dependent on water flow in or under a stream channel and therefore essentially inde pendent of the general climate.

Cottonwood - Willow - Mesquite Bottomland vegetation occurs intermittently in narrow strips on either side of major streams, such as the Colorado, Mojave and Virgin Rivers (near Parker, Victorville and Beaver Dam, respectively). It is dominated by *Populus macdougallii*, *P. fremontii*, *Salix exigua* and other willows, and *Prosopis glandulosa*. This vegetation has been suffering extensive degradation from the after-effects of dam construction, exhaustive recreational development and invasion of tamarisk trees.

Cottonwood - Willow Streamside Woodland occurs along small streams that flow into the desert. Some examples are the Amargosa Gorge near China Ranch, Andreas and Palm Canyons near Palm Springs, the Whitewater River and many canyons draining the Panamint Mountains and the eastern side of the Sierra Nevada. The dominant trees are *Populus Fremontii*, *Salix* spp., occasionally *Platanus racemosa*, and, in the Colorado Desert, *Washingtonia filifera*.

2. Desert Oasis Woodland Subcomplex has one vegetation type occurring primarily in the Colorado Desert, but also at Sonoran localities in Mexico and Arizona, and sparingly in the Mojave Desert as far north as southern Nevada and Death Valley National Monument.

Palm Oases occur around springs and seeps, being especially common along the San Andreas fault. *Washingtonia filifera* is the only species consistently found in all palm oases. The soil surface is often salt encrusted. Plants of the Saltgrass Meadow and Allscale- Alkali Scrub are frequent in the understory. The climate is similar to that of the Paloverde-Ironwood-Smoketree Woodland (Table E4).

V. Desert and Semidesert Grassland Complex

A Desert and Semidesert Grassland Complex, occurs in rather scattered locations, usually near the ecotone between scrub vegetation and woodland vegetation.

1. A Desert-Semidesert Scrub Steppe Subcomplex, in which perennial bunch grasses are at least co-dominant with shrubs, is widespread but scattered in the Mojave Desert. It includes four vegetation types (Table E2).

Indian Ricegrass Scrub-Steppe occurs in the Western and Southern Mojave where winter rainfall is the primary moisture source, or in mountains above 1,500 meters where winters are cold. The dominant grasses, *Oryzopsis hymenoides* and *Stipa speciosa*, have C3 metabolism. Shrub components within the grass matrix are usually *Larrea tridentata* and *Ambrosia dumosa*. A scattered overstory of *Yucca brevifolia* or *Juniperus californica* frequently occurs at higher elevations. The climate is somewhat like that of Blackbush Scrub, but a little hotter in summer (Table E4) and perhaps a little wetter.

Desert Needlegrass Scrub-Steppe also occurs in the Western and Southern Mojave, frequently at localities with significant summer rain. Extensive stands of *Stipa speciosa* often have a scattered overstory of *Yucca brevifolia* or *Juniperus californica*. Shrub associates are mostly those of the Blackbush Scrub (Table E3). The climate is slightly cooler than that of the Ricegrass Scrub Steppe (Table E4).

Big Galleta Scrub-Steppe is widely distributed through the Mojave Desert in areas where at least 20% of the precipitation falls in summer. It is dominated by *Hilaria rigida*, *Bouteloua eriopoda* and *Muhlenbergia porteri*, which are summer-active C4 grasses. The scattered overstory consists of *Juniperus osteosperma* and *Yucca brevifolia jaegeriana* in the Eastern Mojave and *Juniperus californica* and *Yucca brevifolia brevifolia* in the Western and Southern Mojave Desert. Associated scrub species are mostly those of the Hopsage Scrub and Blackbush Scrub (Table E3). Below 1,000 meters, where an overstory is not present, conditions approach those of Creosote Bush Scrub. Above 1,000 meters, an overstory is usually present and conditions are more like those of Hopsage Scrub or Blackbush Scrub (Table E4).

Galleta - Blue Grama Scrub-Steppe occurs mostly in the Eastern Mojave Desert at elevations above 1,400 meters where it replaces the preceding type. It is dominated by the summer active C4 grasses, *Hilaria jamesii* and *Bouteloua gracilis*. Shrub associates are usually those of Sagebrush Scrub and the overstory, when present, is usually *Juniperus osteosperma*. The climate is similar to that of Sagebrush Scrub (Table E4.)

2. A Desert Alkali Grassland Subcomplex with one vegetation type, occurs on highly saliferous substrates around springs and alkali seeps at low elevations.

Saltgrass Meadow occurs locally at Saratoga Springs, Tecopa Springs, and various places along the Amargosa River. It is dominated by *Distichlis spicata* and may also include *Sporobolus airoides*, *Anemopsis californica*, *Juncus cooperi* and several others (Table E4). Shrub cover and biomass are rather low. The few shrubs are mostly halophytes like *Allenrolfea*. The climate is very harsh with little precipitation and very high summer temperatures.

VI. Desert Saxicole Shrub Complex

A Desert Saxicole Scrub Complex, with two subcomplexes occurs on steep cliffs and rock faces, and therefore consists of highly localized and edaphically specialized azonal plant assemblages.

1. The Calciphyte Saxicole Subshrub Subcomplex has one vegetation type which grows on rock outcrops widely distributed in the Northern and Eastern Mojave Desert.

Calciphyte Saxicole Subscrub occurs in crevices and on rock faces of dolomite, dolomitic limestone and similar calciferous outcroppings. It includes two series: a dolomitic series on rocks high in calcium-magnesium carbonate; and, a gypsicolus series on rocks rich in calcium sulfate. The species composition is highly variable from one locality to another. Many are rare endemics. A partial list of such species for each series is given in Table E3.

2. The Non - Calciphyte Saxicole Subshrub Subcomplex also has one vegetation type which occurs on rock outcrops which are not or only slightly, calciferous.

Non - Calciphyte Saxicole Subscrub also occurs in the Northern and Eastern Mojave Desert but is more common to the south. The rock substrates are rather heterogeneous, and the species assemblages vary extensively from one locality to another. A partial list of species is given in Table E3.

VII. Desert Psammophyte Complex

A Desert Psammophyte Complex with only one subcomplex, the Desert Psammophyte Subcomplex, occurs on sand dunes.

1. The Desert Psammophyte Subcomplex occurs on sand dunes in both deserts. The largest dunes have the richest flora, and the most constant species, *Larrea tridentata* and *Coldenia plicata*, are not restricted to dunes and certainly are not obligate psammophytes. Many species are restricted to sand dunes or sandy substrates. Some of these obligate psammophytes apparently do not occur in northern dune systems and others do. Some rare endemics occur only on the Eureka Valley dune system (*Swallenia alexandre*, *Oenothera avita eurekensis*). Some rare species occur only in the Algodones Dunes (*Astragalus magdalenae peirsonii*, *Croton wigginsii*, *Helianthus niveus tephrodes*, *Pholisma sonorae*). The species composition varies from one locality to another. The vegetation is quite complex, consisting of local azonal assemblages. They are probably mediated largely by the fact of sand substrate, perhaps with associated water availability characteristics, rather than by climate *per se*.

Table E1. Climatic Summary for stations in several desert regions. (% J-S = percent of precipitation falling in summer; W and S = number of winter and spring days with 2.5 mm precipitation.)

Station	Elev	Temperature (°C) Mean Ann Min	Mean Jan	Mean July Max	No. Days Freeze	Precipitation (mm) Mean Ann	% J-S	No. of days w/ 2.5 mm ppt W	S
Great Basin									
Sarcobatus	1225	13.5	-6.5	36.8	144	89.9	40.0	6	3
Bishop	1252	13.4	-6.2	34.9	147	157.5	4.7	9	0
Caliente	1342	11.7	-8.7	35.2	165	202.7	27.4	18	5
Deep Spr.	1593	11.3	-10.1	33.4	155	131.3	12.8	9	3
Goldfield	1733	----	-6.8	32.0	150	127.8	23.3	---	---
Northern Mojave									
Cow Creek	-38	25.1	4.9	46.7	3	49.5	17.4	4	0
Greenland	-51	22.4	3.1	46.6	8	41.4	18.4	4	0
Beatty	1010	15.3	-2.4	37.5	88	118.0	14.9	11	2
Wildrose RS	1250	----	-1.6	35.1	---	185.2	19.8	---	---
Eastern Mojave									
Baker	319	----	0.9	42.9	---	75.2	20.7	8	1
Littlefield	567	18.2	-1.1	40.3	74	157.5	23.8	15	3
Las Vegas WPAP	659	18.9	-0.1	40.1	46	99.1	40.0	8	3
Boulder City	770	19.4	3.3	38.4	13	137.2	33.4	11	3
St. George	823	15.6	-5.3	38.4	96	209.6	29.2	16	4
Desert Game R	890	16.8	-1.5	38.2	127	103.9	27.1	6	3
Kingman	1016	16.4	-0.7	36.6	59	276.9	33.1	15	7
Alamo	1049	13.7	-5.9	37.7	157	164.9	30.7	12	2
Searchlight	1070	17.5	1.7	36.1	34	208.7	37.3	11	5
Pierce Ferry	1177	----	-2.2	35.6	---	256.5	35.9	---	---
Yucca Grove	1204	----	-2.5	35.3	---	185.4	21.0	---	---
Mitchell's Cav	1320	----	-3.1	34.2	---	171.5	27.5	---	---
Mountain Pass	1442	----	-2.0	34.8	---	173.0	31.2	---	---

Table E1. Climatic Summary for stations in several desert regions. (Continued.)

Station	Elev	Temperature (°C) Mean Ann Min	Mean Jan	Mean July Max	No. Days Freeze	Precipitation (mm) Mean Ann	% J-S	No. of days w /2.5 mm ppt W	S
Western Mojave									
Trona	517	18.9	-0.6	41.3	47	82.0	8.4	8	0
Lancaster	717	16.1	-1.9	37.4	80	124.2	2.9	11	0
Inyokern	744	17.6	-1.1	39.4	65	90.7	5.6	8	0
Palmdale AP	767	15.8	-1.6	36.7	81	139.2	3.2	12	0
Buckus Ranch	806	16.6	-1.2	37.0	67	162.9	5.5	12	1
Palmdale	809	16.5	-2.7	36.6	60	130.8	3.7	12	0
Mojave	846	----	-0.7	37.4	---	128.5	8.1	---	---
Victorville	871	15.3	-2.7	35.4	84	135.7	5.6	9	0
Fairmont	933	15.7	2.2	32.6	29	376.7	2.3	20	0
Randsberg	1076	17.2	1.6	36.7	33	149.6	9.9	11	1
Valyermo	1129	13.9	-2.5	40.3	103	263.3	7.6	13	1
Llano	1164	16.1	0.9	34.5	44	174.8	7.9	13	2
Haiwee	1166	15.5	-1.3	37.0	73	150.6	9.6	8	2
Central Mojave									
Barstow	653	17.7	-0.4	39.1	57	108.5	27.2	10	2
Southern Mojave									
Twentynine Palms	602	19.7	1.6	37.2	29	104.4	36.3	5	4
Joshua Tree	838	----	----	----	---	123.7	23.4	---	---
Lucerne Valley	919	15.8	-2.4	38.9	104	108.2	18.1	10	3
Hesperia	974	----	----	----	---	157.7	6.3	---	---
Kee Ranch	1318	----	----	----	----	167.6	9.2	7	2
Northern Colorado									
Parker Res	225	23.3	5.3	42.3	1	129.3	32.8	8	3
Needles	278	22.5	4.7	42.3	6	111.8	33.9	7	3
Iron Mtn	281	23.0	5.6	42.1	2	79.5	20.1	5	2

Table E1. Climatic Summary for stations in several desert regions. (Continued.)

Station	Elev	Temperature (°C) Mean Ann Min	Mean Jan	Mean July Max	No. Days Freeze	Precipitation (mm) Mean Ann	% J-S	No. of days w/ 2.5 mm ppt W	S
Eastern Colorado									
Blythe	81	22.2	2.0	42.2	12	100.3	32.7	5	1
Eagle Mtn	297	23.0	5.6	41.0	1	82.8	36.5	5	1
Hayfield	418	21.1	3.4	40.5	16	95.6	31.9	6	1
Southwestern Colorado									
El Centro	-11	22.6	3.4	42.8	15	65.3	28.0	5	1
Imperial	-20	22.4	3.9	41.6	5	49.0	25.0	5	0
Brawley	-36	22.9	3.2	42.1	7	59.4	21.4	2	0
Thermal	-37	22.8	3.9	41.8	12	70.1	21.4	4	1
Mecca	-53	22.1	2.9	41.2	12	75.9	24.1	3	0
Indio	3	22.9	3.4	41.6	15	79.8	19.7	4	0
Palm Springs	128	22.3	4.4	42.2	12	138.9	11.2	9	2
Borrego Spr.	191	21.1	2.6	41.4	19	89.2	26.8	7	1
Yuman Desert									
Yuma	42	22.2	3.7	41.3	11	82.3	38.0	3	3
Wellton	79	21.4	1.1	41.6	38	105.7	41.6	4	4
Dateland	138	22.9	3.4	43.1	15	76.7	35.1	4	4
Gila Bend	225	22.3	3.0	42.7	13	142.5	39.9	7	5
Phoenix PO	330	21.5	4.0	39.8	6	194.1	39.0	8	10
Organ Pipe NM	507	20.7	2.8	39.2	19	207.8	47.6	8	10
Ajo	537	21.8	4.8	39.4	6	231.9	48.6	9	9
Kofa Mtns	541	23.1	8.0	39.9	0	140.7	58.8	8	6
Yucca	594	----	----	----	---	167.1	36.3	---	---
Wickenburg	631	18.2	-1.1	39.3	65	272.0	40.3	13	8
Wickieup	648	18.8	0.6	40.3	55	264.6	38.8	12	7
Aguila	665	18.8	0.2	39.7	58	236.1	37.0	12	7
Signal	762	----	----	----	----	281.2	40.7	---	---

Table E2. Classification of Desert Vegetation.

- ***Complex***
  - ***Subcomplex***
    - Vegetation Type

- ***Desert Scrub***
  - ***Great Basin Scrub***
    - Sagebrush Scrub
    - Blackbush Scrub
    - Hopsage Scrub
  - ***Saline Alkali Scrub***
    - Shadscale Scrub
    - Desert Holly Scrub
    - MOjave Saltbush-Allscale Scrub
    - Allscale-Alkali Scrub
    - Iodinebush-Alkali Scrub
  - ***Mojave Colorado Desert Scrub***
    - Creosote Bush Scrub
    - Cheesebush Scrub
    - Succulent Scrub

- ***Desert Conifer Woodland-Forest***
  - ***Xeric Conifer Woodland***
    - Utah Juniper-Oneleaf Pinyon Woodland
    - California Juniper-Oneleaf Pinyon Woodland
    - California Juniper-Fourleaf Pinyon Woodland
  - ***Desert Montane Forest***
    - White Fir Forest
    - Subalpine Woodland
    - Bristlecone Pine Forest

Table E2. Classification of Desert Vegetation. (Continued.)

Desert Microphyll Woodland

Paloverde Microphyll Woodland

Foothill Paloverde-Saguaro Woodland

Blue Paloverde-Ironwood-Smoketree Woodland

Mesquite Microphyll Woodland

Mesquite Thicket

Riparian and Oasis Woodlands

Riparian Woodland

Cottonwood-Willow Riparian Woodland

Cottonwood-Willow-Mesquite Bottomland

Oasis Woodland

Palm Oasis

Desert and Semidesert Grassland

Desert and Semidesert Scrub Steppe

Indian Ricegrass Scrub Steppe

Desert Needlegrass Scrub Steppe

Big Galleta Scrub Steppe

Galletta - Blue Grama Scrub Steppe

Desert Alkali Grassland

Saltgrass Meadow

Desert Saxicole Subscrub

Calciphyte Saxicole Subscrub

Calciphyte Saxicole Subscrub

Non-Calciphyte Saxicole Subscrub

Non-Calciphyte Saxicole Subscrub

Desert Sand Dune

Desert Psammophyte

Desert Psammophyte

Table E3. Some characteristic plants of desert vegetation.

Great Basin Scrub Subcomplex

Sagebrush Scrub	
Artemisia tridentata	*Artemisia nova*
Purshia glandulosa	*Chrysothamnus nauseosus*
Chrysothamnus viscidiflorus	*Coleogyne ramosissima*
Cowania mexicana	*Ceratoides lanata*
Tetradymia sp.	*Oryzopsis hymenoides*
Gutierrezia sarothrae	*Poa secunda*
Sitanion hystrix	*Ephedra viridis*
Blackbush Scrub	
Coleogyne ramosissima	*Yucca baccata*
Yucca brevifolia	*Thamnosma montana*
Grayia spinosa	*Ceratoides lanata*
Artemisia spinescens	*Agave utahensis*
Ephedra nevadensis	*Ephedra viridis*
Atriplex confertifolia	*Atriplex canescens*
Tetradymia spp.	*Eriogonum* spp.
Lycium spp.	*Haplopappus* spp.
Hopsage Scrub	
Grayia spinosa	*Lycium pallidum*
Lycium andersonii	*Lycium shockleyi*
Haplopappus cooperi	*Larrea tridentata*
Ambrosia dumosa	*Yucca brevifolia*

Saline - Alkali Scrub Subcomplex

Shadscale Scrub	
Atriplex confertifolia	*Atriplex canescens*
Ceratoides lanata	*Artemisia spinescens*
Grayia spinosa	*Menodora spinescens*
Gutierrezia spp.	*Coleogyne ramosissima*
Yucca brevifolia	
Desert Holly Scrub	
Atriplex hymenelytra	*Atriplex polycarpa*
Tidestromia oblongifolia	
Mojave saltbush - Allscale Scrub	
Atriplex spinifera	*Atriplex polycarpa*
Ceratoides lanata	*Larrea tridentata*
Tetradymia glabrata	*Yucca brevifolia*
Tetradymia stenolepis	
Allscale-alkali Scrub	
Atriplex polycarpa	*Atriplex confertifolia*
Atriplex torreyi	*Atriplex lentiformis*
Atriplex canescens	*Kochia* spp.
Suaeda torreyana	*Haplopappus acradenius*
Allenrolfea occidentalis	*Prosopis* spp.
Sarcobatus vermiculatus	*Nitrophila occidentalis*
Suaeda spp.	*Atriplex* spp.

Table E3. Some characteristic plants of desert vegetation. (Continued.)

Saline - Alkali Scrub Subcomplex

Allscale-alkali Scrub (Continued.)

Salicornia utahensis	*Sporobolus airoides*
Phragmites australis	*Juncus cooperi*
Pluchea sericea	

Mojave-Colorado Desert Scrub Subcomplex

Creosote Bush Scrub

Larrea tridentata	*Ambrosia dumosa*
Hymenoclea salsola	*Atriplex* spp.
Encelia farinosa	*Acamptopappus sphaerocephalus*
Opuntia spp.	*Yucca* spp.
Lycium spp.	*Dalea* spp.
Hilaria rigida	*Stipa speciosa*
Oryzopsis hymenoides	

Cheesebush Scrub

Hymenoclea salsola	*Encelia farinosa*
Brickellia incana	*Brickellia oblongifolia*
Chrysothamnus paniculatus	*Baccharis* spp.
Ambrosia eriocentra	*Larrea tridentata*
Cassia armata	*Acacia greggii*
Chilopsis linearis	

Succulent Scrub

Agave spp.	*Nolina* spp.
Yucca spp.	*Opuntia* spp.
Ferocactus acanthodes	*Echinocereus* spp
Mammilaria spp.	*Coryphantha* spp.
Fouquieria splendens	*Larrea tridentata*
Ambrosia dumosa	*Encelia farinosa*

Xeric Conifer Woodland Subcomplex

Utah Juniper - Oneleaf Pinyon Woodland

Juniperus osteosperma	*Pinus monophylla*
Yucca brevifolia	*Artemisia tridentata*
Artemisia nova	*Ephedra viridis*
Coleogyne ramosissima	*Eriogonum wrightii*
Ceanothus greggii	*Cercocarpus ledifolius*
Fallugia paradoxa	*Chrysothamnus teretifolius*
Chrysothamnus viscidiflorus	*Rhus trilobata*
Quercus turbinella	*Cowania mexicana*
Purshia glandulosa	*Ribes velutinum*
Hilaria jamesii	*Stipa* spp.
Gutierrezia spp.	*Thamnosma montana*

Table E3. Some characteristic plants of desert vegetation. (Continued.)

Xeric Conifer Woodland Subcomplex (Continued.)

California Juniper - Oneleaf Pinyon Woodland

Juniperus californica	*Pinus monophylla*
Yucca brevifolia	*Quercus turbinella*
Quercus dunnii	*Arctostaphylos glauca*
Eriogonum spp.	*Ephedra* spp.
Crossosoma bibelovii	*Haplopappus* spp.
Purshia glandulosa	*Prunus fasciculata*
Nolina parryi	*Salvia dorii*
Opuntia basillaris	*Hilaria rigida*
Stipa speciosa	*Bouteloua gracilis*

California Juniper - Fourleaf Pinyon Woodland

Juniperus californica	*Pinus quadrifolia*
Arctostaphylos glauca	*Pinus monophylla*
Nolina parryi	*Yucca whipplei*
Yucca schidigera	*Rhus ovata*
Ceanothus greggii	*Opuntia* spp.
Adenostoma fasciculatum	*Adenostoma sparsifolium*

Desert Montane Forest Subcomplex

White Fir Forest

Abies concolor	*Pinus monophylla*
Juniperus osteosperma	*Acer glabrum diffusum*
Amelanchier utahensis	*Fraxinus anomala*
Holodiscus microphyllus	*Petrophytum caespitosum*
Philadelphus microphyllus	*Quercus chrysolepis*
Quercus turbinella	*Ribes cereum*
Ribes velutinum	

Subalpine Woodland

Pinus flexilis	*Pinus longaeva*
Acer glabrum diffusum	*Juniperus occidentalis*
Artemisia tridentata	*Ribes cereum*
Chamaebatiaria millefolium	*Chrysothamnus viscidiflorus*
Ribes montigenum	*Symphoricarpus longiflorus*

Bristlecone Pine F.

Pinus longaeva	*Pinus flexilis*
Antennaria rosea	*Arenaria kingii*
Astragalus kentrophyta	*Chrysothamnus viscidiflorus*
Cymopterus cinerarius	*Erigeron pygmaeus*
Haplopappus acaulis	*Muhlenbergia richardsonis*
Phlox covillei	

Table E3. Some characteristic plants of desert vegetation. (Continued.)

Paloverde Microphyll Woodland Subcomplex

Foothill Paloverde -Saguaro Woodland

Cercidium microphyllum	*Carnegiea gigantea*
Larrea tridentata	*Encelia farinosa*
Opuntia bigelovii	

Blue Paloverde-Ironwood-Smoketree Woodland

Cercidium floridum	*Bebbia juncea*
Olneya tesota	*Prosopis* spp.
Psorathamnus spinosa	*Hymenoclea salsola*
Chilopsis linearis	*Ambrosia dumosa*
Castela emoryi	*Larrea tridentata*
Acacia greggii	*Chrysothamnus paniculatus*
Hyptis emoryi	*Hoffmannseggia microphylla*
Cassia armata	*Brickellia* spp.

Mesquite Microphyll Woodland Subcomplex

Mesquite Thicket

Prosopis glandulosa	*Prosopis pubescens*
Atriplex polycarpa	*Atriplex confertifolia*
Atriplex torreyi	*Atriplex lentiformis*
Atriplex canescens	*Kochia* spp.
Nitrophila occidentalis	*Suaeda torreyana*
Sarcobatus vermiculatus	*Salicornia utahensis*

Streamside Woodland Subcomplex

Cottonwood - Willow - Mesquite Bottomland

Populus fremontii	*Salix exigua*
Salix spp.	*Prosopis glandulosa*
Tamarix spp.	

Cottonwood - Willow - Streamside Woodland

Populus fremontii	*Salix* spp.
Platanus racemosa	*Prosopis* spp.
Washingtonia filifera	*Typha* spp.
Pluchea sericea	*Phragmites australis*
Baccharis spp.	

Desert Oasis Woodland Subcomplex

Palm Oasis

Washingtonia filifera	*Pluchea sericea*
Sporobolus airoides	*Distichlis spicata*

Table E3. Some characteristic plants of desert vegetation. (Continued.)

Desert-Semidesert Scrub Steppe Subcomplex

Indian Ricegrass Scrub Steppe

Oryzopsis hymenoides	*Stipa speciosa*
Larrea tridentata	*Ambrosia dumosa*

Desert Needlegrass Scrub Steppe

Stipa speciosa	*Juniperus californica*
Yucca brevifolia	*Coleogyne ramosissima*
Ephedra nevadensis	*Haplopappus linearifolius*
Purshia glandulosa	*Lycium andersonii*
Tetradymia spinosa	
Eriogonum fasciculatum var. polifolium	

Big Galleta Scrub Steppe

Hilaria rigida	*Bouteloua eriopoda*
Muhlenbergia porteri	*Stipa speciosa*
Oryzopsis hymenoides	*Yucca brevifolia*
Juniperus spp.	*Larrea tridentata*
Ambrosia dumosa	*Ephedra nevadensis*
Hymenoclea salsola	*Yucca schidigera*
Haplopappus spp.	*Salazaria mexicana*
Thamnosma montana	*Menodora spinescens*
Yucca baccata	*Opuntia* spp.

Galleta-Blue Grama Scrub Steppe

Hilaria jamesii	*Bouteloua gracilis*
Sitanion hystrix	*Oryzopsis hymenoides*
Juniperus osteosperma	*Artemisia tridentata*

Desert Alkali Grassland Subcomplex

Salt Grass Meadow

Distichlis spicata	*Sporobolus airoides*
Phragmites australis	*Allenrolfea occidentalis*
Anemopsis californica	*Juncus cooperi*
Pluchea sericea	

Saxicole Subscrub Subcomplexes

Calciphyte Saxicole Subscrub
-dolomitic-

Arctomecon merriami	*Arenaria kingii*
Astragalus funereus	*Astragalus panamintensis*
Buddleia utahensis	*Cymopterus gilmani*
Cowania mexicana	*Dedeckera utahensis*
Dudleya saxosa	*Eriogonum gilmani*
Eriogonum intrafactum	*Eriogonum heermannii floccosum*
Fendlerella utahensis	*Forsellesia pungens*
Forsellesia nevadensis	*Gilia ripleyi*

Table E3. Some characteristic plants of desert vegetation. (Continued.)

Saxicole Subscrub Subcomplexes

Calciphyte Saxicole Subscrub
-dolomitic- (Continued.)

Hecastocleis shockleyi
Hedeoma nana
Mortonia utahensis
Penstemon calcareus
Salvia funerea
Viola charlestonensis
Notholaena jonesii
Mentzelia pterosperma
Enceliopsis argophylla
Eriogonum insigne
Phacelia palmeri
Arctomecon californica
Holmgrenanthe petrophile
Mimulus rupicola
Phacelia mustelina
Penstemon stephensii
Scopulophila rixfordii
Cheilanthes feei
Notholaena sinuata
Phacelia pulchella
Enceliopsis nudicaulis
Petalonyx parryi
Psathyrotes pilifera
Camissonia multijuga

Non-Calciphyte - Saxicole Subscrub

Peucephyllum schottii
Perityle emoryi
Pleurocoronis pluriseta
Arabis spp.
Dudleya spp.
Notholaena spp.
Pellaea spp.
Haplopappus cuneatus
Brickellia desertorum
Heuchera rubescens
Mimulus spp.
Cheilanthes spp.

Desert Psammophyte Subcomplex

Desert Psammophyte

Larrea tridentata
Coldenia plicata
Psorothamnus emoryi
Ephedra trifurca
Palafoxia arida
Atriplex canescens
Petalonyx thurberi
Oryzopsis hymenoides
Croton wigginsii
Haplopappus acradenius
Abronia villosa
Hesperocallis undulata
Ammobroma sonorae
Hilaria rigida
Prosopis glandulosa
Atriplex polycarpa
Helianthus niveus
Swallenia alexandre
Oenothera avita eurekensis
Astragalus lentiginosus micans
Astragalus magdalenae peirsonii

Table E4. Vegetation types within the California desert together with a summary of the ranges of climatological variable associated with each (LL = Lower limit, UL = Upper Limit).

Vegetational Category	Mean Annual Precip (mm)		Temperature (°C) Mean Jan. Minima		Mean July Maxima		PotE/Ppt Range		Approx. Elev. (x100m)	
	LL	UL	LL	UL	LL	UL	LL	UL	LL	UL
I. Desert Scrub Complex										
A. Great Basin Scrub Subcomplex										
1. Sagebrush Scrub	175	325	-12	-4	25	36	2	5	12	26 (30)
2. Blackbush Scrub	150	240	-8	-4	29	37	3	7	10	20
3. Hopsage Scrub	150	240	-8	-4	29	37	3	7	10	20
B. Saline-Alkali Scrub Subcomplex										
1. Shadscale Scrub	130	225	-8	-4	31	37	3	7	10	18
2. Desert Holly Scrub	42	90	-8	-4	37	47	10	32	-0.8	8 (15)
3. Mojave Saltbush - Allscale Scrub	110	150	-1	1	37	40	6	8	6	10
4. Allscale - Alkali Scrub	82	170	-5	5	36	43	8	20	-0.8	12 (18)
5. Iodinebush - Alkali Scrub	42	275	-10	6	39	47	10	32	-0.8	7
C. Mojave - Colorado Desert Scrub Subcomplex										
1. Creosote bush Scrub	42	275	-6	6	30	47	4	32	-0.7	13
2. Cheesebush Scrub	42	275	-10	6	30	47	3	32	-0.7	20
3. Succulent Scrub	150	275	-8	-2	29	47	2	7	10	20
II. Xeric Conifer Woodland - Desert Montaine Forest Complex										
A. Xeric Conifer Woodland Complex										
1. Utah Juniper - One-leaf Pinyon Woodland	175	375	-13	-4	23	36	1	4	15	30
2. California Juniper - One-leaf Pinyon Woodland	175	400	-9	-2	34	38	1	4	12	18
3. California Juniper - Four-leaf Pinyon Woodland	225	400	-9	-1	35	39	1	4	11	17

Table E4. Vegetation types within the California desert together with a summary of the ranges of climatological variable associated with each (LL = Lower limit, UL = Upper Limit). (Continued.)

Vegetational Category	Mean Annual Precip (mm)		Temperature (°C) Mean Jan. Minima		Temperature (°C) Mean July Maxima		PotE/Ppt Range		Approx. Elev. (x100m)	
	LL	UL	LL	UL	LL	UL	LL	UL	LL	UL
II. Xeric Conifer Woodland - Desert Montaine Forest Complex (Continued.)										
B. Desert Montaine Forest Subcomplex										
1. White Fir Forest Enclaves	250	325	-10	-7	26	30	1.5	3	19	24
III. Desert Microphyll Woodland Complex										
A. Paloverde Microphyll Woodland Subcomplex										
1. Foothil Paloverde - Saguaro Woodland	115	160	1	6	40	44	10	12	3	4
2. Blue Paloverde - Ironwood - Smoketree Woodland	80	160	1	6	40	44	10	20	0	8
B. Mesquite Microphyll Woodland Subcomplex										
1. Mesquite Thicket	42	160	-2	6	40	47	8	32	-0.8	8
IV. A. Streamside and Oasis Woodland Complex										
1. Cottonwood - Willow - Mesquite Bottomland	80	160	-4	6	35	42	5	17	0	10
2. Cottonwood - Willow - Streamside Woodland	125	250	-7	1	30	38	3	9	8	20
B. Desert Oasis Woodland Subcomplex										
1. Palm Oases	80	150	1	6	40	44	10	15	0	10

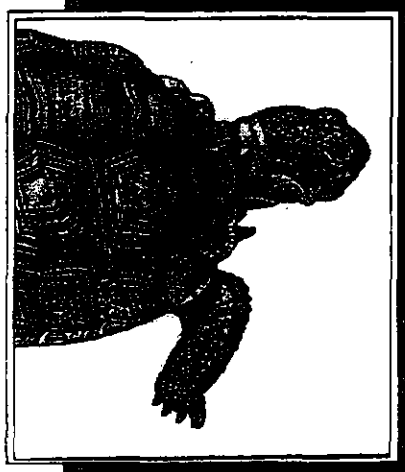
Table 4. Vegetation types within the California desert together with a summary of the ranges of climatological variable associated with each (LL = Lower limit, UL = Upper Limit). (Continued.)

Vegetational Category	Mean Annual Precip (mm)		Temperature (°C) Mean Jan. Minima		Mean July Maxima		PotE/Ppt Range		Approx. Elev. (x100m)	
	LL	UL	LL	UL	LL	UL	LL	UL	LL	UL
V. Desert and Semidesert Grassland Complex										
A. Desert - Semidesert Scrub-Steppe Subcomplex										
1. Indian Ricegrass Scrub-Steppe	120	300	-9	0	28	40	2	8	6	23
2. Desert Needlegrass Scrub-Steppe	120	250	-9	-2	30	38	2	5	10	20
3. Big Galleta Scrub-Steppe	110(80)	250	-4	3	35	44	3	8(15)	3(0)	23
4. Galleta - Blue Grama Scrub-Steppe	175	300	-9	-3	28	36	2	4	12	23
B. Desert Alkali Grassland Subcomplex										
1. Saltgrass Meadow	42	120	-5	5	38	47	8	32	-0.8	10
VI. Desert Savicole Subscrub Complex										
A. Calciphyte Saxicole Subscrub Subcomplex										
1. Calciphyte Saxicole Subscrub[1]	100	300	-9	0	26	38	2	10	6	24
B. Non-Calciphyte Saxicole Subscrub Subcomplex										
1. Non-Calciphyte Saxicole Subscrub[1]	100	300	-9	0	26	38	2	10	6	24
VII. Desert Psammophyte (Sand Dune) Complex										
A. Desert Psammophyte Subcomplex										
1. Desert Psammophyte[1]	42	150	-4	6	37	47	7	32	0	10

[1]An adequate synecologoical analysis should result in substantial subdivision of these types.

Appendix F

Desert Tortoise
(Mojave Population)



Recovery Plan

Appendix F: Summary Descriptions of Proposed Desert Wildlife Management Areas

I. Northern Colorado Recovery Unit

1. Chemehuevi DWMA

Current densities: 10 to 275 adult desert tortoises per square mile.

Location and Description:

The proposed Chemehuevi DWMA in San Bernardino County, California, lies approximately south of Interstate 40; north of Highway 62; west of Havasu National Wildlife Refuge and the Chemehuevi Indian Reservation; and east of the Old Woman Mountains and Essex (Figure 7). The Chemehuevi DWMA is varied, both vegetationally and topographically. It includes elements of both Colorado Desert and Mojave Desert floras, and elevations range from about 600 to 4,700 feet. A number of basins and ranges are represented. The BLM manages 67% of the lands in the proposed DWMA; remaining lands are in private (25%) or State (6%) ownership.

The desert tortoise population in this DWMA is relatively large, unfragmented, and little affected by human impacts. If this DWMA is made large, as proposed here, it could provide a relatively secure refuge for the species as populations in other areas are recovering.

Desert Tortoise Densities and Trends:

Currently the largest and most robust population of desert tortoises remaining within the geographic range is found in portions of the Ward and Chemehuevi valleys (Berry and Nicholson 1984a, Berry 1990, as amended). Between 1979 and 1988, densities in the Chemehuevi Valley increased from 145 to 224 tortoises per square mile, but had declined by 1992, at least among adults and subadults by 1992. The changes were not statistically significant. At the northern Ward Valley plot, total numbers of tortoises captured increased substantially between 1980 and 1991, and densities of the tortoises in the larger size classes increased markedly from 107 to 190 tortoises per square mile, but the changes were not statistically significant. Regional densities are probably depressed from military activities in the 1940s, livestock grazing, and other human uses (Berry and Nicholson 1984b). Densities along major highways,

such as Interstate 40 and Highways 62 and 95, are also depressed (Berry and Turner 1984, Karl 1989).

Threats:

In terms of current and planned human uses which may adversely affect desert tortoises, the Chemehuevi DWMA is one of the least threatened DWMAs. Major current human uses which impact desert tortoises include cattle grazing on the Lazy Daisy and Chemehuevi allotments; and fragmentation and mortality caused by highways, roads, and the Colorado River Aqueduct. Wild burros are also present in the DWMA and degrade desert tortoise habitat. Harvest of Mojave yucca is a problem in some areas.

As of 1991, no documented cases of URTD were known from the Chemehuevi DWMA, however, about 25% of desert tortoises are symptomatic for a shell disease, which appears different from that described for the Chuckwalla DWMA (K.H. Berry, pers. comm. 1993).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.2.), the following specific actions should be implemented in the Chemehuevi DWMA:

(1) Remove livestock grazing.

(2) Maintain feral burros within herd management areas at zero population levels, or as experimental populations. Remove feral burros outside of herd management areas.

(3) Construct desert tortoise barriers and underpasses along Interstate 40; Highways 95 and 62; the Atchison, Topeka, and Santa Fe Railroad; and frequently used roads. Evaluate the need for barrier fencing along the Colorado River Aqueduct and around communities such as Essex and Vidal, California.

(4) Establish a center, at or near Needles, where unwanted captive desert tortoises could be deposited. Develop programs to make unwanted desert tortoises available for research and educational purposes.

(5) Monitor health of desert tortoises, particularly URTD and shell disease.

Recommended Research:

The following research topic is especially suited to the management needs and opportunities presented in the Chemehuevi DWMA.

(1) The effects of feral burros, utility corridors, and barrier fencing on desert tortoises.

II. EASTERN COLORADO RECOVERY UNIT

1. Chuckwalla DWMA

Current densities:

5 to 175 desert tortoises per square mile.

Location and Description:

The proposed Chuckwalla DWMA is located in Riverside and Imperial Counties, California. Starting with the northwest corner, the proposed boundary would extend along the north facing slopes of the Orocopia Mountains, then run eastward along the southern edge of Interstate 10 to Wiley Well Road, then south to near Midway Well, and then north and west along the eastern portion of the Chocolate Mountains Aerial Gunnery Range to the south slopes of the Orocopia Mountains and the Southern Pacific Railroad (Figure 7). The DWMA contains several mountain ranges and valleys, ranging in elevation from 400 to 4,500 feet. Included is the Chuckwalla Bench, a bajada which has in the recent past supported the highest known densities of desert tortoises. Plant communities are typical of the Colorado Desert (Appendix E). Land ownership is a checkerboard of BLM, military, and private lands.

This DWMA is not large enough to support 50,000 adult desert tortoises at target density. Although the Joshua Tree DWMA is primarily in the western Mojave recovery unit, its southeast corner is in the eastern Colorado recovery unit. Protection of habitat there, as well as in the Chuckwalla DWMA, should be implemented to protect sufficient habitat for recovery.

Desert Tortoise Densities and Trends:

The Chuckwalla Bench DWMA has two study plots that provide density estimates and trend data: Chuckwalla Bench and Chuckwalla Valley (Berry 1990, as amended, Berry and Nicholson 1984a). In 1979-1982, estimated densities were 578 tortoises per square mile on the Chuckwalla Bench; by 1990 densities had declined to 160 tortoises per square mile. On the second plot, Chuckwalla Valley, densities were 163 tortoises per square mile in 1980 and subsequently declined to 73 tortoises per square mile in 1992. The density figures reflect the higher density portions of the DWMA (Berry and Nicholson 1984a). Declines are attributable to vandalism, vehicle kills, raven predation, and a shell disease (Berry 1990, as amended, BLM et al. 1989, Rosskopf 1989, Jacobson et al. 1994).

Threats:

Habitat in the Chuckwalla DWMA has been degraded or destroyed due to military activities in the 1940s, domestic sheep grazing, agricultural development, diversion dikes along Interstate 10, bombing associated with the Chocolate Mountains Aerial Gunnery Range, unauthorized ORV activity, and mining (Berry 1984b, Berry and Nicholson 1984b, Bernstein 1989, Hurst and Healy 1989, Kataoka 1989, Marquis 1989). A proposed landfill site in the Eagle Mountains is of concern because refuse would be transported via the old Southern Pacific railroad, which would contribute to fragmentation of desert tortoise habitat in the Chuckwalla Bench area.

The presence of URTD has not been confirmed in the proposed Chuckwalla DWMA; however, a substantial portion of desert tortoises on the Chuckwalla Bench experienced a shell disease that was associated with high mortality rates between 1982 and 1991 (Berry 1990, as amended, Jacobson et al. 1994).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.D.2), the following specific actions should be implemented in the Chuckwalla DWMA:

(1) Restrict train traffic to 1991 levels or construct barrier fencing and desert tortoise underpasses along the railroad tracks to reduce or eliminate mortality and population fragmentation.

(2) Construct barrier fences and underpasses for desert tortoises along well-used roads in the DWMA, including the south side of Interstate 10.

(3) Determine actual and potential raven use of palm trees and other roost and perch sites at the Chuckwalla Prison and the adjacent new prison site. Eliminate raven perch and nest sites.

(4) Work cooperatively with the Chocolate Mountains Aerial Gunnery Range to eliminate unauthorized bombing of public lands and mitigate habitat damage which has resulted from these activities.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in the Chuckwalla DWMA:

(1) The effects of dirt roads and mining on desert tortoise populations and habitat. Research habitat restoration, particularly of old agricultural fields and areas adversely affected by diversion dikes.

(2) Continue research on shell and other diseases to isolate causes of high mortality.

III. UPPER VIRGIN RIVER RECOVERY UNIT

1. Upper Virgin River DWMA

Current densities:

Small areas of the DWMA contain up to at least 250 adult desert tortoises per square mile; desert tortoises in this DWMA occur in a mosaic of high to low densities.

Location and Description:

The proposed Upper Virgin River DWMA in Washington County, Utah, lies approximately north of St. George and Hurricane, Utah, west of Highway 18, east of Snow Canyon, and south of Yant Flat and Cedar Bench (Figure 8). Desert tortoises of this proposed DWMA are notable among populations in the Mojave Region because they represent the northern-most population of the species and densities are currently very high in some areas. Desert tortoise habitat in this DWMA is characterized by rugged terrain of rocky outcrops and hills interspersed with sandy areas. Vegetation is diverse and includes creosote scrub, blackbush scrub, big galleta scrub steppe, desert psammophyte, and Utah juniper - one-leaf pinyon woodland (Appendix E). Land ownership is a patchwork of BLM, State, and private lands.

Because this recommended DWMA will not contain 1,000 square miles of contiguous desert tortoise habitat intensive management, even after recovery, will be necessary to ensure a reasonable probability of long-term population persistence (Figure 6D).

Desert Tortoise Densities and Trends:

On the City Creek study plot (1-mile square), 243 desert tortoises were marked in 1988, of which 163 were adults or subadults (Rick Fridell, Utah Division of Wildlife Resources, pers. comm. 1993). However, densities are much lower and patchy throughout most of the proposed Upper Virgin River DWMA. Data are insufficient to evaluate population trends; but, populations could decrease in the future as tcities in Washington County grow and human use of this area increases.

Threats:

Quantitative, rather than qualitative, loss of habitat is the primary threat to the desert tortoise population in this proposed DWMA. Although a variety of human uses occur, the condition of the habitat is generally good. ORV use occurs in Snow Canyon but is limited by topography. Cattle grazing occurs, but is limited by topography

and access to water. A popular shooting area is located in the western portion of the DWMA on BLM land. A turkey farm occupies a large tract of private land, and dumps and landfills occur in the DWMA and nearby. Desert tortoise populations are also affected by human activities in and around St. George, a growing community with a population of 35,600 in 1993, up from 28,500 in 1990. Interstate 15 and Highway 18 are the major transportation corridors in the area. No mining occurs in this DWMA.

URTD is not currently known to be a threat to desert tortoises in this DWMA.

Specific Management Actions:

This is the only DWMA proposed for the Upper Virgin River recovery unit. Because of the small size of this proposed DWMA, management will need to be intensive and promptly implemented if this desert tortoise population is to be given a reasonable chance of long-term persistence. Acquisition of private inholdings (or *development of conservation easements in perpetuity)*is imperative for recovery, particularly for non-Federal and private lands north and northeast of St. George, Paradise and Padre canyons, and north of Hurricane. In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Upper Virgin River DWMA:

(1) Remove livestock grazing from the DWMA.

(2) Construct and maintain desert tortoise barrier fencing along Interstate 15, Highway 18, and the road to the turkey farm.

(3) Install underpasses for desert tortoises along Highway 18 between Paradise Canyon and Twist Hollow, and the road to the turkey farm.

(4) Close the debris dam road north of St. George or restrict access through installation of a locked gate.

(5) Establish a visitor center outside the DWMA which would educate the public about the desert tortoise and serve as a drop-off site for unwanted captive tortoises. Develop a program to make these animals available for educational and research purposes.

(6) Consolidate ownership and management of the entire DWMA, primarily for desert tortoise, under Federal management as a National Conservation Aea.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in the Upper Virgin River DWMA:

(1) Desert tortoise reproduction and growth rates.

(2) Desert tortoise nutritional ecology and physiology.

(3) Factors governing desert tortoise distribution in this DWMA.

IV. EASTERN MOJAVE RECOVERY UNIT

1. Fenner DWMA

Current densities:

10 to 350 desert tortoises per square mile.

Location and Description:

The proposed Fenner DWMA in San Bernardino County, California, would include the northeastern part of the Clipper Valley, north-central part of the Fenner Valley, and the southern Piute Valley. The DWMA would be bounded by the Providence Mountains on the west, Hackberry and Piute Mountains and the Nevada border on the north, the Dead Mountains on the east, and Interstate 40 and the Clipper Mountains on the south (Figure 9). This proposed DWMA is primarily in the eastern Mojave recovery unit, but as described here, the southeastern edge is in the northern Colorado recovery unit. The area is heterogeneous topographically with elevations from about 1,600 to 3,454 feet. Several plant communities are present, including Big Galleta Scrub Steppe, Succulent Scrub, a rich Creosotebush Scrub, Hop Sage Scrub and Blackbush Scrub (Appendix E). This proposed DWMA includes portions of the East Mojave National Scenic Area. Land ownership is about 67% public, 28% private, and 5% State.

Desert Tortoise Densities and Trends:

The highest densities of desert tortoises occur in only a few patches of a few square miles each (Berry et al. 1994), with the Goffs study plot supporting the highest levels. In the Goffs area, densities west of Lanfair Road range from 50 to 100 desert tortoises per square mile. To the east of the Lanfair Road, densities probably average about 50 per square mile. The desert tortoise population on the Goffs plot declined from 440 tortoises per square mile in 1980 to 362 in 1990 (Berry 1990, as amended). In less than 2 years of work on a health profile study in this DWMA, 7 of 20 desert tortoises either died or were presumed dead (Berry 1991, Nagy et al. 1990). Densities are probably depressed throughout the proposed DWMA as a result of a variety of human impacts (Berry 1984a).

Threats:

The Fenner, Clipper, and Piute valleys have experienced harvest of Mojave yuccas on Southern Pacific lands, with some unauthorized

harvest on BLM lands, and long-term cattle grazing. The valleys are the sites of major transportation and utility corridors, which undoubtedly have contributed to declines of adjacent desert tortoise populations. Settlements at Goffs, Essex, and the Providence Mountains State Park add to the cumulative impact load. As general recreation pressures increase in the East Mojave National Scenic Area, desert tortoise mortality rates from collecting, vandalism, and roadkills are likely to increase. Raven populations appear to be growing in the valley and nearby areas (Knowles et al. 1989a, 1989b).

Four ill desert tortoises were found on the Goffs study plot in 1990. The poor condition of these animals was attributed to below optimum water and nutrient uptake (Jacobson and Gaskin 1990), probably due to drought. *Mycoplasma sp.* and *Pasteurella testudinis* were found in a Goffs' desert tortoise in the summer of 1991. Both these organisms often appear together in desert tortoises with URTD (Jacobson et al. 1991).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Fenner DWMA:

(1) Remove livestock grazing.

(2) Implement a program to control raven predation on juvenile desert tortoises.

(3) Construct and maintain desert tortoise-proof fencing and underpasses along the Atchison, Topeka, and Santa Fe Railroad; Interstate 40; and well-used roads, such as the Goffs Road.

(4) Sign the DWMA boundary near the Goffs settlement.

(5) Establish a drop-off site for unwanted captive desert tortoises. Develop a program to make these animals available for research and educational purposes.

(6) Implement emergency action to halt harvest of yuccas and other vegetation.

(7) Closely monitor predation by ravens on desert tortoise populations. Where appropriate, ensure that excessive predation is controlled and that sufficient recruitment of juveniles into the subadult and adult cohorts occurs.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities of the Fenner DWMA:

(1) Health profiles, disease, and reproduction in desert tortoises at established sites (continue ongoing studies until complete).

(2) Population demography, movements, and food preferences and availability.

(3) The effects of small settlements, road densities, and railroads on adjacent desert tortoise populations and habitat, and effectiveness of barriers and underpasses.

(4) Methods to protect desert tortoises from high density forms of general recreation.

2. *Ivanpah DWMA*

Current densities:

5 to 250 desert tortoises per square mile.

Location and Description:

The proposed Ivanpah DWMA in San Bernardino County, California, is horseshoe in shape and is composed of the Ivanpah, Kelso, and Shadow valleys and interconnecting corridors (Figure 9). Although most of this proposed DWMA lies in the eastern Mojave recovery unit, Ivanpah Valley is in the northeastern Mojave recovery unit. Elevations range from 2,500 to 4,764 feet and topography includes bajadas, rolling hills, lava flows, one playa lake, and a few major drainages. Vegetation is diverse and includes seven distinct communities (Appendix E). This proposed DWMA includes portions of the East Mojave National Scenic Area. This area is managed almost entirely by BLM.

Desert Tortoise Densities and Trends:

The highest known densities of desert tortoise occurred in southern Ivanpah Valley, where about 20 square miles support densities of 200 to 250 per square mile. Throughout much of the northern Ivanpah, Kelso, and Shadow valleys, densities were generally less than 50 per square mile. About half of these were adult or subadult animals (Berry 1990, as amended, Berry 1991). On the Ivanpah Valley plot, densities declined from 368 tortoises per square mile in 1970 to 249 in 1990, but this trend was not statistically significant (Berry 1990, as amended). Nine of 18 desert tortoises monitored in Ivanpah Valley from 1989 to 1991 succumbed to drought-related stress (Nagy et al. 1990, Berry 1992, Jacobson and Gaskin 1990). In addition, the proportion of juvenile desert tortoises declined from the 1970's to the 1990's at the Ivanpah Valley plot, apparently as a result of high predation rates by ravens (Berry et al. 1986b, Berry 1990, as amended, 1991, BLM et al. 1989).

Threats:

A variety of human uses have contributed to habitat loss and degradation in this DWMA. Military maneuvers during the mid 1960's impacted areas in the southern Ivanpah Valley, while motorcycle races, including the Barstow to Vegas race, affected habitat in the Shadow Valley and northern Ivanpah Valley. Cattle grazing occurs on portions of five allotments in this DWMA, and perennial grasses are heavily grazed in some areas. Other major human uses include recreation that contributes to habitat degradation, mining, powerline corridors. Urban development at

Stateline, Nevada; OHV use in northern Ivanpah Valley and around Roach Lake; and landfills, garbage dumps, and sewage ponds which attract ravens all contribute to desert tortoise mortality and habitat destruction.

A few desert tortoises in a health profile research program tested positive for URTD (*Mycoplasma*) during 1991 (Brown et al. 1993). Some animals also have shell disease (Berry pers. comm. 1993). An adult desert tortoise was found paralyzed in Shadow Valley in 1991. Possible causes of the paralysis included poisoning resulting from ingestion of locoweed (*Astragalus sp.*) or some other toxin (Klaasan 1991, Blood et al. 1989, Casteel et al. 1985, Fuller and McClintock 1986).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Ivanpah DWMA:

(1) Remove livestock grazing from the Crescent Peak, Clark Mountain, Kessler Springs, Valley Wells, and Valley View allotments.

(2) Construct and maintain desert tortoise-proof barriers and underpasses to protect tortoises and habitat from Interstate 15 and well-used roads, such as Nipton and Ivanpah Roads. Also, construct fencing to protect desert tortoises from recreational vehicle use on the Ivanpah Dry Lake and near Whiskey Pete's casino.

(3) Conduct intensive new surveys (using strip transects) in northern Ivanpah, Shadow, and Kelso valleys and Cima Dome to gather information on distribution and densities of desert tortoises.

(4) Implement a raven-control program to reduce predation on juvenile tortoises. Monitor desert tortoise populations to ensure that juveniles are recruited into subadult and adult cohorts in sufficient numbers to promote population recovery.

(5) Sign DWMA boundaries in the vicinity of Nipton, Kelso, and other similar settlements and areas with conflicting land uses.

(6) Promote return of perennial grasses and increases in cover values of native grasses and decreaser species.

(7) Construct desert tortoise barriers and underpasses along the Union Pacific Railroad.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in this DWMA:

(1) Disease, health, nutritional requirements and physiology, as well as effects of grazing on vegetation, soils, and desert tortoise behavior (continue ongoing intrusive research).

(2) The extent and potential causes of toxicosis (possibly selenium poisoning, locoweed poisoning, or some other form of toxicosis) in desert tortoises in the Shadow Valley and elsewhere in this DWMA. Identify sources of poison and distribution of potentially poisonous plants.

(3) Genotypes of desert tortoises in areas of potential linkages between this DWMA, and the Fenner and Piute-El Dorado DWMAs.

(4) The effects of utility towers on the desert tortoise and its habitat. Towers and similar structures may encourage an increase in avian predators.

3. *Piute-Eldorado DWMA*

Current densities:

40 to 90 adult desert tortoises per square mile

Location and Description:

The proposed Piute-Eldorado DWMA in Clark County, Nevada, lies approximately west of the Colorado River, north and east of the California State line, south of Boulder City, and southeast of Goodsprings and the north end of the McCullough Mountains (Figure 9). As described here, this proposed DWMA would include portions of both the eastern and northeastern Mojave recovery units. This DWMA is heterogeneous vegetationally and topographically, and includes several parallel mountain ranges divided by valleys, dry lakes, and bajadas. Several plant communities are represented, including Shadscale Scrub, Creosote Bush Scrub, Blackbush Scrub, and Utah Juniper - One-Leaf Pinyon Woodland (Appendix E). The proposed Piute-Eldorado DWMA has a common border with the Fenner and Ivanpah DWMAs in California. Land ownership is a mix of National Park Service, BLM, and private lands.

Desert Tortoise Densities and Trends:

The Piute Valley represents the largest area of high density desert tortoise habitat known in Nevada. The population is contiguous with a larger high-density area in California and represents a zone of contact between two genetic types (Brussard 1992). Data are insufficient to assess population trends; however, densities are likely declining due to human-related disturbances which adversely affect desert tortoises, such as recreation, mines, residential development, and livestock grazing (Appendix D, Nevada Department of Wildlife 1990).

Threats:

Desert tortoises have been adversely affected by a variety of human uses in the proposed DWMA. ORV activity, including organized races, is the principle recreational activity affecting desert tortoises. Transmission lines and associated access roads run southwest from Hoover Dam through the DWMA. Six cattle grazing allotments are also present. Interstate 15 and Highway 95 pass through the DWMA and act as formidable barriers to east-west movement. Road density in the area was estimated at 0.9 miles per section in 1984, but has probably increased since that time. Historic as well as current mining is evident in many portions of the proposed DWMA.

A habitat management plan for this area, prepared by the BLM in cooperation with the National Park Service, Nevada Department of Wildlife, and the Nature Conservancy, is currently in draft form. This plan will implement mitigation actions required in a 10(a)(1)(B) incidental take permit issued to Clark County and the cities of Las Vegas, North Las Vegas, Henderson, and Boulder City. The habitat management plan proposes management plans and policies for about 430,000 acres in the Eldorado, Cottonwood, and Piute Valleys. It provides for land use controls including removal of livestock grazing, restriction of landfills and intensive recreation, elimination of most competitive off-highway vehicle events, and increased law enforcement (BLM 1983). To date four of the six grazing allotments have been purchased and are currently being held in non-use by The Nature Conservancy.

URTD has been observed in desert tortoises in this area. The occurrence of this disease is correlated with locations of releases of captive desert tortoises, particularly in and around urban areas and degraded habitats (Marlow and Brussard 1992).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the proposed Piute-Eldorado DWMA:

(1) Maintain feral equids within herd management areas at zero population levels. Remove feral equids outside herd management areas.

(2) Construct and maintain desert tortoise barrier fencing to protect desert tortoises and their habitat from vehicles and access provided by Highway 95, State Route 163, and the Nipton Highway. Install underpasses to allow for movements and gene flow within this DWMA.

(3) Establish a visitor center which would educate the public about the desert tortoise and its habitat and include a drop-off site for unwanted captive desert tortoises. Develop a program to make unwanted captives available for research and educational purposes.

(4) Sign DWMA boundaries around Searchlight, Laughlin and other settlements.

(5) Acquire Colorado River Commission lands or secure conservation easements for surface and subsurface management.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in the Piute-Eldorado DWMA:

(1) The effects of ORV use in the Eldorado Valley on the desert tortoise and its habitat.

(2) The impacts of various linear features, particularly Highway 95, which divides the proposed DWMA.

(3) Movements of desert tortoises through narrow passes (i.e., between Eldorado Valley and Jean Lake) compared with movement patterns in unstructured, unbounded areas (i.e., Piute Valley).

(4) Genetic relationships between desert tortoises in the northern and southern ends of the DWMA.

V. NORTHEASTERN MOJAVE RECOVERY UNIT

1. Beaver Dam Slope DWMA

Current densities:

5 to 56 desert tortoises per square mile.

Location and Description:

The proposed Beaver Dam Slope DWMA in extreme southwestern Washington County, Utah, and northwestern Mohave County, Arizona, lies approximately north of Interstate 15 and Littlefield, Arizona; west of the western slope of the Beaver Dam Mountains; south of Motoqua, Utah; and east of the Nevada State border (Figure 9). This proposed DWMA would include critical habitat designated for the desert tortoise in 1980 (Fish and Wildlife Service 1980). Desert tortoise habitat in this DWMA is typically eastern Mojave Desert Scrub, characterized primarily by Creosote Bush Scrub. Joshua trees (*Yucca brevifolia*) are well developed in this vegetation type, especially in the more northerly parts of the Beaver Dam Slope. Topography varies from the steep, lower slopes of the Beaver Dam Mountains to gently sloping creosote bush flats intersected by small to major washes, which often provide deep caliche-cave hibernacula for desert tortoises. Most lands within this proposed DWMA are in private ownership or managed by the BLM. About 22.4 square miles of this proposed DWMA were designated critical habitat for the desert tortoise in 1980 (Fish and Wildlife Service 1980).

The desert tortoise population in this DWMA is currently linked to the Mormon Mesa population across about 15 miles of fair to poor habitat north of the Virgin River. Because of its small target population, the probability of long-term persistence of desert tortoises on the Beaver Dam Slope DWMA would be enhanced if this corridor remains viable.

Desert Tortoise Densities and Trends:

Monitoring of desert tortoise numbers in this DWMA began with the Woodbury-Hardy study plot in the 1930s (Woodbury and Hardy 1948). Currently, desert tortoise numbers are monitored at 2 plots; one on the Beaver Dam Slope and one near Littlefield. Since the late 1970's, desert tortoise densities on the Beaver Dam Slope plot have declined; these declines have been drastic in some areas (Fridell and Coffeen 1993). Densities on the Littlefield plot have remained approximately constant at about 50 desert tortoises per square mile (Duck and Snider 1988), but more carcasses than expected have

been found over the last several years, suggesting increased mortality.

Threats:

The proposed Beaver Dam Slope DWMA is one of the most threatened DWMAs. Cattle grazing occurs over most of the area. Non-native annual plants comprise significant portions of the ephemeral cover, and perennial grasses are reduced or eliminated in some areas due, in part, to grazing. (Appendix D). Mining and agricultural development have eliminated desert tortoise habitat in Beaver Dam Wash. Access through the area is provided by Highway 91 and a network of ranch, mine, and graded dirt roads. ORV use is increasing in some areas.

Desert tortoises with signs of URTD have been found on the Beaver Dam Slope in Utah and extreme northern Arizona. A study of higher than expected mortality on the Beaver Dam Slope concluded that thinning of shell bone (osteopenia) had occurred in 16% of more than 200 desert tortoise carcasses examined and that the osteopenia may be related to poor nutrition (Jarchow and May 1989).

Specific Management Actions:

Current densities in this DWMA are at the minimum necessary to avoid demographic and stochastic effects that accelerate population declines (Section II.A.2). Immediate implementation of proposed management actions will be necessary to avoid extirpation of this population. In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific management actions should be implemented in the Beaver Dam Slope DWMA:

(1) Remove livestock grazing or, if desired, establish terms for experimental livestock grazing in EMZs.

(2) Initiate a semi-wild breeding program (Appendix B) to rebuild and restore the population of desert tortoises in this DWMA.

(3) Sign DWMA boundaries adjacent to communities and settlements to reduce conflicting land uses.

(4) Construct desert tortoise barrier fencing along Interstate 15 and Highway 91 to protect desert tortoises from vehicle kills, collection, and vandalism.

(5) Construct underpasses along Highway 91 to allow movement of desert tortoises and exchange of genetic material within this DWMA.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in this DWMA:

(1) The impacts of ORV use on the desert tortoise and its habitat.

(2) The effects of small settlements on the desert tortoise and its habitat.

(3) Translocation of desert tortoises.

2. *Coyote Spring DWMA*

Current densities:

0 to 90 adult desert tortoises per square mile.

Location and Description:

The proposed Coyote Spring DWMA in Lincoln and Clark Counties, Nevada, would consist mostly of Fish and Wildlife Service refuge lands on the Desert National Wildlife Refuge (DNWR). This DWMA would be bounded approximately by the Nye County line on the west, the DNWR boundary on the north and south, and Highway 93 on the east (Figure 9). The flats and lower slopes within this DWMA are characterized by well-drained alluvial sands and gravels dominated floristically by creosote and bursage. Mojave yucca and Joshua trees are common at higher elevations, and a shadscale scrub community is present west of the Sheep Range (Schneider et al. 1982).

Desert Tortoise Densities and Trends:

1986 transect data estimated adult desert tortoise densities at 36 to 62 per square mile in the Coyote Spring Valley and Hidden Valley (Nevada Department of Wildlife 1990, BLM, Las Vegas District, Las Vegas files). In 1982, transects were conducted on the DNWR east of Alamo Road, including areas around Desert Dry Lake which revealed low to moderate densities (0 to 90 desert tortoises per square mile). The area east of Alamo Road remains unsurveyed, but desert tortoises there are thought to be patchily distributed in low densities. Data are insufficient to evaluate trends.

Threats:

Due to resource management by DNWR, human impacts have left a minimal imprint throughout much of this DWMA. Near Highway 93, habitat has been degraded by ORV use, dumping, utility construction, sand and gravel mining, and other impacts. Large herds of feral horses are currently present, and the recent drought has caused heavy use of the range by these animals. Grazing by livestock is absent or minimal as all allotments are currently inactive. Military activities on the Nellis Bombing Range have resulted in some localized habitat destruction.

Several cases of desert tortoises with URTD have been reported in this area (Nevada Department of Wildlife 1990, RECON 1991).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following actions should be implemented in the Coyote Spring DWMA:

(1) Maintain feral equid within herd management areas at zero populations. Remove feral equids outside herd management areas.

(2) Remove livestock grazing of, if desired, establish terms for experimental cattle grazing in EMZs.

(3) Construct and maintain desert tortoise barrier fencing to protect desert tortoises and habitat along Highways 93 and 95. Install desert tortoise underpasses along Highway 93 to allow for movements and gene flow between the Coyote Springs DWMA and the Mormon Mesa DWMA.

(4) Establish a visitor center which would include a drop-off site for unwanted captive desert tortoises. Develop a program to make these animals available for educational and research purposes.

(5) Modify existing management plans and policies at DNWR to be consistent with this Recovery Plan.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in the Coyote Spring DWMA:

(1) The effects of bombing activities on the desert tortoise and its habitat. This research should include a comparison of survivorship of desert tortoises both inside and outside bombing ranges. Withdraw areas from bombing in which research shows adverse effects on desert tortoises or their habitat.

(2) The impacts of all road types (e.g., highways, roads, tracks, ways, etc.) on the desert tortoise and its habitat, particularly in the Indian Springs Valley and Three Lakes Valley area of Nellis Air Force Base.

(3) Movement patterns of desert tortoises through managed corridors (i.e., underpasses) and along fences (i.e., railroads and highways). This research should examine desert tortoise behavior, establishment, gene flow, reproduction, etc.).

(4) Distribution and abundance of desert tortoises east of Alamo Road.

3. *Gold Butte-Pakoon DWMA*

Current densities:

5 to 56 desert tortoises per square mile.

Location and Description:

The proposed Gold Butte-Pakoon DWMA in Mohave County, Arizona, and Clark County, Nevada, would be approximately bounded on the north by the Virgin River, on the east by the Virgin Mountains and Grand Wash, on the west by the Virgin River and Gold Butte, and on the south by Lake Mead (Figure 9). A habitat corridor to promote genetic exchange between this Gold Butte-Pakoon area and the proposed Mormon Mesa DWMA is included on the southwestern corner of the this DWMA. Desert tortoises in this area inhabit rolling hills and sloping bajadas, but are also found in volcanic boulder fields of the Pakoon Basin. The vegetation is mostly creosote bush scrub with occasional stands of Joshua trees or Mojave yucca. Land ownership is a mix of BLM, National Park Service, and private lands.

Desert Tortoise Densities and Trends:

Density estimates are available from transect data and at the Gold Butte study plot (RECON 1991, SWCA 1990). Most of the DWMA has densities of about 20 adult desert tortoises per square mile. Data are insufficient to derive trends.

Threats:

The entire Gold Butte-Pakoon DWMA has been grazed by livestock over the past century. Native perennial grasses have been reduced or eliminated in some areas, and non-native annual weeds such as filaree and red brome are common. Fires, carried by stands of introduced annuals, have contributed to the loss of perennial grasses and shrubs in some areas. Historic and current mining activity is evident in parts of the DWMA, but the most intensive mining has historically occurred in less important desert tortoise habitat areas, such as Gold Butte. The ruggedness of the terrain and relatively few roads, especially in the Gold Butte and Pakoon Basin areas, tend to limit human impacts to desert tortoise habitat. Recently, however, there have been noticeable increases in ORV vehicle activity, especially both north and south of the Virgin River in Arizona and Nevada.

One desert tortoise with signs of URTD was found in 1991 in the Pakoon Basin, Arizona (T.A. Duck, pers. comm.). URTD has not been reported in the Gold Butte area in Nevada.

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Gold Butte-Pakoon DWMA:

(1) Remove livestock grazing or, if desired, establish terms for experimental cattle grazing in EMZs.

(2) Construct desert tortoise barrier fencing along Interstate 15 and Highway 91 to protect desert tortoises from vehicle kills, collection, and vandalism.

(3) Sign DWMA boundaries adjacent to communities and settlements (e.g. Littlefield, Arizona, Mesquite, Nevada, etc.) and other areas with conflicting land uses.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities of this DWMA:

(1) The direct and indirect impacts (including, soils and vegetation) of grazing to the desert tortoise and its habitat.

(2) The impacts of ORV use on the desert tortoise and its habitat.

(3) Restoration of desert tortoise habitat converted to annual grasslands.

4. *Mormon Mesa DWMA*

Current density:

41 to 87 subadult and adult desert tortoises at the Mormon Mesa study plot.

Location and Description:

The Mormon Mesa DWMA in Clark and Lincoln Counties, Nevada, would lie east of Highway 93; south of the northern end of the Mormon Mountains; west of the east Mormon Mountains, Flat Top Mesa, and the Virgin River; north of the Moapa Valley; and northeast of Hidden Valley (Figure 9). The vegetation is predominantly creosote bush scrub. Mohave yucca, Joshua tree, and juniper increase in dominance with elevation (Appendix E). Major landowners include the BLM, Union Pacific Railroad, and other private parties.

Desert Tortoise Densities and Trends:

Estimated 1989 desert tortoise densities from the BLM permanent study plot at Mormon Mesa were 41-87 subadults and adults per square mile. Desert tortoise densities are patchy with the best habitat occurring in the northern portions of the DWMA. Data are insufficient to assess population trends.

Threats:

A variety of human, or human-associated, uses and impacts affect desert tortoises in the Mormon Mesa DWMA (Nevada Department of Wildlife 1990). A network of roads averaging about 1.3 linear miles per section crisscrosses the DWMA, including Interstate 15 which separates South Mormon Mesa from North Mormon Mesa. ORV use occurs in some BLM-designated "open" areas, as well. Domestic sheep grazing occurs on the eastern half of Mormon Mesa and cattle grazing occurs on the western side of the DWMA. Parts of 17 grazing allotments are contained within the Mormon Mesa DWMA. Mining and utility corridors have also adversely affected desert tortoises in this area.

Two cases of URTD were reported in 1989 in this proposed DWMA. Several animals with symptoms of nutritional deficiency were also noted at the same time (Nevada Department of Wildlife 1990).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Mormon Mesa DWMA.

(1) Remove livestock grazing or, if desired, establish terms for experimental cattle grazing in EMZs.

(2) Maintain feral equids within herd management areas at zero population levels. Remove feral equids outside herd management areas.

(3) Construct desert tortoise barrier fencing and underpasses along Highway 93 and Interstate 15 to allow movement of desert tortoises between the Mormon Mesa DWMA and Coyote Spring DWMA, and to connect the northern and southern parts of the Mormon Mesa DWMA.

(4) Construct desert tortoise barrier fencing and underpasses along the Union Pacific Railroad.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in the Mormon Mesa DWMA:

(1) Movement patterns of desert tortoises through natural corridors to determine what constitutes a corridor or boundary edge (see Beaver Dam Slope DWMA description). Research should include the movement patterns of desert tortoises through managed corridors (i.e., underpasses) and along fences (i.e., railroads and highways), and examine desert tortoise behavior, establishment, gene flow, reproduction, etc.

(2) The impacts of all road types (highways, roads, tracks, ways, trails, etc.) on the desert tortoise and its habitat.

(3) Distribution and abundance of desert tortoises throughout the DWMA.

VI. WESTERN MOJAVE RECOVERY UNIT *

1. Fremont-Kramer DWMA

Current densities:

5 to 100 desert tortoises per square mile.

Location and Description:

The proposed Fremont-Kramer DWMA in Kern and San Bernardino Counties, California, includes the Desert Tortoise Natural Area on its northwestern boundary as well as other lands south and east of Koehn Lake to the Randsburg Wash test range of the China Lake Naval Air Weapons Station in the northeast, almost to Helendale in the southeast, and to Edwards Air Force Base in the southwest (Figure 10). Six plant communities are represented (Appendix E); and the terrain is characterized by rolling hills and mountains up to 5,270 feet and valleys as low as 1,900 feet. Land ownership is a mix of private, BLM, military, and State lands.

Desert Tortoise Densities and Trends:

Data on population densities and trends are available from five plots: two at the Desert Tortoise Natural Area, as well as in Fremont Valley, near Fremont Peak and at Kramer Hills (Berry 1990, as amended). For example, in 1979 densities at the Desert Tortoise Natural Area ranged from 339 to 387 tortoises per square mile; in 1981, the Fremont Valley plot had 278 tortoises per square mile, and Fremont Peak had 99 tortoises per square mile. By the early 1990's, densities had declined precipitously, e.g. 88% at the Desert Tortoise Natural Area, due to a number of human impacts, URTD, and raven predation.

* The Western Mojave recovery unit is the largest and most heterogenous of the recovery units in terms of climate, vegetation and topography. It includes three major vegetation types—the Western Mojave, Central Mojave, and Southern Mojave—each of which has significant and distinctive elements (Tables 4 and 5). Four DWMAs within the Western Mojave recovery unit represent this diversity. The Fremont-Kramer DWMA represents the Western Mojave region; the Superior-Cronese DWMA represents the Central Mojave region, and the Ord-Rodman DWMA represents the Southern Mojave region. The Joshua Tree DWMA, the fourth within this recovery unit, contains Southern Mojave and Eastern Colorado elements. The tortoises have responded to this habitat heterogeneity with different food habits and behavior in each of these areas. Thus, three DWMAs are essential in this recovery unit to preserve the heterogeneity. Secure, large reserves are especially critical because of the severe population declines and heavy human use in these areas.

Threats:

The Fremont-Kramer DWMA is one of the most threatened DWMAs. Collecting, vandalism, road kills, disease, raven predation, ORV activity, and other human-related impacts have contributed to significant population declines. Since the mid-1980's, numbers of adult desert tortoises have dropped 90% over large areas. The area has been grazed by cattle and domestic sheep, explored for hard-rock and leasable minerals, and has experienced human settlements since the 1860's. Since the 1960's, ORV recreationists have traveled cross-country over much of the region. Major transportation routes exist, including paved Highways 58 and 395, the Garlock Road, and Red-Rock Randsburg Road. The Fremont-Kramer DWMA has little, if any, habitat in pristine or climax condition (Berry and Nicholson 1984b, Chambers Group Inc. 1990 a and b). The Desert Tortoise Natural Area, which is fenced and intensively managed for desert tortoises, has some of the least disturbed habitat in the region.

URTD was first detected on the Fremont Valley plot in 1979 and is now present throughout the DWMA (Avery and Berry 1990, Berry 1990, as amended, Berry and Slone 1989). Recent high mortality rates are due in part to this disease (Berry 1990, as amended).

Specific Management Actions:

Current densities in this proposed DWMA are at the minimum necessary to avoid demographic and stochastic effects that accelerate population declines (Section II.A.2.). Immediate implementation of proposed management actions will be necessary to avoid extirpation of this population. In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Fremont-Kramer DWMA.

(1) Remove livestock grazing or, if desired, establish terms for experimental cattle grazing in EMZs.

(2) Implement emergency measures to control unleashed dogs and dog packs.

(3) Initiate a semi-wild breeding program to rebuild and restore the population. The Desert Tortoise Research Natural Area is an ideal place to begin such a program.

(4) Construct a visitor education center at the Desert Tortoise Natural Area which would include facilities for research as well as a drop-off site for unwanted captive desert tortoises. Develop programs to promote use of unwanted captives for research and educational purposes.

(5) Construct desert tortoise barrier fencing and underpasses along Highway 395; parts of Highway 58; the Randsburg-Mojave Road; the Red Rock-Randsburg Road; the Red Rock-Garlock Road; and the Atchison, Topeka, and Santa Fe Railroad north and adjacent to Highway 58 to protect desert tortoises from vehicle kills, collection, and vandalism; and to promote movement of desert tortoises within this DWMA.

(6) Sign or fence DWMA boundaries adjacent to communities and settlements such as Kramer Junction, California City, Cantil, Galileo Hill, Randsburg, Johannesburg, Atolia, and Helendale.

(7) Reduce populations of the common raven in the Fremont-Kramer DWMA to reduce predation on small desert tortoises to a point where recruitment of young into the adult cohort can occur at as rapid a rate as possible.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities of the Fremont-Kramer DWMA:

(1) Desert tortoise diseases, including URTD; toxicosis; shell lesions; general health; nutritional status; food preferences and requirements; water balance and energy flow; predation by feral dogs and other mammalian predators; raven predation; habitat restoration; the effectiveness of desert tortoise-proof fencing and culverts in eliminating road kills; interactions of desert tortoises with urban barrier fencing; protective barriers between urban development and open desert; and effects of mining, domestic sheep and cattle grazing, noise/vibrations, and cumulative impacts on mortality and survivorship (ongoing research should be continued).

(2) Translocation. Desert tortoises from adjacent lands, such as the El Mirage Open Area, should be experimentally translocated into this DWMA to increase the density of desert tortoises and salvage breeding stock.

2. *Ord-Rodman DWMA*

Current densities:

5 to 150 desert tortoises per square mile.

Location and Description:

The proposed Ord-Rodman DWMA southeast of Barstow in San Bernardino County, California, would lie approximately south of Interstate 40, east of Highway 247, west of Argus Mountain, and north of the central portion of the Fry Mountains (Figure 10). Elevations range from about 2,500 feet in Stoddard Valley to over 6,000 feet in the Ord Mountains. Several plant communities are present: Creosotebush Scrub, Indian Rice Grass Scrub-Steppe, Blackbush Scrub, and Cheesebush Scrub (west Mojave type) (Appendix E). Land ownership is a checkerboard comprised of about 65% public and 35% private lands.

Desert Tortoise Densities and Trends:

Data on population densities and trends are available from three study plots in the DWMA: Stoddard Valley, Lucerne Valley, and Johnson Valley (Berry 1990, as amended). In 1991, the densities at the Stoddard Valley plot were 125 tortoises per square mile (Berry 1990, as amended). In 1990, density at the Lucerne Valley was estimated at 82, a decline of 53% from 1980. At Johnson Valley, the 1990 density estimate was 18 tortoises per square mile, a decline of 84% from 1980. Densities over most of the DWMA are generally much lower than at these plots. Densities were probably considerably higher between the 1930's and 1950's (Berry 1984a). Declines appear to be due to human-related activities, URTD, and raven predation (Berry 1984b, Berry 1992).

Threats:

Collecting, vandalism, road kills, disease, ORV activities, livestock grazing, mining, excessive raven predation and other human-related impacts have contributed to significant population declines. The Ord-Rodman DWMA has a long history of domestic grazing by cattle and domestic sheep. Vegetation has largely been altered by grazing, but pockets of substantially unaltered vegetation remain in northern Lucerne Valley, and perhaps elsewhere. Major transportation routes for recreationists occur along power line corridors and Camp Rock, Troy, and Ft. Cady Roads.

Desert tortoises with signs of URTD have consistently been observed in eastern Stoddard Valley and Lucerne Valley since 1988 (Berry and Slone 1989). This disease is now thought to be present

throughout the DWMA and contributing to the observed high levels of mortality (Berry 1990, as amended).

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Ord-Rodman DWMA.

(1) Remove livestock grazing or, if desired, establish terms and conditions for experimental cattle grazing in EMZs.

(2) Implement emergency measures to control off-leash dogs.

(3) Construct and maintain desert tortoise barrier fencing and underpasses to protect desert tortoises and their habitat from traffic on well-used highways and roads sueh as Highway 247.

(4) Construct and maintain special fencing to protect desert tortoises from recreational-vehicle use in the Johnson Valley Open Area and surrounding lands.

(5) Sign DWMA boundaries in the vicinity of Barstow, Newberry Springs, Lucerne, Landers, Lucerne Valley, etc.

(6) Establish a drop-off site for unwanted captive desert tortoises at the BLM's Barstow Way Station. Develop programs to promote use of unwanted desert tortoises for research and educational purposes.

(7) Reduce populations of the common raven to lessen predation on juvenile desert tortoises and ensure recruitment of juveniles into the subadult and adult populations, thus allowing a rapid recovery of the desert tortoise.

(8) Designate the Ord-Rodman DWMA as an Ecological Reserve and Research Natural Area.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities of the Ord-Rodman DWMA:

(1) Translocation of desert tortoises from adjacent lands, such as the Johnson and Stoddard Valley Open Areas, into the DWMA to augment low densities of desert tortoises and to salvage breeding stock.

(2) Disease epidemiology; the effects of ravens and other predators on desert tortoise populations; and the effects of hunting of upland birds, big game, and fur bearers on desert tortoises and their habitat.

3. Superior-Cronese DWMA

Current densities:

20 to 250 desert tortoises per square mile.

Location and Description:

The proposed Superior-Cronese DWMA in San Bernardino County, California, would be bordered on the west by the Fremont-Kramer DWMA and Cuddeback Dry Lake, on the north by the northern end of Superior Valley and NASA Road on the National Training Center, on the east by West Cronese Dry Lake, on the southeast by Interstate 15, and on the south and southwest by Rainbow Basin National Natural Landmark and the southern end of the Gravel Hills (Figure 10). This DWMA is diverse topographically and vegetationally. It includes numerous dry lakes and springs and parts of several mountain ranges. Land ownership is about 63% BLM, 22% private, and 15% Department of Defense.

Desert Tortoise Densities and Trends:

Part of the Superior-Cronese DWMA has been surveyed for desert tortoises with triangular transects (Berry and Nicholson 1984a; Chambers Group 1990; Kiva Biological Consulting and McClenahan and Hopkins Associates 1991; Woodman and Goodlett 1990; Woodman et al. 1984). These data indicate patchy concentrations of desert tortoises throughout the DWMA. D. Morafka and M. Joyner-Griffith (California State University, Northridge, pers. comm.) found a wide range of younger age-size classes represented throughout the eastern portion of the DWMA, indicating a high probability of successful reproduction and possible recruitment there. Densities are thought to be depressed as a result of a number of human impacts and disease.

Threats:

The Superior-Cronese DWMA is one of the more threatened DWMAs. Current activities include livestock grazing (mostly cattle, but some sheep), small local mining operations, power and other utility lines, civilian and military ORV activity, aerial ordnance testing on the northern periphery, construction and operation of space communications and experimental stations, small-scale horticulture and agriculture in the vicinity of Coyote Lake, and hunting. The Kern River natural gas pipeline was constructed through the DWMA in 1991. One herd management area for feral equids occurs in this area (BLM 1980a).

An adult desert tortoise symptomatic for URTD was discovered near Barstow on the Ft. Irwin Road in spring 1991; however, the proposed Superior-Cronese DWMA contains at least some areas where desert tortoises are apparently free of URTD, shell disease, and other diseases. The observed health of desert tortoises within the DWMA appeared to be excellent as of spring 1992.

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Superior-Cronese DWMA.

(1) Remove livestock grazing or, if desired, establish terms and conditions for experimental grazing in EMZs.

(2) Establish a drop-off site for unwanted captive desert tortoises at BLM's Barstow Way Station (see Ord-Rodman DWMA summary). Develop programs to make unwanted captives available for research and educational purposes.

(3) Construct barrier fencing along Interstate 15, Ft. Irwin Road, Manix Trail, Superior Lake Road, and the northern border of the DWMA to protect desert tortoises from vehicles, collection, and habitat degradation.

(4) Sign DWMA boundaries adjacent to communities and settlements including Barstow, small settlements north of Barstow, and other areas with conflicting uses.

(5) Construct highway underpasses along the Ft. Irwin Road to allow desert tortoise movement and to facilitate genetic exchange throughout this DWMA.

(6) Reduce raven populations in the DWMA to lessen mortality of small desert tortoises to a point where recruitment into the adult cohort can occur at as rapid a rate as possible.

(7) Initiate cleanup of surface toxic chemicals and unexploded ordnance.

(8) Fence the periphery of the DWMA as needed to enforce regulations and protect desert tortoises from human impacts. Along the boundary with the Fremont-Kramer DWMA, a double row of desert tortoise barrier fencing may be necessary to prevent the spread of URTD into the Superior-Cronese DWMA.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented by the Superior-Cronese DWMA:

(1) The effects of domestic sheep grazing, wave/radiant energy, visitor use, military traffic, ORVs, and highways on the desert tortoise and its habitat.

(2) Epidemiology of URTD and other diseases; physiological, ecological, nutritional, and behavioral requirements of hatchling and juvenile desert tortoises; nutritional qualities of preferred food plants; habitat restoration; and characteristics of undisturbed desert tortoise habitat. Continue using the latest medical techniques to assess the health of desert tortoises. Conduct epidemiological surveys to determine the distribution and frequency of desert tortoises with URTD and other diseases. These surveys are critical to determine if fencing is necessary within the DWMA or between the Fremont-Kramer DWMA and the Superior-Cronese DWMA.

4. Joshua Tree DWMA

Current densities:

Up to 200 desert tortoises per square mile.

Location and Description:

The proposed Joshua Tree DWMA in Riverside and San Bernardino Counties, California, includes Joshua Tree National Monument (Monument) and adjacent lands in the Pinto Mountains, Eagle Mountains, and elsewhere on the perimeter of the Monument (Figure 10). It includes elements of both the Colorado and Mojave deserts, and it occurs partly in the eastern Colorado recovery unit and primarily in the western Mojave recovery unit. Elevations range from below 1,500 feet in Pinto Basin to 5,814 feet at Quail Mountain. Most of the proposed DWMA is managed by the National Park Service.

Desert Tortoise Densities and Trends:

Density data are available from two study plots in the Monument: the Panorama and Pinto Basin plots. In 1991, densities were estimated at 200 and 226 desert tortoises per square mile at the Pinto Basin and Panorama plots, respectively (Freilich and Moon 1991). Triangular transects have also been conducted in the Monument. These data show that distribution and densities of desert tortoises in the Monument are patchy, and densities are typically much lower than at the two study plots. Desert tortoises are frequently reported from between Smoke Tree Wash and Cottonwood Pass near the southern end of the Monument, and relatively high densities are thought to occur near the Coxcomb Mountains (Karl 1988, Dr. Jerry Freilich, Monument, pers. comm., 1992). Recent surveys in the Monument indicate few tortoises occur near the main road which dissects the Monument (J. Freilich, pers. comm., 1992).

Because of differing techniques used to calculate densities at different times, existing data are not appropriate to derive trends. Based on a large number of remains, Barrow (1979) believed densities were declining at the Pinto Basin plot; however higher densities were registered (using different techniques) in 1991 (Freilich and Moon 1991).

Threats:

Because of protective management by the National Park Service, this DWMA is one of the least threatened DWMAs. Within the Monument, vehicle access is restricted to 130 miles of roads, and no mining, ORV use, or grazing is permitted. Prior to establishment of

the Monument in the 1930's, the western half of the DWMA was intensively grazed, hard-rock mining occurred, and numerous settlements were present. Limited grazing continued into the 1950's (Hickman 1977). Areas of the proposed Joshua Tree DWMA which lie outside the Monument are primarily managed by BLM for multiple use. Evidence of mining can be seen in the Eagle and Pinto Mountains, east and north of the Monument, respectively. The proposed Eagle Mountain Landfill is located at the eastern end of the DWMA.

In 1991, two desert tortoises were found with signs of URTD at the western end of the Monument where releases of desert tortoises have occurred in the past. No other diseased animals have been reported.

Specific Management Actions:

In addition to the management actions recommended for all DWMAs (Section II.E.2.), the following specific actions should be implemented in the Joshua Tree DWMA:

(1) Establish a portion of the visitor center for the purpose of educating visitors to the Monument on the status and plight of the desert tortoise and its recovery needs, and to serve as a drop-off site for unwanted captive desert tortoises. Develop programs to make these animals available for educational or research purposes.

(2) Construct desert tortoise barrier fencing to protect desert tortoises and their habitat from human activities along roads and in urban settings. This should include desert tortoise barrier fencing along the north side of the DWMA boundary and along the road from Cottonwood Pass through the Monument from Desert Center to the Eagle Mountain Mine. Desert tortoise underpasses should accompany fence construction along the Cottonwood Pass Road, as well. Chain-link fence may be needed in some areas as barbed wire does not prevent urban encroachment. If fencing is not permitted within the Monument, expand the boundary of the DWMA to the boundary of the Monument.

Recommended Research:

The following research topics are especially suited to the management needs and opportunities presented in the Joshua Tree DWMA:

(1) The genetic origin of existing desert tortoises in the Monument, focusing at the northwestern end of the Monument near the release locations.

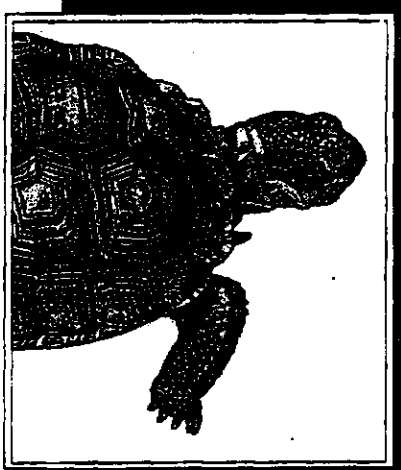
(2) Habitat restoration.

(3) Desert tortoise predation, including level of raven predation at the Monument and adjacent urban areas, and raven predation as a reflection of certain types of human uses.

(4) The effects of non-vehicular oriented recreation on desert tortoises and their habitat.

Appendix G

Desert Tortoise
(Mojave Population)



Recovery Plan

Appendix G: Environmental Determinants of Population Size

Census data and anecdotal accounts indicate that desert tortoise populations existed at quite different densities in various parts of the Mojave region prior to their recent decline. Thus, it is reasonable to expect that different DWMAs will support different tortoise densities after recovery, depending upon each reserve's particular ecological conditions and geographic location. Site-specific density might be equivalent to "carrying capacity," the density at which population growth is reduced as a result of competition among individual animals, although no data demonstrate such density-dependent feedback in desert tortoise populations. Another of the many possible factors that might determine site-specific density is the average amount of food available to tortoises during their active season. Food availability has the potential to control individual growth rates and, consequently, the age at which a tortoise reaches the size of reproductive competence. Food availability also influences fecundity. Both of these factors influence population growth rates and, hence, densities.

Some data do suggest that food availability is related to site-specific desert tortoise densities. Figure G1 shows the relationship between the highest recorded population density of adult and subadult tortoises at a study site and the mean production of annual forbs and grasses at the site, the latter being an index of long-term average food availability. Although highly significant, this correlation does not necessarily indicate causation. Many other factors, including those that might covary with food availability (e.g., variance in food availability), could actually be more important in determining population density. Nevertheless, this relationship might be used as a starting point to estimate a "target density" for each DWMA.

Before the concept of target density can be utilized effectively, research must be initiated to determine the strength and generality of the relationship indicated in Figure G1 and to identify the mechanisms underlying this relationship. Figure G1 represents only one hypothesis about factors which might determine desert tortoise population densities.

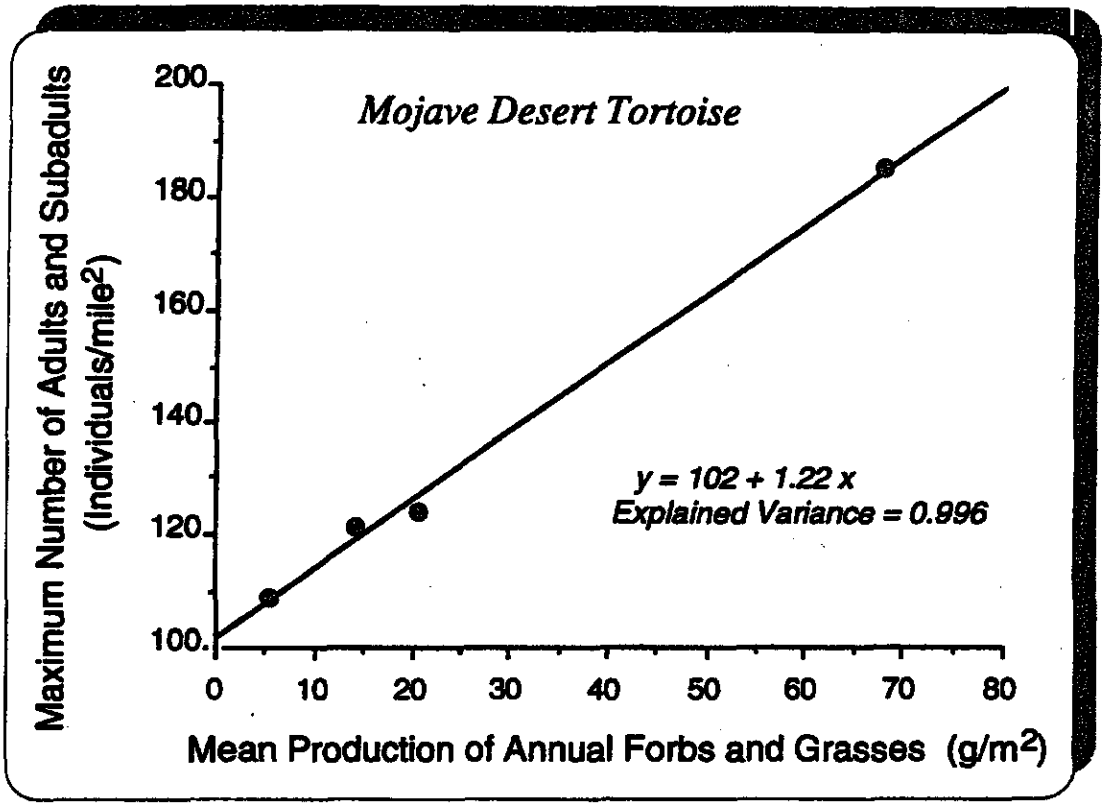
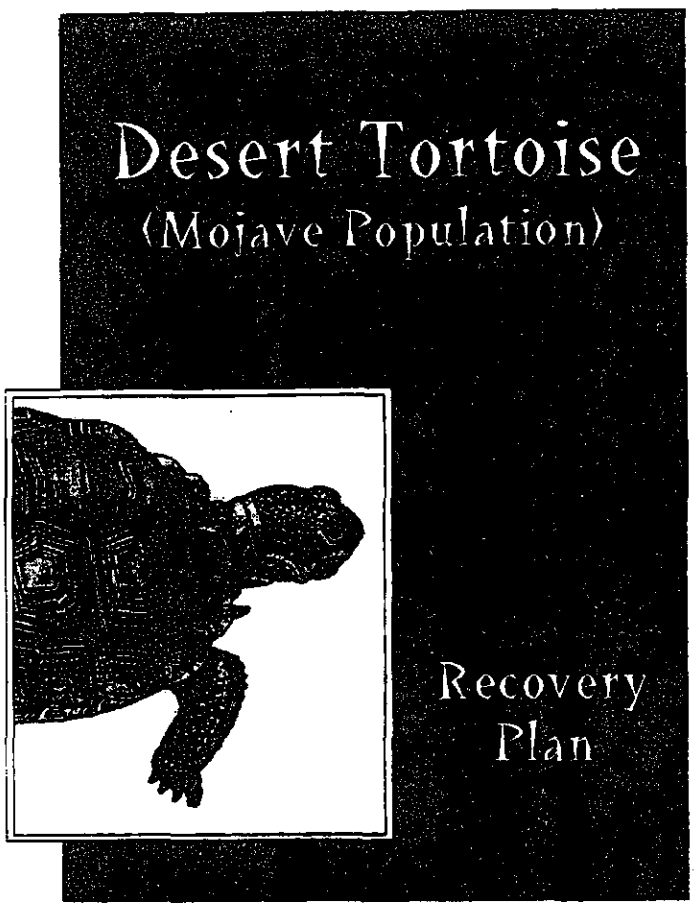


Figure G1. The highest estimated number of adult and subadult desert tortoises in a study site as a function of the long-term average production of spring annuals available in the same area. The sites represented are the Desert Tortoise Natural Area (Interior) Study Site, California; the Stoddard Valley Study Site, California; the Goffs Study Site, California; and the Woodbury/Hardy Study Site, Utah.

Appendix H



Appendix H: Critical Habitat for the Desert Tortoise (Mojave Population)

On February 8, 1994, the U.S. Fish and Wildlife Service published a final rule in the *Federal Register* (59 FR 5820) designating 6.4 million acres of critical habitat for the Mojave population of the desert tortoise (*G. agassizii*). This designation includes primarily Federal lands in southwestern Utah, northwestern Arizona, southern Nevada, and southern California.

In California, critical habitat designation totals 4,754,000 acres in Imperial, Kern, Los Angeles, Riverside, and San Bernardino counties. Of this, 3,327,400 acres are Bureau of Land Management land, and 242,200 acres are military land. The remainder includes 132,900 acres of state land and 1,051,500 acres that are privately owned.

In Nevada, four units totalling 1,224,400 acres are designated in Clark and Lincoln counties. Of this, 1,085,000 acres are Bureau of Land Management land, 103,600 acres are National Park Service land, and 35,800 acres are private.

In Utah, two units totalling 129,100 acres are designated in Washington County. This consists of 89,400 acres of Bureau of Land Management land, 27,600 acres of state land, 1,600 acres of Indian Tribal land, and 10,500 acres of private land.

In Arizona, two units totalling 338,700 acres are designated in Mohave County. This includes 288,800 acres of Bureau of Land Management land, 43,600 acres of National Park Service land, 5,700 acres of state land, and 600 acres of private land.

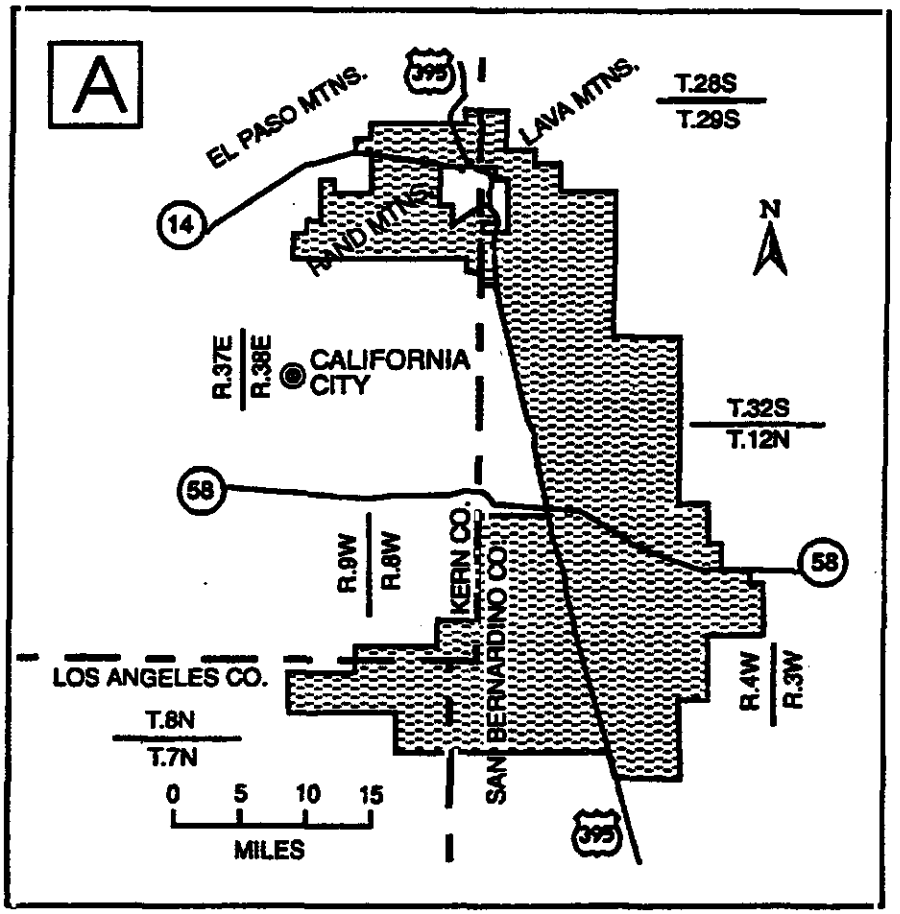
California. Areas of land as follows:

1. **Fremont-Kramer Unit.** Kern, Los Angeles, and San Bernardino Counties. From Bureau of Land Management Maps: Victorville 1978 and Cuddeback Lake 1978. (Index map location A).

Mt. Diablo Meridian: T. 29 S., R. 39 E., secs. 13, 14, 22-26, 35, and 36; T. 29 S., R. 40 E., secs. 12-33; T. 29 S., R. 41 E., secs. 7, 8, 17-20, 27-30, and 32-36; T. 30 S., R. 38 E., secs. 24-26, 35, and 36; T. 30 S., R. 39 E., secs. 1-36 except secs. 3-5; T. 30 S., R. 40 E., secs. 4-9, and 13-36, except that portion of secs. 13, 14, and 23 lying northwesterly of the Randsburg-Mojave Road; T. 30 S., R. 41 E., secs. 1-36, except secs. 5-8, and 20 and that portion of secs. 17 and 18 lying easterly of U.S. Highway 395; T. 30 S., R. 42 E., secs. 7-10, 15-22, and 27-34; T. 31 S., R. 40 E., secs. 1 and 6, except that portion of sec. 6 lying southeasterly of the Randsburg-Mojave Road; T. 31 S., R. 41 E., secs. 1-17, 20-29, and 32-36, except that portion of secs. 20, 29 and 32 lying westerly of U.S. Highway 395; T. 31 S., R. 42 E., secs. 3-10, 15-22, and 27-34; T. 32 S., R. 41 E., secs. 1-4, 9-16, 21-28, and 34-36, except that portion of secs. 4, 9, 16, 21, 27, 28, and 34 lying westerly of U.S. Highway 395; T. 32 S., R. 42 E., secs. 1-36; T. 32 S., R. 43 E., secs. 4-9, 16-21, and 28-33.

San Bernardino Meridian: T. 7 N., R. 5 W., secs. 2-11, and 14-18, except that portion of sec. 18, lying west of U.S. Highway 395; T. 7 N., R. 6 W., secs. 1-6, 12, and 13, except that portion of secs. 1, 12, and 13 lying westerly of U.S. Highway 395; T. 7 N., R. 7 W., secs. 1-6; T. 7 N., R. 8 W., secs. 1-4; T. 8 N., R. 4 W., secs. 6, 7, and 18; T. 8 N., R. 5 W., secs. 1-35 except secs. 24 and 25; T. 8 N., R. 6 W., secs. 1-36; T. 8 N., R. 7 W., secs. 1-36; T. 8 N., R. 8 W., secs. 1-28, and 33-36; T. 8 N., R. 9 W., secs. 1 and 7-24; T. 9 N., R. 4 W., secs. 2-11, 14-23, 30, and 31; T. 9 N., R. 5 W., secs. 1-36; T. 9 N., R. 6 W., secs. 1-36; T. 9 N., R. 7 W., secs. 1-4, 9-16, and 19-36; T. 9 N., R. 8 W., secs. 24, 25, and 31-36; T. 9 N., R. 9 W., sec. 36; T. 10 N., R. 4 W., secs. 6, 7, 18-20, and 29-34; T. 10 N., R. 5 W., secs. 1-36; T. 10 N., R. 6 W., secs. 1-36 except sec. 6; T. 10 N., R. 7 W., secs. 9-16, 21-28, and 33-36; T. 11 N., R. 5 W., secs. 2-11, 14-23, and 26-35; T. 11 N., R. 6 W., secs. 1-36, except that portion of secs. 6, 7, 18, 19, 30, and 31 lying westerly of U.S. Highway 395; T. 11 N., R. 7 W., that portion of sec. 1, lying easterly U.S. Highway 395; T. 12 N., R. 5 W., secs. 31-35; T. 12 N., R. 6 W., secs. 31-36; T. 12 N., R. 7 W., that portion of sec. 36 lying easterly of U.S. Highway 395.

FREMONT-KRAMER

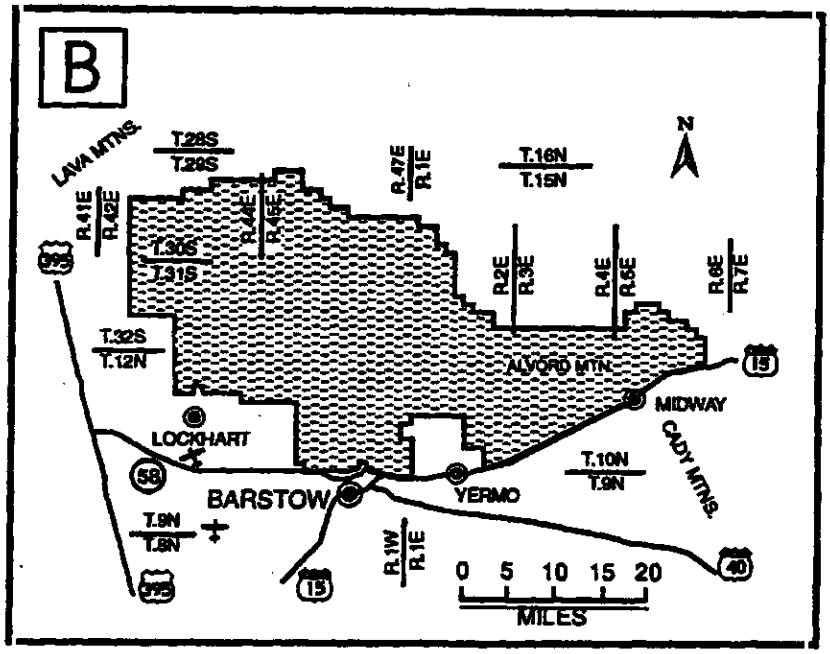


2. **Superior-Cronese Unit.** San Bernardino County. From Bureau of Land Management Maps: Cuddeback Lake 1978, Soda Mts. 1978, Victorville 1978, and Newberry Springs 1978. (Index map location B).

Mt. Diablo Meridian: T. 29 S., R. 42 E., secs. 35 and 36; T. 29 S., R. 43 E., secs. 25, 26, and 31-36; T. 29 S., R. 44 E., secs. 20-36; T. 29 S., R. 45 E., secs. 14-16, 19-23, and 25-36; T. 29 S., R. 46 E., secs. 30-32; T. 30 S., R. 42 E., secs. 1, 2, 11-14, 23-26, 35, and 36; T. 30 S., R. 43 E., secs. 1-36; T. 30 S., R. 44 E., secs. 1-36; T. 30 S., R. 45 E., secs. 1-36; T. 30 S., R. 46 E., secs. 3-36; T. 30 S., R. 47 E., secs. 7-10, 15-22, and 27-34; T. 31 S., R. 42 E., secs. 1, 2, 11-14, 23-26, 35, and 36; T. 31 S., R. 43 E., secs. 1-36; T. 31 S., R. 44 E., secs. 1-36; T. 31 S., R. 45 E., secs. 1-36; T. 31 S., R. 46 E., secs. 1-36; T. 31 S., R. 47 E., secs. 3-10, 15-22, and 27-34; T. 32 S., R. 43 E., secs. 1-3, 10-15, 22-27, and 34-36; T. 32 S., R. 44 E., secs. 1-36; T. 32 S., R. 45 E., secs. 1-36; T. 32 S., R. 46 E., secs. 1-36; T. 32 S., R. 47 E., secs. 3-10, 15-22, and 27-34.

San Bernardino Meridian: T. 9 N., R. 1 W., that portion of secs. 1 and 2 lying northerly of Interstate Highway 15; T. 9 N., R. 1 E., that portion of sec. 6 lying northerly of Interstate Highway 15; T. 10 N., R. 2 W., secs. 1-29; T. 10 N., R. 1 W., secs. 1-28, 30, and 33-36, except that portion of secs. 33-35 lying southwesterly of Interstate Highway 15; T. 10 N., R. 1 E., secs. 18, 19, 30, and 31; T. 10 N., R. 2 E., secs. 1-5, 8-17, and 22-34, except that portion of secs. 25, 26, and 34 lying southeasterly of Interstate Highway 15; T. 10 N., R. 3 E., secs. 1-12, 14-21, and 30, except that portion of secs. 11, 12, 14-16, 19-21, and 30 lying southeasterly of Interstate Highway 15; T. 10 N., R. 4 E., that portion of secs. 5-7 lying northwesterly of Interstate Highway 15; T. 11 N., R. 5 W., secs. 1 and 12; T. 11 N., R. 4 W., secs. 1-7, 9, 11, and 12; T. 11 N., R. 3 W., secs. 1-18; T. 11 N., R. 2 W., secs. 1-36; T. 11 N., R. 1 W., secs. 1-36; T. 11 N., R. 1 E., secs. 1-31; T. 11 N., R. 2 E., secs. 1-36 except sec. 31; T. 11 N., R. 3 E., secs. 1-36; T. 11 N., R. 4 E., secs. 1-34, except that portion of secs. 25, 26, 33, and 34 lying southeasterly of Interstate Highway 15; T. 11 N., R. 5 E., secs. 1-11 and 15-20, except that portion of secs. 1, 2, 10, 11, 15-17, 19, and 20 lying southeasterly of Interstate Highway 15; T. 12 N., R. 5 W., sec. 36; T. 12 N., R. 4 W., secs. 31-36; T. 12 N., R. 3 W., secs. 31-36; T. 12 N., R. 2 W., secs. 31-36; T. 12 N., R. 1 W., secs. 31-36; T. 12 N., R. 1 E., secs. 1-36; T. 12 N., R. 2 E., secs. 3-36; T. 12 N., R. 3 E., secs. 7-36; T. 12 N., R. 4 E., secs. 7-36; T. 12 N., R. 5 E., secs. 1-5 and 7-36; T. 12 N., R. 6 E., secs. 5-9, 15-22, and 27-34, except that portion of secs. 31-34 lying southerly of Interstate Highway 15; T. 13 N., R. 1 E., secs. 1-36; T. 13 N., R. 2 E., secs. 19 and 29-34; T. 13 N., R. 5 E., secs. 26-28 and 32-36; T. 14 N., R. 1 E., secs. 5-10, 15-23, and 24-36.

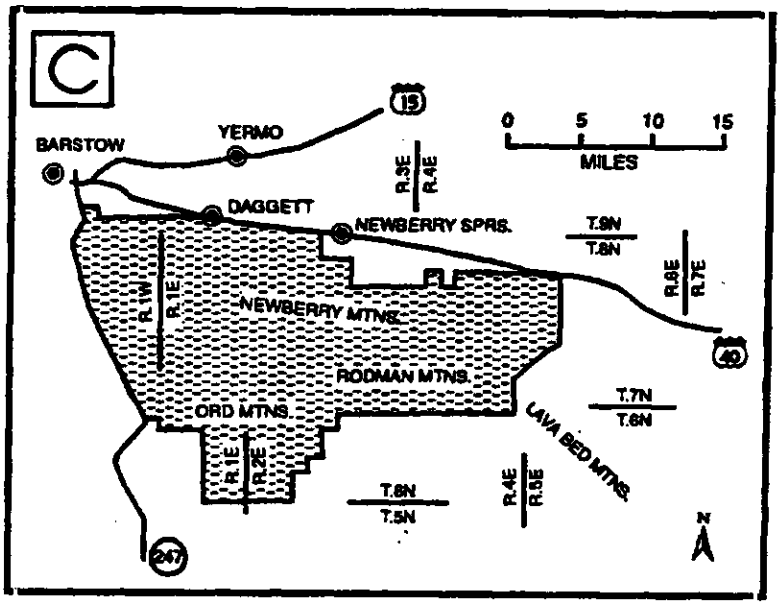
SUPERIOR-CRONESE



3. **Ord-Rodman Unit.** San Bernardino County. From Bureau of Land Management Maps: Newberry Springs 1978 and Victorville 1978. (Index map location C).

San Bernardino Meridian: T. 6 N., R. 1 E., secs. 1-6, 10-15, 22-27, and 34-36; T. 6 N., R. 2 E., secs. 1-11, 14-22, and 28-33; T. 7 N., R. 1 W., secs. 1-4, 9-15, 22-26, 35, and 36, except that portion of secs. 4, 9, 10, 15, 22, 23, 26, and 35 lying southwesterly of State Highway 247; T. 7 N., R. 1 E., secs. 1-36; T. 7 N., R. 2 E., secs. 1-36; T. 7 N., R. 3 E., secs. 1-36; T. 7 N., R. 4 E., secs. 1-36; T. 7 N., R. 5 E., secs. 4-9 and 17-19, except that portion of secs. 4, 8, 9, and 17-19 lying southerly of the northern boundary of Twentynine Palms Marine Corps Base; T. 8 N., R. 1 W., secs. 1-18, 20-29, and 32-36, except that portion of secs. 6, 7, 17, 18, 20, 29, 32, and 33 lying southwesterly of State Highway 247; T. 8 N., R. 1 E., secs. 1-36; T. 8 N., R. 2 E., secs. 2-36; T. 8 N., R. 3 E., secs. 7 and 18-36; T. 8 N., R. 4 E., secs. 13-16 and 18-36; T. 8 N., R. 5 E., secs. 16-18, 19-21, 28-30, and 31-33, except that portion of secs. 16 and 17 lying northerly of Interstate Highway 40; T. 9 N., R. 1 W., secs. 19, 20, and 25-36, except that portion of secs. 19, 20, and 29-31 lying westerly of State Highway 247; T. 9 N., R. 1 E., secs. 25-36, except that portion of secs. 25-27 lying northerly of Interstate Highway 40; T. 9 N., R. 2 E., secs. 27-35, except that portion of secs. 27-30 lying northerly of Interstate Highway 40.

ORD-RODMAN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NEWBERRY MTNS.
RODMAN MTNS.
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LAVA BED MTNS.
R.1E
R.2E
T.6N
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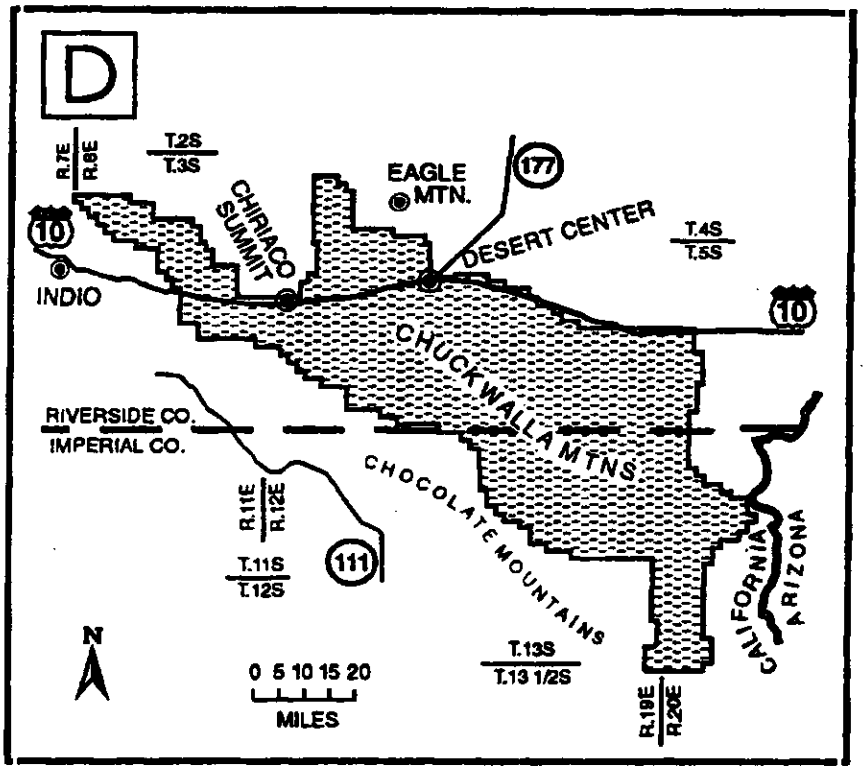
R.4E
R.5E
247
N

4. **Chuckwalla Unit.** Imperial and Riverside Counties. From Bureau of Land Management Maps: Chuckwalla #18 1978, Parker-Blythe #16 1978, Salton Sea #20 1978, and Midway Well #21 1979. (Index map location D).

San Bernardino Meridian: T. 3 S., R. 13 E., secs. 19-21 and 27-35; T. 4 S., R. 8 E.. secs. 1-6, 8-16, 22-26, and 36; T. 4 S., R. 9 E., secs. 6-10, and 15-36; T. 4 S., R. 10 E., secs. 19-21, and 27-34; T. 4 S., R. 13 E., secs. 2-36 except secs. 12 and 13; T. 4 S., R. 14 E., secs. 27-36; T. 4 S., R. 15 E., secs. 31 and 32; T. 5 S., R. 9 E., secs. 1-4, 12, 13, and 24; T. 5 S., R. 10 E., secs. 2-36 except sec. 31; T. 5 S., R. 11 E., secs. 19-21 and 28-33; T. 5 S., R. 12 E., sec. 36; T. 5 S., R. 13 E., secs. 1-36 except secs. 6 and 7; T. 5 S., R. 14 E., secs. 1-36; T. 5 S., R. 15 E., secs. 4-9, 16-21, 25, S 1/2 sec. 26, S 1/2 sec. 27, and secs. 28-36; T. 5 S., R. 16 E., secs. 28-35; T. 6 S., R. 10 E., secs. 1-4, 9-16, 21-26, 35 and 36; T. 6 S., R. 11 E., secs. 4-36; T. 6 S., R. 12 E., secs. 1-36; T. 6 S., R. 13 E., secs. 1-36; T. 6 S., R. 14 E., secs. 1-36; T. 6 S., R. 15 E., secs. 1-36; T. 6 S., R. 16 E., secs. 1-36; T. 6 S., R. 17 E., secs. 5-9, and 14-36; T. 6 S., R. 18 E., secs. 29-36; T. 6 S., R. 19 E., secs. 31-36; T. 6 S., R. 20 E., secs. 31-34; T. 7 S., R. 11 E., sec. 1; T. 7 S., R. 12 E., secs. 1-6, 9-15, and 23-25; T. 7 S., R. 13 E., secs. 1-30 and 31-36; T. 7 S., R. 14 E., secs. 1-36; T. 7 S., R. 15 E., secs. 1-36; T. 7 S., R. 16 E., secs. 1-36; T. 7 S., R. 17 E., secs. 1-36; T. 7 S., R. 18 E., secs. 1-36; T. 7 S., R. 19 E., secs. 1-36; T. 7 S., R. 20 E., secs. 3-10, 14-23, and 26-35; T. 8 S., R. 13 E., secs. 1, 2, and 11-14; T. 8 S., R. 14 E., secs. 1-18, and secs. 21-26; T. 8 S., R. 15 E., secs. 1-30 and 34-36; T. 8 S., R. 16 E., secs. 1-36; T. 8 S., R. 17 E., secs. 1-36; T. 8 S., R. 18 E., secs. 1-36; T. 8 S., R. 19 E., secs. 1-36; T. 8 S., R. 20 E., secs. 3-10, 15-22, and 28-33; T. 9 S., R. 15 E., sec. 1; T. 9 S., R. 16 E., secs. 1-17, 20-29, and 32-36; T. 9 S., R. 17 E., secs. 1-36; T. 9 S., R. 18 E., secs. 1-36; T. 9 S., R. 19 E., secs. 1-36; T. 9 S., R. 20 E., secs. 5-8, 17-20, and 29-33; T. 10 S., R. 16 E., secs. 1-5, 9-16, and 22-26; T. 10 S., R. 17 E., secs. 1-36; T. 10 S., R. 18 E., secs. 1-36; T. 10 S., R. 19 E., secs. 1-36; T. 10 S., R. 20 E., secs. 3-36; T. 10 S., R. 21 E., secs. 18-21 and 28-34; T. 10 1/2 S., R. 21 E., secs. 31-33; T. 11 S., R. 17 E., secs. 1-5 and 8-15; T. 11 S., R. 18 E., secs. 1-24; T. 11 S., R. 19 E., secs. 1-26, 35, and 36; T. 11 S., R. 20 E., secs. 1-23 and 26-34; T. 11 S., R. 21 E., secs. 4-8; T. 12 S., R. 19 E., secs. 1, 2, 11-14, 23-26, 35, and 36; T. 12 S., R. 20 E., secs. 3-10, 15-22, and 27-34; T. 13 S., R. 19 E., secs. 1, 2, 11, 12, 22-27, and 34-36; T. 13 S., R. 20 E., secs. 3-10, 14-23, and 26-34.

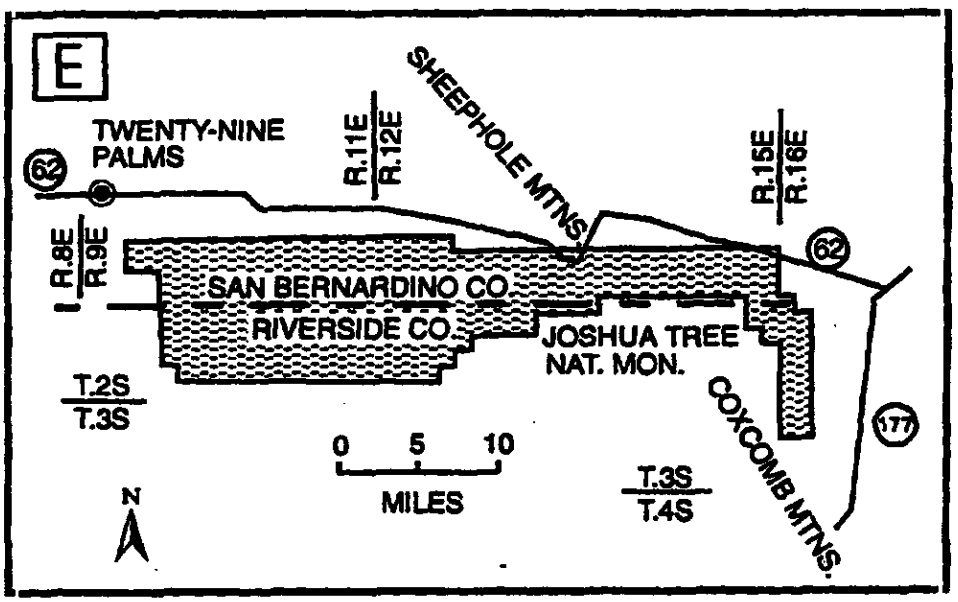
CHUCKWALLA


D
R.7E
R.8E
T.2S
T.3S
CHIRIACO SUMMIT
EAGLE MTN.
177
DESERT CENTER
T.4S
T.5S
10
INDIO
CHUCKWALLA MTNS.
RIVERSIDE CO.
IMPERIAL CO.
CHOCOLATE MOUNTAINS
R.11E
R.12E
T.11S
T.12S
111
N
0 5 10 15 20
MILES
T.13S
T.13 1/2S
R.19E
R.20E
CALIFORNIA
ARIZONA

5. **Pinto Mountain Unit.** Riverside and San Bernardino Counties. From Bureau of Land Management Maps: Yucca Valley 1982, Sheep Hole Mountains 1978, Chuckwalla 1978, and Palm Springs #17 1978. (Index map location E).

San Bernardino Meridian: T. 1 S., R. 9 E., secs. 10-15, 24, 25, and 36; T. 1 S., R. 10 E., secs. 7-36; T. 1 S., R. 11 E., secs. 7-36; T. 1 S., R. 12 E., secs. 7-36 except sec. 12; T. 1 S., R. 13 E., secs. 13-36; T. 1 S., R. 14 E., secs. 13-32; T. 1 S., R. 15 E., secs. 13-30 and 36; T. 1 S., R. 16 E., secs. 18, 19, and 30-32; T. 2 S., R. 9 E., secs. 1, 12, and 13; T. 2 S., R. 10 E., secs. 1-24; T. 2 S., R. 11 E., secs. 1-24; T. 2 S., R. 12 E., secs. 1-22 except sec. 13; T. 2 S., R. 13 E., secs. 3-6; T. 2 S., R. 15 E., sec. 1; T. 2 S., R. 16 E., secs. 4-9, 16, 17, 20, 21, 28, 29, 32, and 33; T. 3 S., R. 16 E., secs. 4, 5, 8, and 9.

PINTO MOUNTAIN

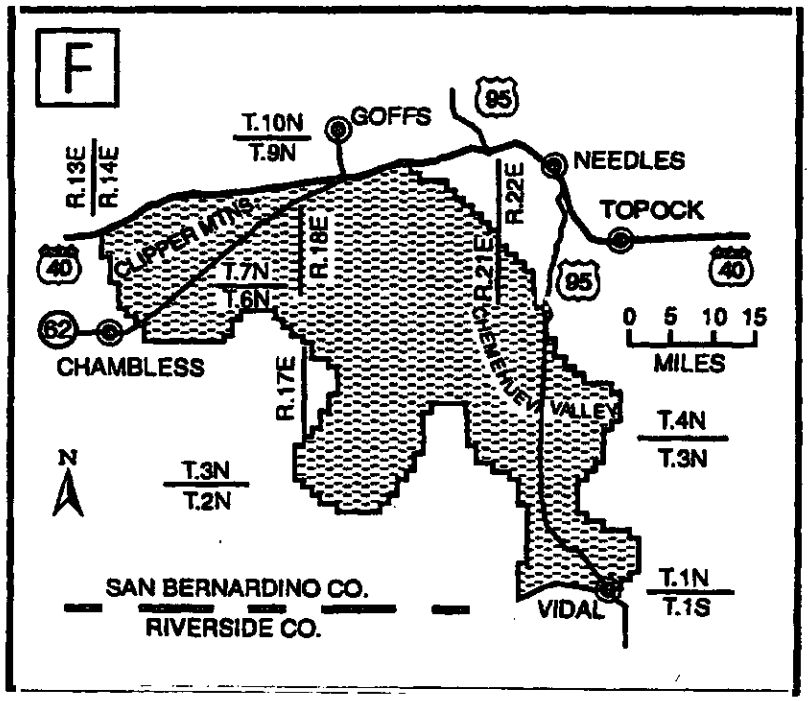


6. **Chemehuevi Unit.** San Bernardino County. From Bureau of Land Management Maps: Sheep Hole Mts. 1978, Parker 1979, Needles 1978, and Amboy 1991. (Index map location F).

San Bernardino Meridian: T. 1 S., R. 22 E., that portion of secs. 3-5, lying northwesterly of the Atchison Topeka and Santa Fe Railroad; T. 1 S., R. 23 E., that portion of secs. 1-3 lying northerly of the Atchison Topeka and Santa Fe Railroad, except that portion of sec. 1, lying easterly of U.S. Highway 95; T. 1 N., R. 22 E., secs. 1-4, 9-16, 20-29, and 32-36, except that portion of secs. 34-36 lying southerly of the Atchison Topeka and Santa Fe Railroad; T. 1 N., R. 23 E., secs. 1-36, except that portion of secs. 31-34 lying southerly of Atchison Topeka and Santa Fe Railroad; T. 1 N., R. 24 E., secs. 4-9, 16-21, and 29-31; T. 2 N., R. 18 E., secs. 1-5, and 9-14; T. 2 N., R. 19 E., secs. 2-10, and 16-18; T. 2 N., R. 22 E., secs. 1-5, 8-16, 21-28, and 33-36; T. 2 N., R. 23 E., secs. 5-8, 17-21, and 26-36; T. 2 N., R. 24 E., secs. 31 and 32; T. 3 N., R. 17 E., secs. 12, 13, 24, and 25; T. 3 N., R. 18 E., secs. 1-36; T. 3 N., R. 19 E., secs. 1-35; T. 3 N., R. 20 E., secs. 5-8, 18, and 19; T. 3 N., R. 21 E., secs. 1-5, 9-16, 23, and 24; T. 3 N., R. 22 E., secs. 1-36 except sec. 31; T. 3 N., R. 23 E., secs. 2-11, 14-22, and 28-32; T. 4 N., R. 18 E., secs. 1, 2, 10-15, 21-28, and 32-36; T. 4 N., R. 19 E., secs. 1-36; T. 4 N., R. 20 E., secs. 1-12, 16-20, and 29-32; T. 4 N., R. 21 E., secs. 1-17, 20-29, and 32-36; T. 4 N., R. 22 E., secs. 1-36; T. 4 N., R. 23 E., secs. 1-35; T. 4 N. R. 24 E., Secs 6, 7, 18, and 19; T. 5 N., R. 15 E., secs. 1-6; T. 5 N., R. 16 E., secs. 4-6; T. 5 N., R. 18 E., secs. 1-6, 8-17, 22-26, 35, and 36; T. 5 N., R. 19 E., secs. 1-36; T. 5 N., R. 20 E., secs. 1-36; T. 5 N., R. 21 E., secs. 1-36; T. 5 N., R. 22 E., secs. 2-36; (Unsurveyed) T. 5 N., R. 23 E., protracted secs. 19, and 29-33; T. 6 N., R. 14 E., secs. 1-3, 10-15, and 23-25; T. 6 N., R. 15 E., secs. 1-36; T. 6 N., R. 16 E., secs. 1-23, and 27-34; T. 6 N., R. 17 E., secs. 1-18, 22-26, and 36; T. 6 N., R. 18 E., secs. 1-36; T. 6 N., R. 19 E., secs. 1-36; T. 6 N., R. 20 E., secs. 1-36; T. 6 N., R. 21 E., secs. 1-36; T. 6 N., R. 22 E., secs. 3-10, 15-23, and 26-35; T. 7 N., R. 14 E., secs. 1-5, 8-17, 21-28, and 33-36; T. 7 N., R. 15 E., secs. 1-36; T. 7 N., R. 16 E., secs. 1-36; T. 7 N., R. 17 E., secs. 1-36; T. 7 N., R. 18 E., secs. 1-36; T. 7 N., R. 19 E., secs. 1-36; T. 7 N., R. 20 E., secs. 1-36; T. 7 N., R. 21 E., secs. 1-36; T. 7 N., R. 22 E., secs. 18-20, and 28-34; T. 8 N., R. 14 E., secs. 13, 23-28, and 31-36, except that portion of secs. 13, 23, 24, 26, 27, 28, 31, 32, and 33 lying northwesterly of Interstate Highway 40; T. 8 N., R. 15 E., secs. 9-36, except that portion of secs. 9-12, 17, and 18 lying northwesterly of Interstate Highway 40; T. 8 N., R. 16 E., secs. 1, 2, and 7-36, except that portion of secs. 1, 2, and 7-10 and 11 lying northerly of Interstate Highway 40; T. 8 N., R. 17 E., secs. 1-36, except that portion of secs. 1-6 lying northerly of Interstate Highway 40; T. 8 N., R. 18 E., secs. 1-36, except that portion of sec. 6 lying northerly of Interstate Highway 40; T. 8 N., R. 19 E., secs. 1-36; T. 8 N., R. 20 E., secs. 1-36; T. 8 N., R. 21 E., secs. 7, 17-21, and 27-35; T. 9 N., R. 18 E., that portion of secs. 31-36 lying southerly of Interstate

Highway 40; T. 9 N., R. 19 E., secs. 23-29, 31-36, except that portion of secs. 23, 24, 26-29, 31, and 32 lying northerly of Interstate Highway 40; T. 9 N., R. 20 E., secs. 19, 20, and 29-33, except that portion of secs. 19 and 20 lying northerly of Interstate Highway 40 and S 1/2 S 1/2 sec. 27, SW 1/4 SW 1/4 sec. 26, and W 1/2 W 1/2 sec. 35..

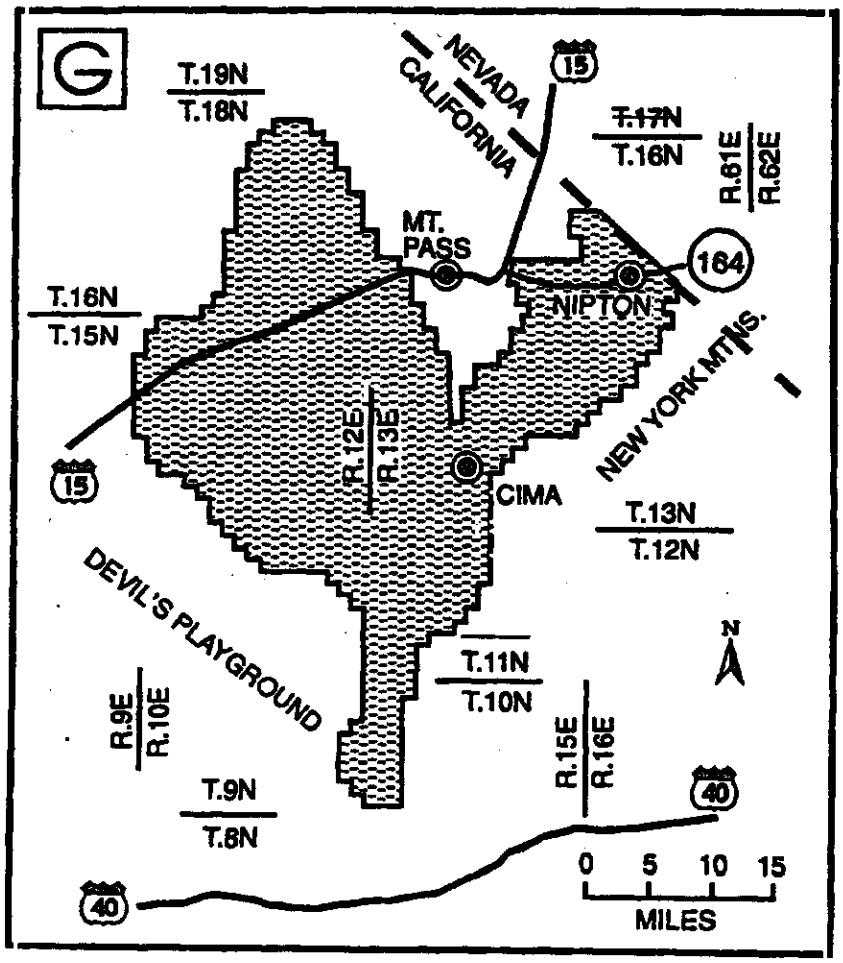
CHEMEHUEVI


F
T.10N
T.9N
GOFFS
95
NEEDLES
TOPOCK
R.13E
R.14E
R.22E
CLIPPER MTNS.
R.18E
R.21E
40
T.7N
T.6N
95
40
62
CHAMBLESS
0 5 10 15
MILES
R.17E
CHEMEHUEVI
VALLEY
T.4N
T.3N
N
T.3N
T.2N
SAN BERNARDINO CO.
RIVERSIDE CO.
VIDAL
T.1N
T.1S

7. **Ivanpah Unit.** San Bernardino County. From Bureau of Land Management Maps: Amboy 1991, Ivanpah 1979, and Mesquite Lake 1990. (Index map location G).

San Bernardino Meridian: T. 9 N., R. 12 E., secs. 1, 2, 11-14, and 24; T. 9 N., R. 13 E., secs. 4-9, 16-21, and 28-30; T. 10 N., R. 12 E., secs. 25, 35, and 36; T. 10 N., R. 13 E., secs. 3-10, 16-21, and 28-33; T. 11 N., R. 12 E., secs. 1, 12, 13, 24, 25, and 36; T. 11 N., R. 13 E., secs. 1-12, 15-21, and 28-33; T. 11 N., R. 14 E., sec. 6; T. 12 N., R. 11 E., secs. 1-5 and 9-15; T. 12 N., R. 12 E., secs. 1-18, 21-27, 35, and 36; T. 12 N., R. 13 E., secs. 1-36; T. 12 N., R. 14 E., secs. 4-9, 16-21, and 29-32; T. 13 N., R. 10 E., secs. 1-5, 10-14, 24, and 25; T. 13 N., R. 11 E., secs. 1-36; T. 13 N., R. 12 E., secs. 1-36; T. 13 N., R. 13 E., secs. 1-36; T. 13 N., R. 14 E., secs. 3-9, 16-21, and 28-33; T. 14 N., R. 9 E., secs. 1, 12, 13, and 24; T. 14 N., R. 10 E., secs. 1-36; (Unsurveyed) T. 14 N., R. 11 E., Protracted secs. 1-35; T. 14 N., R. 11 E., sec. 36; T. 14 N., R. 12 E., secs. 1-36; T. 14 N., R. 13 E., secs. 1-36; T. 14 N., R. 14 E., secs. 1-5, 8-17, and 19-35; T. 14 N., R. 15 E., secs. 1-12, and 14-22; T. 14 N., R. 16 E., sec. 6; T. 15 N., R. 9 E., secs. 24, 25, and 36; T. 15 N., R. 10 E., secs. 1-36 except sec. 6; T. 15 N., R. 11 E., secs. 1-36; T. 15 N., R. 12 E., secs. 1-36; T. 15 N., R. 13 E., secs. 3-11 and 14-36; T. 15 N., R. 14 E., secs. 12, 13, 23-28, and 33-36; T. 15 N., R. 15 E., secs. 1-36; T. 15 N., R. 16 E., secs. 1-11, 14-22, and 28-33; T. 15 1/2 N., R. 14 E., secs. 24 and 25; T. 15 1/2 N., R. 15 E., secs. 19-36; T. 15 1/2 N., R. 16 E., secs. 19-35; T. 16 N., R. 10 E., secs. 25, 35, and 36; T. 16 N., R. 11 E., secs. 1-36; T. 16 N., R. 12 E., secs. 1-36; T. 16 N., R. 12 1/2 E., secs. 12, 13, 24, 25, and 36; T. 16 N., R. 13 E., secs. 7, 17-20, and 29-33; T. 16 N., R. 14 E., secs. 24, 25, 35 and 36, except that portion of secs. 24 and 35 lying northwesterly of Interstate Hwy. 15; T. 16 N., R. 15 E., secs. 1-3, 10-14, and 23-36; T. 16 N., R. 16 E., secs. 6-8, 16-22, and 26-36; T. 17 N., R. 11 E., secs. 1-5, 8-17, 20-29, an 31-36; T. 17 N., R. 12 E., secs. 3-10, 14-23, and 26-36; T. 18 N., R. 11 E., secs. 13, 14, 22-28, and 33-36; T. 18 N., R. 12 E., secs. 18-20, and 28-33.

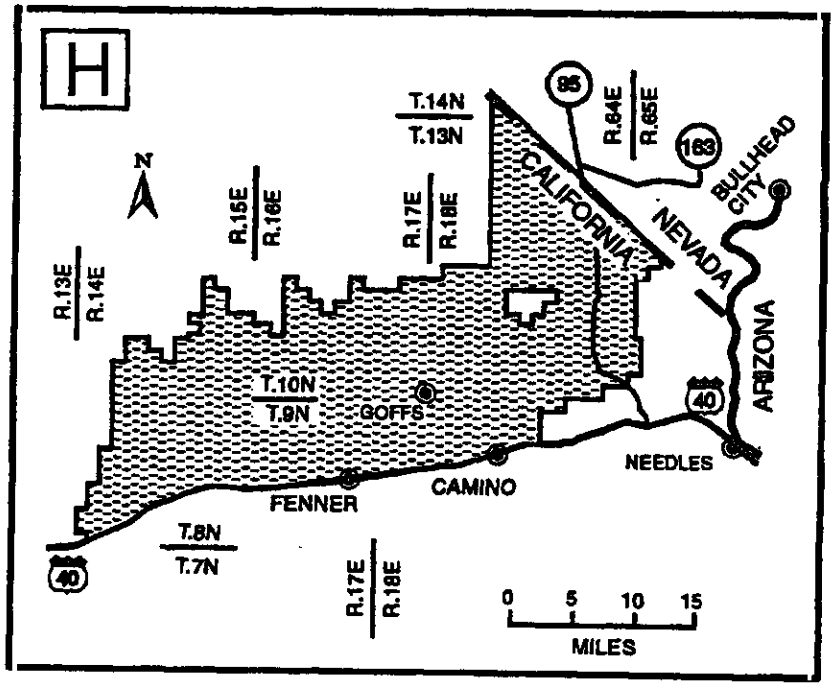
IVANPAH


G
T.19N
T.18N
NEVADA
CALIFORNIA
15
T.17N
T.16N
R.61E
R.62E
MT.
PASS
164
NIPTON
T.16N
T.15N
NEW YORK MTNS.
R.12E
R.13E
CIMA
15
T.13N
T.12N
DEVIL'S PLAYGROUND
N
T.11N
T.10N
R.9E
R.10E
R.15E
R.16E
T.9N
T.8N
40
40
0 5 10 15
MILES

8. <u>Piute-Eldorado Unit.</u> San Bernardino County. From Bureau of Land Management Maps: Amboy 1991, Needles 1978, and Ivanpah 1979. (Index map location H).

San Bernardino Meridian: T. 8 N., R. 14 E., secs. 1-4, 8-17, 19-24, 26-30, 32, and 33, except that portion of secs. 13, 23, 24, 26-28, 32 and 33 lying southeasterly of Interstate Highway 40; T. 8 N., R. 15 E., secs. 1-12, 17, and 18, except that portion of secs. 1, 8-12, 17, and 18 lying southeasterly of Interstate Highway 40; T. 8 N., R. 16 E., secs. 1-10, except that portion of sections 1-3 and 6-10 lying southerly of Interstate Highway 40; T. 8 N., R. 17 E., that portion of secs. 1-6, lying northerly of Interstate Highway 40; T. 9 N., R. 14 E., secs. 1-3, 10-15, 22-28, and 33-36; T. 9 N., R. 15 E., secs. 1-36; T. 9 N., R. 16 E., secs. 1-36; T. 9 N., R. 17 E., secs. 1-36, except that portion of sec. 36 lying southerly of Interstate Highway 40; T. 9 N., R. 18 E., secs. 1-36, except that portion of secs. 31-36 lying southerly of Interstate Highway 40; T. 9 N., R. 19 E., secs. 1-24 and 26-32, except that portion of secs. 26-29, 31, and 32 lying southerly of Interstate Highway 40; T. 9 N., R. 20 E., secs. 3-8 and 17-20, except that portion of secs. 19 and 20 lying southerly of Interstate Highway 40; T. 10 N., R. 14 E., secs. 11-14, 22-27, and 34-36; T. 10 N., R. 15 E., secs. 1-3, 9-16, and 18-36; T. 10 N., R. 16 E., secs. 1-36; T. 10 N., R. 17 E., secs. 1-36; T. 10 N., R. 18 E., secs. 1-36; T. 10 N., R. 19 E., secs. 1-36; T. 10 N., R. 20 E., secs. 1-36; T. 10 N., R. 21 E., secs. 3-10, 15-22, and 28-31; T. 11 N., R. 15 E., secs. 9, 15, 16, 21, 22, 25-29, and 33-36; T. 11 N., R. 16 E., secs. 9, 15, 16, 21-23, 25-28, 31, and 33-36; T. 11 N., R. 17 E., secs. 8, 12-17, and 19-36; T. 11 N., R. 18 E., secs. 1-4 and 7-36; T. 11 N., R. 19 E., secs. 1-13, 18, 19, 23-27, and 29-36; T. 11 N., R. 20 E., secs. 1-11, 14-23, and 26-35; T. 12 N., R. 19 E., secs. 1-36; T. 12 N., R. 20 E., secs. 3-11 and 13-36; T. 12 N., R. 21 E., secs. 19, 30, and 31; T. 13 N., R. 19 E., secs. 3-11 and 13-36; T. 13 N., R. 20 E., secs. 19 and 29-33; T. 14 N., R. 19 E., secs. 19 and 29-33.

PIUTE-ELDORADO, CALIFORNIA

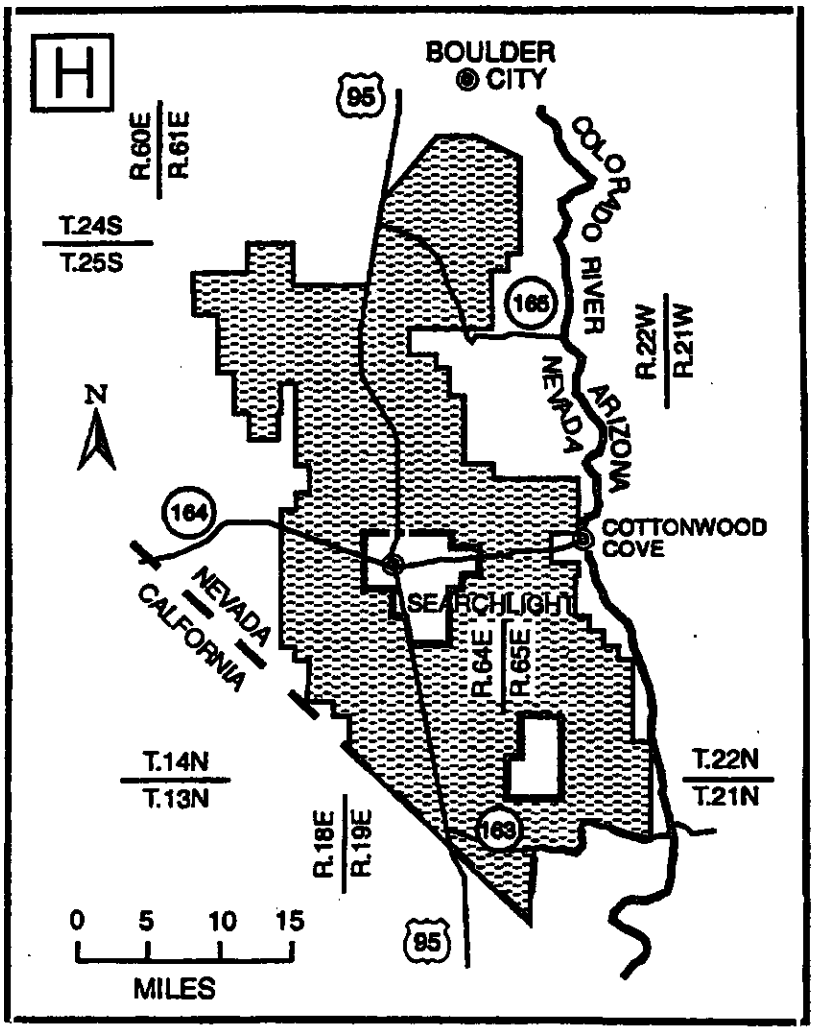


Nevada. Areas of land as follows:

9. **Piute-Eldorado Unit.** Clark County. From Bureau of Land Management Maps: Mesquite Lake 1990, Boulder City 1978, Ivanpah 1979, and Davis Dam 1979. (Index map location H).

Mt. Diablo Meridian: T. 23 S., R. 64 E., secs. 31-36, except that portion of sec. 31 lying northwesterly of the powerline and also except that portion of secs. 34-36 lying northeasterly of the powerline; T. 23 1/2 S., R. 64 E., secs. 31-36, except that portion of sec. 31 lying northwesterly of the powerline; T. 23 1/2 S., R. 65 E., that portion of sec. 31, lying southwesterly of the powerline; T. 24 S., R. 63 E., secs. 1, 2, 11-15, 22-28, and 33-36, except that portion of secs. 1, 2, 11, 14, and 15 lying northwesterly of the powerline and also except that portion of secs. 22, 27, 28, and 33 lying northwesterly of U.S. Highway 95; T. 24 S., R. 64 E., secs. 1-36; T. 24 S., R. 65 E., secs. 6, 7, 18, 19, 30, and 31; T. 25 S., R. 61 E., secs. 13-15, E 1/2 sec. 16, E 1/2 sec. 21, secs. 22-27, E 1/2 sec. 28, secs. 35 and 36; T. 25 S., R. 62 E., secs. 4-9, and secs. 16-36; T. 25 S., R. 63 E., secs. 1-4, 9-16, and 19-36, except that portion of secs. 4, 9, and 16 lying northwesterly of U.S. Highway 95; T. 25 S., R. 64 E., secs. 1-35 except secs. 13, 24, and 25,; T. 25 S. R. 65 E., sec. 6; T. 26 S., R. 61 E., secs. 1, 2, 11-14, 24, 25, and 36; T. 26 S., R. 62 E., secs. 1-36 except secs. 28 and 33; T. 26 S., R. 63 E., secs. 2-36 except sec. 12; T. 26 S., R. 64 E., secs. 18-20, and 29-33; T. 27 S., R. 62 E., secs. 1-3, 5-8, 10-15, 22-26, 35, and 36; T. 27 S., R. 62 1/2 E., secs. 1, 12, 13, 24, 25, and 36; T. 27 S., R. 63 E., secs. 1-36; T. 27 S., R. 64 E., secs. 4-9, 16-21, and 26-36; T. 27 S., R. 65 E., secs. 31-35; T. 28 S., R. 62 E., secs. 1-3, 9-16, 21-28, and 33-36; T. 28 S., R. 63 E., secs. 1-20, and 29-32; T. 28 S., R. 64 E., secs. 1-18, 21-26, 35, and 36; T. 28 S., R. 65 E., secs. 2-11, 14-21, and 28-35; T. 29 S., R. 62 E., secs. 1-4, 9-16, 21-28, 34, 35 and 36; T. 29 S., R. 63 E., secs. 5-10, 15-23, and 26-36; T. 29 S., R. 64 E., secs. 1-3, 9-16, 21-28, and 31-36; T. 29 S., R. 65 E., secs. 2-36 except secs. 12 and 13; T. 29 S., R. 66 E., secs. 30-32; T. 30 S., R. 62 E., secs. 1, 2, and 11-14; T. 30 S., R. 63 E., secs. 1-36 except secs. 30 and 31; T. 30 S., R. 64 E., secs. 1-36; T. 30 S., R. 65 E., secs. 1-26, 30, 31, 35, and 36; T. 30 S., R. 66 E., secs. 4-9, 16-21, and 28-33; T. 31 S., R. 63 E., secs. 1-5, 8-16, 22-26, and 36; T. 31 S., R. 64 E., secs. 1-36; T. 31 S., R. 65 E., secs. 1, 2, 6, 11-14, 23-36, except that portion of sec. 36 lying southwesterly of State Highway 163; T. 31 S., R. 66 E., secs. 3-10, 15-22, and 27-34, except that portion of sec. 31 lying southwesterly of State Highway 163; T. 32 S., R. 64 E., secs. 1-6, 8-16, 22-26, and 36; T. 32 S., R. 65 E., secs. 1-12, 17-20, and 29-32, except that portion of secs. 1, and 9-12 lying southeasterly or easterly of State Highway 163; T. 32 S., R. 66 E., that portion of secs. 3-6 lying northerly of State Highway 163; T. 33 S., R. 65 E., sec. 5.

PIUTE-ELDORADO, NEVADA



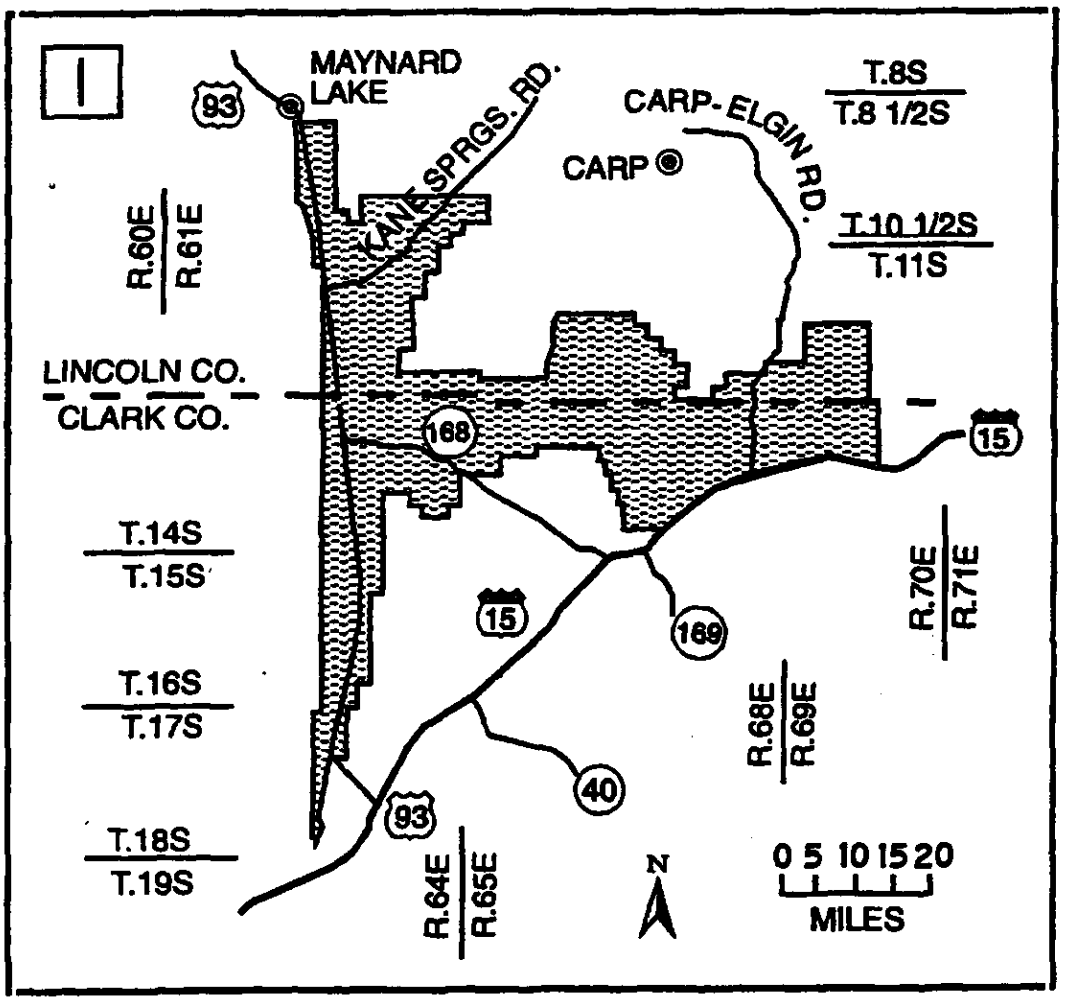
10. Mormon Mesa Unit. Clark and Lincoln Counties. From Bureau of Land Management Maps: Pahranagat 1978, Clover Mts. 1978, Overton 1978, Indian Springs 1979, Lake Mead 1979, and Las Vegas 1986. (Index map location I).

Mt. Diablo Meridian: T. 9 S., R. 62 E., secs. 13-15, 22-27, and 34-36, except that portion of secs. 15, 22, 27, and 34 lying westerly of the easterly boundary line of the Desert National Wildlife Range;

T. 9 S., R. 63 E., secs. 18, 19, 30, and 31; T. 10 S., R. 62 E., secs. 1, 2, 11-14, 23-25, and 36 except that portion of secs. 14, 23, 35, and 36 lying westerly of the easterly boundary line of the Desert National Wildlife Range;
T. 10 S., R. 63 E., secs. 6, 7, 13-15, 18-20, and 22-36; T. 10 S., R. 64 E., secs. 13-24 and 26-34; T. 10 S., R. 65 E., secs. 18, and 19; T. 11 S., R. 62 E., that portion of sec. 1 lying easterly of the easterly boundary line of the Desert National Wildlife Range; T. 11 S., R. 63 E., secs. 1-36; T. 11 S., R. 64 E., secs. 4-9, 17-20, 30, and 31; T. 11 S., R. 66 E., secs. 31-36; T. 12 S., R. 63 E., secs. 1-36; T. 12 S., R. 64 E., secs. 6, 7, and 25-36; T. 12 S., R. 65 E., secs. 1, 12, 13, and 24-36, except that portion of secs. 1, 2, 13, and 24 lying westerly of Union Pacific Railroad; T. 12 S., R. 66 E., secs. 1-36; T. 12 S., R. 67 E., secs. 6-8, 16-22, and 27-33; T. 12 S., R. 68 E., secs. 23-29 and 31-36; T. 12 S., R. 69 E., secs. 1-5, 8-17, and 19-36; T. 12 1/2 S., R. 62 E., that portion of sec. 36, lying easterly of the easterly boundary line of the Desert National Wildlife Range; T. 13 S., R. 62 E., that portion of secs. 1, 12, 13, 24, and 25 lying easterly of the easterly line of the Desert National Wildlife Range; T. 13 S., R. 63 E., secs. 1-36; T. 13 S., R. 64 E., secs. 1-36; T. 13 S., R. 65 E., secs. 1-24, N 1/2 26, N 1/2 27, N 1/2 and SW 1/4 sec. 28, 29-32, and W 1/2 33; T. 13 S., R. 66 E., secs. 1-26, W 1/2 sec. 27, 35, and 36; T. 13 S., R. 67 E., secs. 1-36; T. 13 S., R. 68 E., secs. 1-36, except that portion of secs. 25 and 33-36 lying southeasterly of Interstate Highway 15; T. 13 S., R. 69 E., secs. 1-30, except that portion of secs. 25-30 lying southerly of Interstate Highway 15; T. 13 S., R. 70 E., secs. 6, 7, 18, 19, 30, and 31, except that portion of secs. 30 and 31 lying southerly of Interstate Highway 15; T. 13 1/2 S., R. 63 E., secs. 31-36; T. 13 1/2 S., R. 64 E., secs. 31-36, except that portion of sec. 36 lying southwesterly of State Highway 168; T. 14 S., R. 63 E., secs. 1-23, and 26-35; T. 14 S., R. 64 E., secs. 2-6, 8-11, 15, and 16; T. 14 S., R. 66 E., secs. 1, E 1/2 sec. 2, 12, E 1/2 sec. 13, and E 1/2 sec. 24; T. 14 S., R. 67 E., secs. 1-12 and 14-22, except that portion of secs. 12, 14, 15, 21, and 22 lying southerly of Interstate Highway 15; T. 14 S., R. 68 E., that portion of secs. 4-7 lying northwesterly of Interstate Highway 15; T. 15 S., R. 63 E., secs. 2-11, 14-22, and 27-34; T. 16 S., R. 63 E., secs. 3-10, 15-22, and 28-33; T. 17 S., R. 63 E., secs. 7-9, 16-21, and 28-32, except that portion of secs. 29 and 32 lying easterly of the westerly boundary line of the Apex Disposal Road; T. 18 S., R. 63 E., secs. 5-8, 17-19, and 29-31, except that portion of secs. 5, 8, 17-19, and 29-31 lying easterly of the westerly boundary line of the Apex

Disposal Road, and that portion of sec. 31 lying westerly of the easterly boundary line of Desert National Wildlife Range.

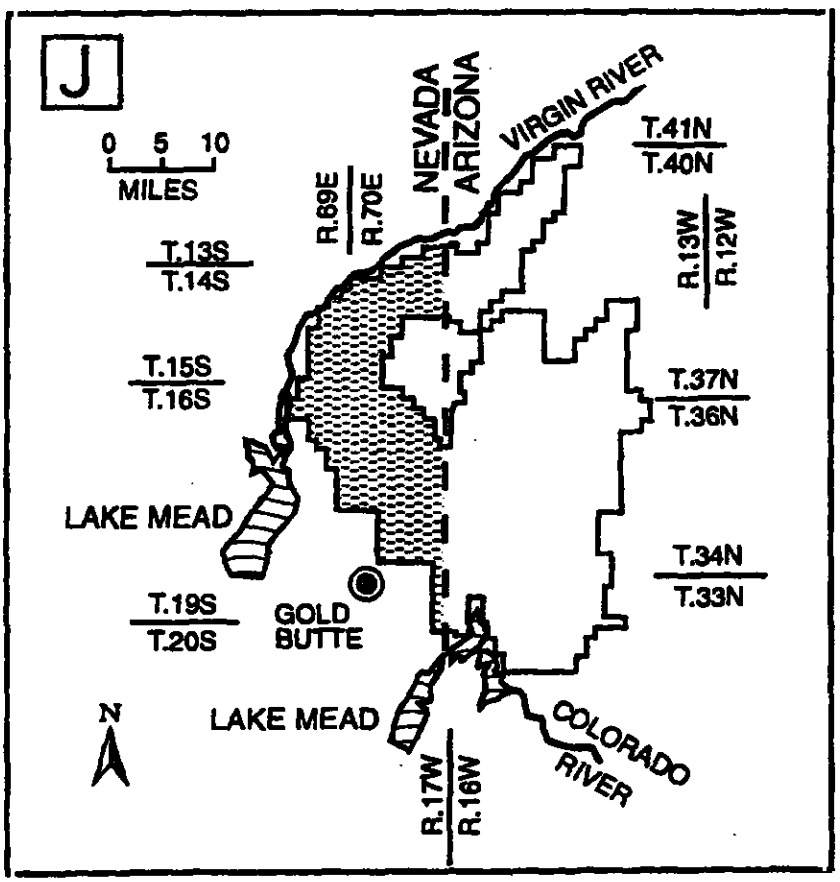
MORMON MESA


I
93
MAYNARD LAKE
LANE SPRGS. RD.
CARP-ELGIN RD.
CARP
T.8S
T.8 1/2S
T.10 1/2S
T.11S
R.60E
R.61E
LINCOLN CO.
CLARK CO.
168
15
T.14S
T.15S
T.16S
T.17S
T.18S
T.19S
15
169
40
93
R.64E
R.65E
R.68E
R.69E
R.70E
R.71E
N
0 5 10 15 20
MILES

11. Gold Butte-Pakoon Unit. Clark County. From Bureau of Land Management Maps: Overton 1978 and Lake Mead 1979. (Index map location J).

Mt. Diablo Meridian: T. 13 S., R. 71 E., secs. 32-34; T. 14 S., R. 69 E., secs. 24-26, and 34-36; T. 14 S., R. 70 E., secs. 1, and 10-36; T. 14 S., R. 71 E., secs. 3-10, 15-22, and 27-34; T. 15 S., R. 69 E., secs. 1-3, 9-16, 21-28, and 33-36; T. 15 S., R. 70 E., secs. 2-11, 15-22, and 28-33; T. 16 S., R. 69 E., secs. 1-36 except secs. 6, 7, and 29-32; T. 16 S., R. 70 E., secs. 4-36 except sec. 12; T. 16 S., R. 71 E., secs. 19, and 29-32; T. 17 S., R. 69 E., secs. 1-3, 11-14, 24, 25, and 36; T. 17 S., R. 70 E., secs. 1-36; T. 17 S., R. 71 E., secs. 4-10, 15-22, and 27-34; T. 18 S., R. 69 E., sec. 1; T. 18 S., R. 70 E., secs. 1-6, 10-15, 22-27, and 34-36; T. 18 S., R. 71 E., secs. 3-10, 15-22, and 27-34; T. 19 S., R. 71 E., secs. 3, 4, 9, 10, 15, 16, 21, 22, 27, 28, 33 and 34; T. 20 S., R. 71 E., secs. 3 and 4.

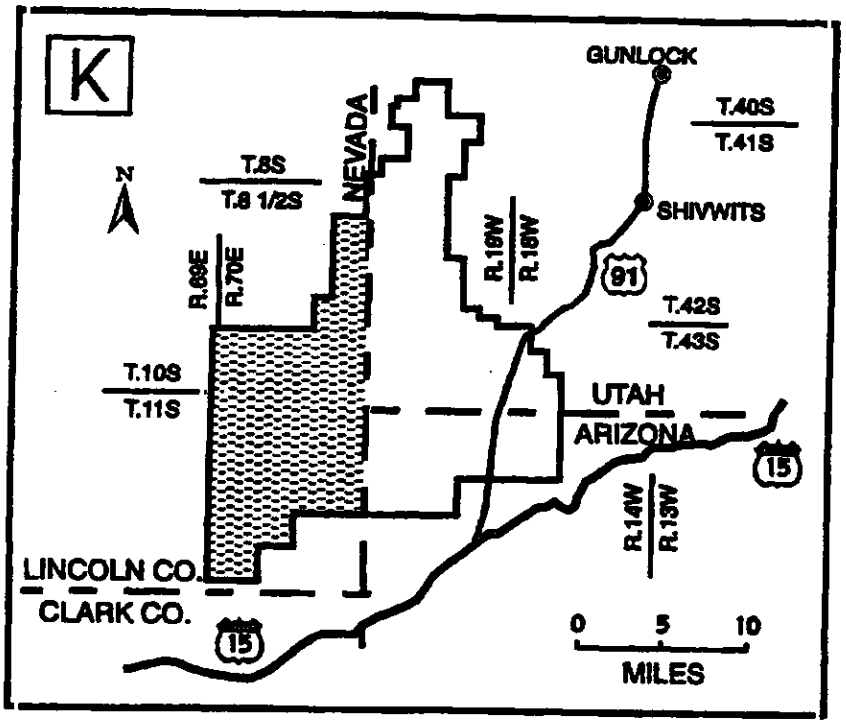
GOLD BUTTE-PAKOON
NEVADA



12. Beaver Dam Slope Unit. Lincoln County. From Bureau of Land Management Maps: Clover Mountains 1978 and Overton 1978. (Index map location K).

Mt. Diablo Meridian: T. 8 1/2 S., R. 71 E., that portion of sec. 34 lying south of a westerly extension of the north line of sec. 26, T. 41 S., R. 20 W. (Salt Lake Meridian), Washington County, Utah; T. 9 S., R. 71 E., secs. 3, 10, 15-17, 20-22, 27-29, and 32-34; T. 10 S., R. 70 E., secs. 19-36; T. 10 S., R. 71 E., secs. 3-5, 7-10, 15-22, and 27-34; T. 11 S., R. 70 E., secs. 1-36; T. 11 S., R. 71 E., secs. 3-10, 15-22, and 27-34; T. 12 S., R. 70 E., secs. 1-12, 14-23, and 28-33; T. 12 S., R. 71 E., secs. 3-10.

BEAVER DAM SLOPE
NEVADA

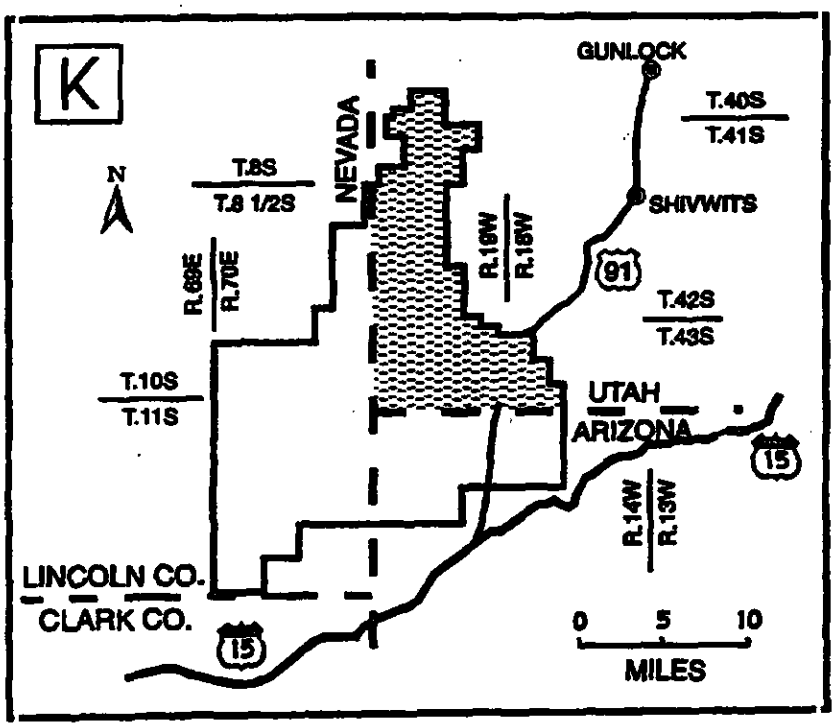


Utah. Areas of land as follows:

13. Beaver Dam Slope Unit. Washington County. From Bureau of Land Management Maps: St. George 1980 and Clover Mts. 1978. (Index map location K).

Salt Lake Meridian: T. 40 S., R. 19 W., S 1/2 sec. 28, S 1/2 sec. 29, S 1/2 sec. 31, secs. 32 and 33; T. 41 S., R. 19 W., S 1/2 sec. 2, S 1/2 sec. 3, secs. 4, 5, 6, E 1/2 sec. 7, secs. 8-11, 15-17, E 1/2 sec. 18, and secs. 19-22, and 28-33; T. 41 S., R. 20 W., E 1/2 sec. 1, secs. 24-26, 35, and 36; T. 42 S., R. 19 W., secs. 4-9, 16-22, and 27-34; T. 42 S., R. 20 W., secs. 1, 2, 11-14, 23-26, 35, and 36; T. 43 S., R. 18 W., secs. 7, 8, S 1/2 sec. 16, secs. 17-21, and 27-34; T. 43 S., R. 19 W., secs. 1-36 except N 1/2 sec. 1; T. 43 S., R. 20 W., secs. 1, 2, 11-14, 23-26, 35, and 36.

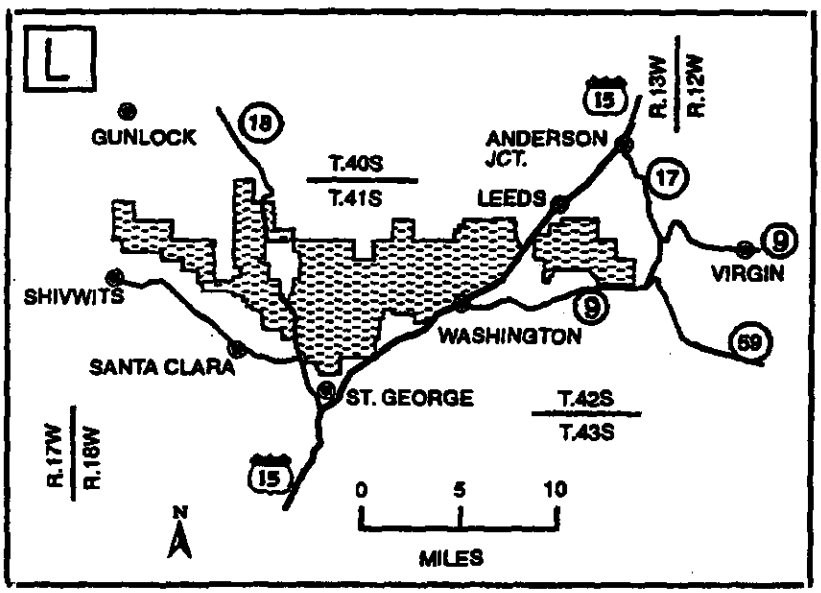
BEAVER DAM SLOPE
UTAH



14. **Upper Virgin River Unit.** Washington County. From Bureau of Land Management Map: St. George 1980. (Index map location L).

Salt Lake Meridian: T. 41 S., R. 13 W., secs. 17-21, except NW 1/4 NW 1/4 sec. 18, W 1/2 and W 1/2 E 1/2 sec. 27, 28, N 1/2 sec. 29, N 1/2 sec. 30, N 1/2 N 1/2 sec. 33, except that portion of secs. 28 and 33 lying westerly of Gould Wash, and N 1/2 NW 1/4 and NW 1/4 NE 1/4 sec. 34; T. 41 S., R. 14 W., S 1/2 S 1/2 and NE 1/4 SE 1/4 and SE 1/4 NE 1/4 sec. 13, that portion of sec. 14 lying westerly of Red Cliff Road, secs. 15-17 except N 1/2 NW 1/4 and SW 1/4 NW 1/4 sec. 17, secs. 19-22, that portion of sec. 23 lying westerly of Red Cliff Road and westerly of Interstate Highway 15, sec. 24, NE 1/4 and N 1/2 SE 1/4 and SW 1/4 SE 1/4 sec. 25, that portion of secs. 26, 27, and 32-34 lying northwesterly of Interstate Highway 15, and secs. 28-31; T. 41 S., R. 15 W., secs. 14, 19, 20, and 22-36; T. 41 S., R. 16 W., secs. 4, 9, 10, S 1/2 sec. 14, 15-16, 19, 21, W 1/2 sec. 22, secs. 24-25 except W 1/2 SW 1/4 sec. 24 and W 1/2 NW 1/4 and W 1/2 SW 1/4 sec. 25, and W 1/2 W 1/2 sec. 25, SW 1/4 NE 1/4 and NW 1/4 NW 1/4 and S 1/2 NW 1/4 and SW 1/4 and W 1/2 SE 1/4 sec. 27, E 1/2 and E 1/2 W 1/2 and NW 1/4 NW 1/4 and SW 1/4 SW 1/4 sec. 28, N 1/2 and SE 1/4 and E 1/2 SW 1/4 sec. 30, NE 1/4 sec. 31, N 1/2 sec. 32, N 1/2 and SE 1/4 and N 1/2 SW 1/4 sec. 33, sec. 34, SE 1/4 SE 1/4 and that portion of sec. 35 lying westerly of Utah Highway 18, and sec. 36; T. 41 S., R. 17 W., secs. 9, 14-16, NE 1/4 sec. 21, N 1/2 sec. 22, NW 1/4 and E 1/2 sec. 23, sec. 24, and NE 1/4 sec. 25; T. 42 S., R. 14 W., that portion of secs. 5 and 6 lying northwesterly of Interstate Highway 15; T. 42 S., R. 15 W., secs. 1, N 1/2 and N 1/2 S 1/2 sec. 2, NE 1/4 and W 1/2 sec. 3, secs. 4-9, W 1/2 W 1/2 sec. 10, N 1/2 N 1/2 sec. 12, secs. 16-18, N 1/2 and N 1/2 SE 1/4 and NE 1/4 SW 1/4 sec. 19, W 1/2 NW 1/4 and NW 1/4 SW 1/4 sec. 20, except that portion of secs. 1 and 12 lying southeasterly of Interstate Highway 15; T. 42 S., R. 16 W., secs. 1, 2, NW 1/4 and E 1/2 sec. 3, NE 1/4 NE 1/4 sec. 4, NE 1/4 sec. 10, NW 1/4 and E 1/2 sec. 11, sec. 12, E 1/2 and NW 1/4 and N 1/2 SW 1/4 sec. 13, N 1/2 NE 1/4 sec. 24, except that portion of sec. 13 lying westerly of Utah Highway 18.

UPPER VIRGIN RIVER

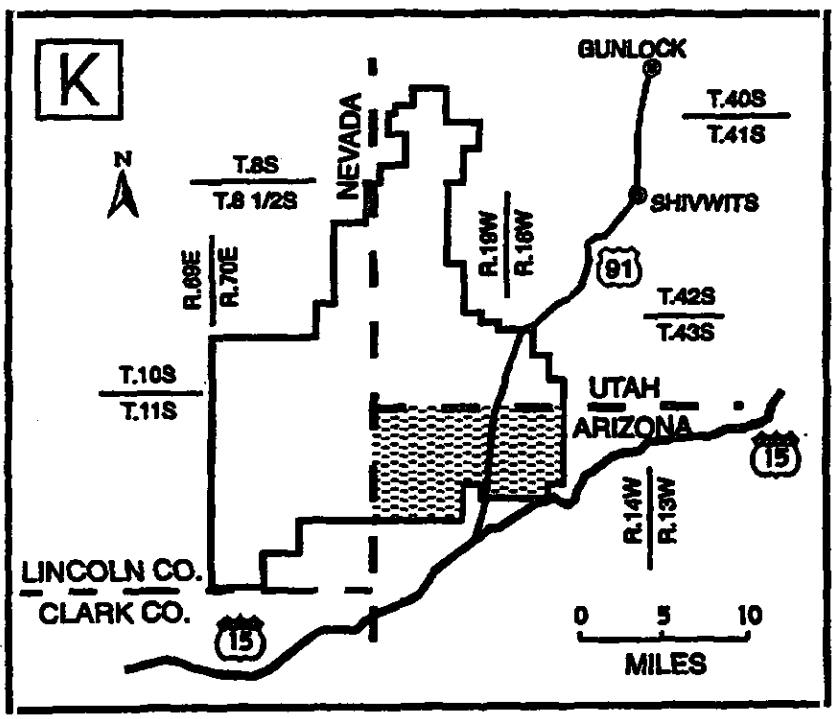


Arizona. Areas of land as follows:

15. <u>Beaver Dam Slope Unit.</u> Mohave County. From Bureau of Land Management Maps: Overton 1978 and Littlefield 1987. (Index map location K).

Gila and Salt River Meridian: T. 41 N., R. 14 W., secs. 6, 7, 18, and 19; T. 41 N., R. 15 W., secs. 1-24, 26-28, 30, and 31; T. 41 N., R. 16 W., secs. 1-5, 8-17, 20-29, and 32-36; T. 42 N., R. 14 W., sec. 31; T. 42 N., R. 15 W., secs. 31-36; T. 42 N., R. 16 W., secs. 32-36.

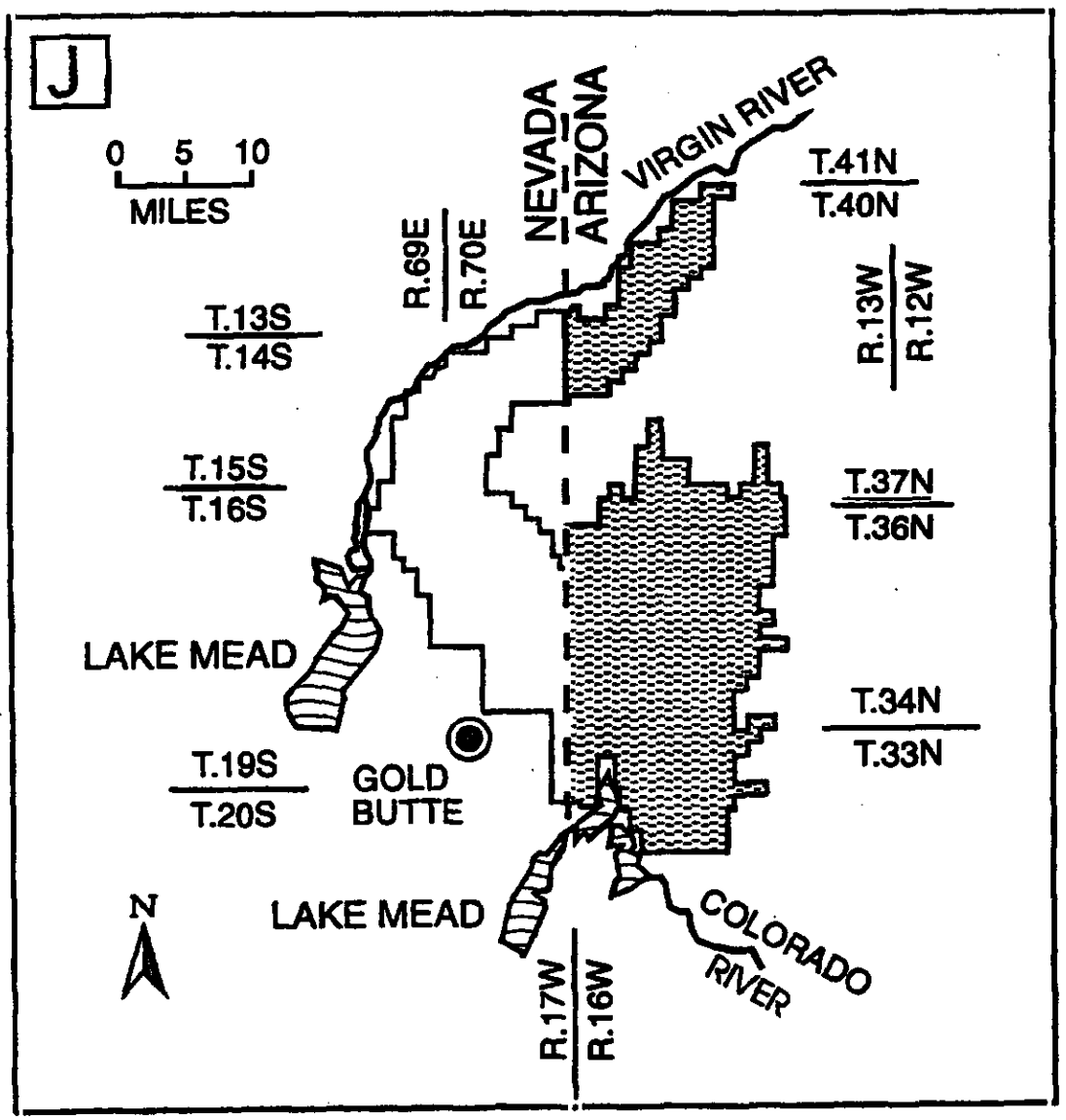
BEAVER DAM SLOPE
ARIZONA



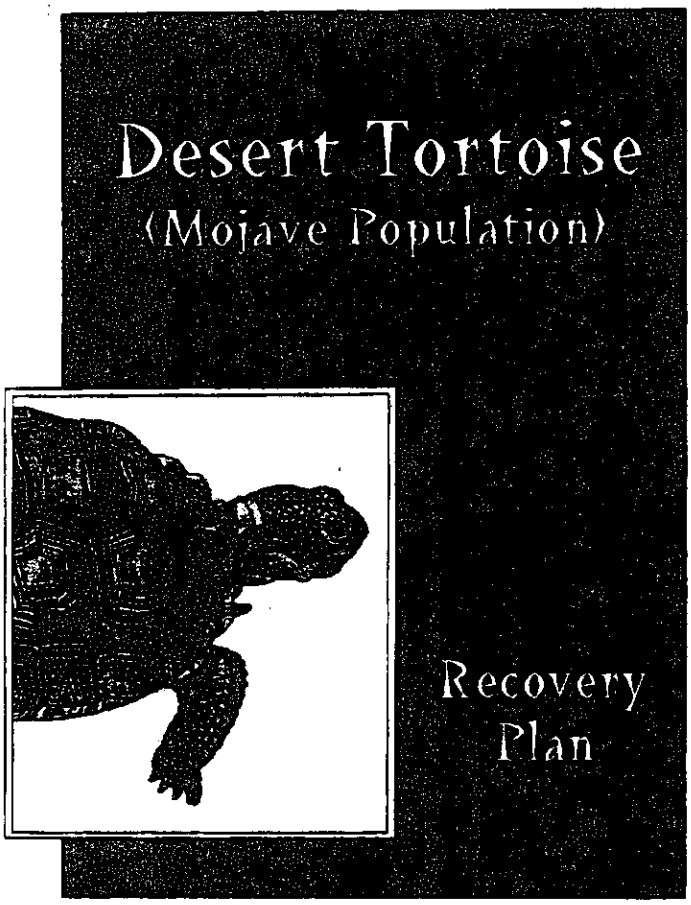
16. Gold Butte-Pakoon Unit. Mohave County. From Bureau of Land Management Maps: Overton 1978, Littlefield 1987, Mount Trumbull 1986, and Lake Mead 1979. (Index map location J).

Gila and Salt River Meridian: T. 32 N., R. 15 W., secs. 1-18, except those portions of secs. 13-18 lying south of the Lake Mead National Recreation area boundary line; T. 32 N., R. 16 W., secs. 1, 2, 12, and 13; T. 32 1/2 N., R. 15 W., secs. 31-36; T. 32 1/2 N., R. 16 W., secs. 35 and 36; T. 33 N., R. 14 W., secs. 4-8, 18, 19, and 28-31; T. 33 N., R. 15 W., secs. 1-36; T. 33 N., R. 16 W., secs. 1-14, 17-20, 23-26, 29-32, 35, and 36; T. 34 N., R. 14 W., secs. 4-9, 17-19, 30, 31, 33, and 34; T. 34 N., R. 15 W., secs. 1-36; T. 34 N., R. 16 W., secs. 1-36; T. 35 N., R. 14 W., secs. 3-9, 16-22, and 28-35 ; T. 35 N., R. 15 W., secs. 1-36; T. 35 N., R. 16 W., secs. 1-36; T. 36 N., R. 14 W., secs. 2-11, 14-22, and 27-34; T. 36 N., R. 15 W., secs. 1-36; T. 36 N., R. 16 W., secs. 1-36 except secs. 4-9; T. 37 N., R. 14 W., secs. 15, 22, 27, 31, and 33-35; T. 37 N., R. 15 W., secs. 5, 8, 17-22, and 27-36; T. 37 N., R. 16 W., sec. 35; T. 38 N., R. 15 W., sec. 6; T. 38 N., R. 16 W., secs. 1-12 and
14-22 and 30; T. 39 N., R. 15 W., secs. 2-10, 16 -21, and 29-32; T. 39 N., R. 16 W., secs. 1, 12, 13, 20, 23-29, and 32-36; T. 40 N., R. 14 W., sec. 6; T. 40 N., R. 15 W., secs. 1, 10-15, and 21-36.

GOLD BUTTE-PAKOON
ARIZONA



Appendix I



Appendix I: Summary of the Agency and Public Comment on the Draft Desert Tortoise Recovery Plan

I. Summary of the Agency and Public Comment on the Draft Desert Tortoise Recovery Plan

In April, 1993, the U.S. Fish and Wildlife Service (Service) released the Draft Recovery Plan for the Desert Tortoise (Mojave Population) (Draft Plan) for a 60-day comment period ending on June 1, 1993 for Federal agencies, state and local governments, and members of the public (58 FR 16691). Due to the complexity of the plan, the Service extended this comment period an additional 30 days, ending on June 30, 1993 (58 FR 28894).

This section summarizes the content of significant comments on the Draft Plan. A total of 143 letters was received, each containing varying numbers of comments. Many specific comments re-occurred in letters.

This section provides a summary of general demographic information including the total number of letters received from various affiliations and states. It also provides a summary of the 21 major comments. A complete index of the commenters, by affiliation, is available from the U.S. Fish and Wildlife Service, Las Vegas Field Office, 1500 N. Decatur 01, Las Vegas, Nevada 89108. All letters of comment on the Draft Plan are kept on file in the Las Vegas Field Office.

Demographic Information

The following is a breakdown of the number of letters received from various affiliations:

Federal agencies	15 letters
state agencies	9 letters
local governments	6 letters
business/industry	12 letters
environmental/conservation organizations	15 letters
academia/professional	7 letters
multiple use/recreation organizations	9 letters
individual responses	70 letters

II. Summary of Comments and Service Responses

Executive Summary

Comment: The difference between the utility of Desert Wildlife Management Areas (DWMAs) and recovery units in the recovery and delisting of desert tortoises is unclear.

Response: As now defined in the Final Plan, the six recovery units are geographic areas which harbor evolutionarily distinct populations of the desert tortoise, and the 14 proposed DWMAs are the smaller administrative areas within each of the six geographic areas. DWMAs are the managed reserves which protect the desert tortoise populations until such time as recovery and delisting can occur while also maintaining and protecting other sensitive species and ecosystem functions. Each recovery unit should have at least one DWMA containing 1,000 square miles of desert tortoise habitat. Multiple 1,000 square mile DWMAs would provide additional protection in ensuring the persistence of the six evolutionarily distinct populations segments. Figure 6 further describes this concept in reserve design.

Comment: The budget numbers shown under "Need 1" are in three year increments after 1995. Does this mean that all the money will only be spent every third year? Additionally, these numbers do not appear to be consistent with the 10 year budget tables in the supplementary document "Proposed Desert Wildlife Management Areas for Recovery...."

Response: The expenditure of funds every 3 years reflects the 3-year cycle recommended in the Recovery Plan for monitoring desert tortoise populations. The 10-year tables shown in the supplementary document reflect what funding is projected to be necessary for implementation of all recovery actions. These figures will be revised following development of management plans for each DWMA, which will be much more site-specific and detailed.

Comment: The education budget listed under "Need 2" should be revised to allow some expenditures for public education throughout the term of the recovery plan, rather than spending all the money during the first year.

Response: As shown in the Implementation Schedule (Section III), continuing costs for implementing education programs are to be determined based on what is recommended in the environmental programs that are developed the first year.

Comment: What is Public Law 1010-618?

Response: Public Law 1010-618 is not relevant to this Recovery Plan, and the reference has been deleted.

Section I - Introduction

Comment: Based on an overview of the plant literature provided to Fish and Wildlife Service's Region 1 by the National Ecology Research Center (NERC), there is no scientific analysis of changes in perennial grass composition in the Mojave Desert.

Response: This information is reflected in D'Antonio and Vitousek's 1992 paper (see Literature Cited, Section IV) which was published after NERC's 1990 document.

Comment: It would be useful to provide the number of acres of desert tortoise habitat which is currently impacted by livestock grazing.

Response: Until DWMA boundaries are determined, it is not possible to estimate the number of acres within recovery areas impacted by livestock grazing.

Comment: Section 9 of the Endangered Species Act applies to endangered species only. The regulations at 50 CFR 1731 include threatened species such as the desert tortoise.

Response: Through section 4(d) of the Endangered Species Act, the Fish and Wildlife Service may issue regulations deemed necessary and advisable to provide for the conservation of threatened species. Through such regulation, the Fish and Wildlife Service may prohibit take of threatened species.

Section II - Recovery

Comment: Target densities for desert tortoise populations are specified without reference to or knowledge of predisturbance population levels. Many of the target densities appear unrealistically high and unobtainable. Under such circumstances delisting will not be possible in some recovery units.

Response: The Recovery Team agrees with this comment and has eliminated the reaching of target densities of desert tortoises within recovery units as a goal of recovery and delisting. Rather, the population within a recovery unit must show an upward or stationary (not declining) trend and maintain a population growth rate (Lambda) within each recovery unit equal to or greater than 1.0 for delisting to be considered by the Fish and Wildlife Service.

Comment: The definition of and prohibition within the Limited Use Zones (LUZs) should apply to the entire DWMA, provided that these parcels are being designated principally for the protection and preservation of Mojave Desert wildlife, including the desert tortoise; in this respect, the need for the special LUZ designation is questioned.

Response: The Recovery Team agrees with this comment, has eliminated the LUZ designation and extended LUZ-level protection to the entire DWMA, except where Experimental Management Zones (EMZs) are proposed. EMZs may only occupy 10% of a DWMA's total area and should be located on the periphery of the DWMA boundary where any negative effects from experimental activities will be less profoundly felt within the more protected area.

Comment: It is not clear when there is more than one DWMA established within a recovery unit if all DWMAs must meet the delisting criteria or can a recovery unit population be delisted if only one DWMA population meets the four criteria?

Response: Delisting is considered on a recovery unit basis. If more than one DWMA is established to meet the delisting criteria then the combined population trend and population growth rates (lambdas) are evaluated for recovery and delisting purposes.

Comment: Twelve years is too short a time period for evidence of upward trends in adult populations, upon which monitoring plans are based. Therefore, it is unrealistic to assume delisting can occur within this time frame.

Response: The Recovery Team agrees with this comment. The population within a recovery unit must exhibit a statistically significant upward tend or remain stationary for at least 25 years (one desert tortoise generation), thus allowing time for recruitment of baby and juvenile tortoises into the adult age class.

Comment: This method of population density estimation of desert tortoises is unrealistic in application due to the monetary expense and amount of time that would be required.

Response: The Recovery Team is aware of the potential problems associated with the recommended method, however, the proposal has initiated a useful dialogue on appropriate methodology for the estimation of desert tortoise population densities. Forthcoming (1994) will be a workshop at which statistically and economically acceptable methods will be discussed and recommended on an experimental basis.

Comment: The Desert Tortoise Management Oversight Group (MOG) is recommended as the group to facilitate interagency cooperation. As it is currently structured, this group's ability to perform this task is questioned. The Fish and Wildlife Service (FWS) should take the lead in facilitating interagency cooperation and coordination. The MOG has no formal status and it is a BLM-orchestrated group. If this is the group to be used, it should be restructured with the FWS assuming the leadership role.

Response: Because the majority of desert tortoise habitat is managed by the BLM, the MOG has proved to be a useful tool in implementing desert tortoise recovery efforts over the range of the desert tortoise in four states. The FWS will also be working closely with communities through the habitat conservation planning process to implement recovery on a local basis.

Comment Public education is not adequately addressed in the Recovery Plan.

Response: Both the Recovery Team and the FWS agree that public education is a vital component of desert tortoise recovery and has revised portions of the Recovery Plan to reflect more emphasis on public education. Cost estimates for development of a public information program are provided in the Implementation Schedule (Section III). The yearly costs for implementation of the program will be determined based on the requirements of the program.

Comment: The Recovery Plan makes no explicit recommendations for management of vehicle-caused mortalities on existing highways and roads in proposed DWMAs. Eleven of the 14 proposed DWMAs are bounded or transected by high traffic volume highways or roads.

Response: The Recovery Team agrees with this comment and has added an additional statement to Section II.E.2. of the Recovery Plan which recommends the establishment of fencing or other effective barriers along heavily-traveled roads to decrease desert tortoise mortality, and the installation of culverts that allow underpass of tortoises to alleviate habitat fragmentation.

Comment: The negative effects of human activities (including cattle grazing) on desert tortoises have not been demonstrated. Disallowing certain of these activities within DWMAs without providing quality supporting material which shows that these activities are contributing to declines in desert tortoise populations detracts from the credibility of the Recovery Plan.

Response: Desert tortoise recovery is the goal of management within DWMAs. Until data are forthcoming which show that these human activities can be compatible with recovery, it is important that they not be permitted.

Comment: The Service has failed to comply with the National Environmental Policy Act of 1969 (NEPA) by not preparing an Environmental Impact Statement (EIS) for this Plan.

Response: The Service is not required to comply with NEPA in development of recovery plans. Recovery plans are planning documents that list all tasks recommended for recovery of a species. These tasks involve potential actions by the Service, other Federal agencies, State and local governments, the private sector, or a combination of the above. Recovery plans impose no obligations on any agency, entity, or persons to implement the various tasks. Implementation of recovery actions will be subject to NEPA compliance, as appropriate, at the time they are actually "proposed" and an environmental assessment (EA) or EIS would be completed at that time.

Comment: The Service has failed to comply with Executive Order 12291.

Response: Executive Order 12291 requires Federal agencies to prepare regulatory impact analyses for any "major rule." A major rule is defined as any regulation that is likely to result in: (1) An annual effect on the economy of $100 million or more; (2) a major increase in costs or prices for consumers, individual industries, Federal, State, or local government agencies, or geographic regions; or (3) significant or adverse effects on competition, employment, investment, productivity, innovation, or on the ability of United States-based enterprises to compete with foreign-based enterprises in domestic or export markets (46 FR 13193). A recovery plan does not meet the definition of a regulation or rule as set forth in the Order. Recovery plans do not implement, interpret, or prescribe law or policy or describe the procedure or practice requirements of the Service. Therefore, the Service is not obligated to prepare a regulatory impact analysis.

Comment: The recommended desert tortoise habitat to be managed as DWMAs is unnecessary for recovery of the desert tortoise because existing reserved lands, such as national parks and wildlife refuges, provide sufficient land for the tortoise.

Response: The Service determined that the tortoise should be listed as a threatened species in 1990 (55 FR 12178) partly because insufficient habitat is protected within congressionally protected areas to adequately conserve desert tortoises. In addition, the Recovery Plan recognizes that

areas of sufficient size to support self-sustaining tortoise populations do not exist in already protected habitats.

Section III - Implementation Schedule

Comment: The budget in unconvincing. Where did the numbers come from?

Response: The numbers in the Implementation Schedule are estimates of what recovery will cost. The number will be revised as new information becomes available. Cost for full implementation of recovery actions will be based on the management plans that will be developed for each DWMA.

Comment: The Utah Division of Wildlife Resources (UDWR) is not included in the tasks for the Northeastern Mojave Recovery Unit, although a significant portion of the Beaver Dam Slope DWMA occurs in Utah. In addition, UDWR is included in the development activities for the Upper Virgin River DWMA, but is not included in the implementation and research sections. The UDWR is the lead agency on tortoise density research and monitoring, and reproductive research in Utah, as well as a cooperator on health and nutrition studies.

Response: The Implementation Schedule has been revised to reflect UDWR's role in the Northeastern Mojave Recovery Unit and in research and monitoring activities.

Acronyms Used in this Document

BLM	= Bureau of Land Management
BRTF	= Blue Ribbon Task Force of the BLM
CDSP	= California Department of State Parks
CFR	= Code of Federal Regulations
DTNA	= Desert Tortoise Natural Area
DWMA	= Desert Wildlife Management Area
ECRU	= Eastern Colorado recovery unit
EMRU	= Eastern Mojave recovery unit
EMZ	= Experimental Management Zone
ESU	= Ecologically significant unit
HCP	= Habitat conservation plan
kHz	= kilohertz
LUZ	= Limited Use Zone
mm	= millimeter
mtDNA	= mitochondrial deoxyribose nucleic acid
MVP	= Minimum viable population
NCRU	= Northern Colorado recovery unit
NEMRU	= Northeastern Mojave recovery unit
OHV	= off-highway vehicle
ORV	= off-road vehicle
PVA	= Population Viability Analysis
RECON	= Regional Environmental Consultants
TBD	= To be determined
UCLA	= University of California at Los Angeles
UDWR	= Utah Department of Wildlife Resources
USP	= Utah State Parks
URTD	= Upper Respiratory Tract Disease
U.S.C.	= United States Code
UVRRU	= Upper Virgin River recovery unit

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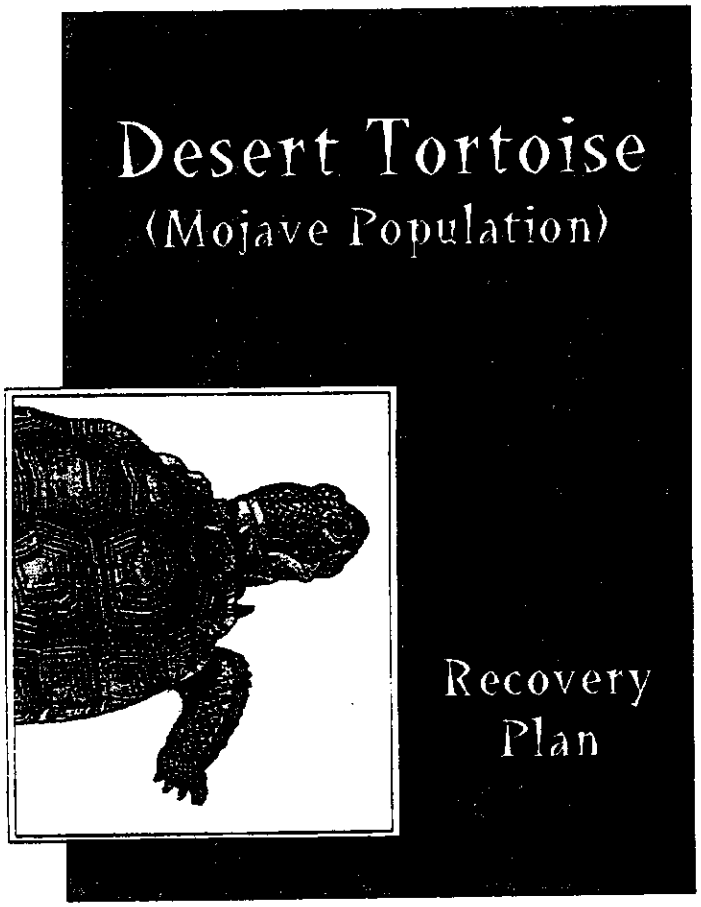

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CURRENT STATUS OF THE MOHAVE GROUND SQUIRREL

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ABSTRACT: The Mohave ground squirrel (*Spermophilus mohavensis*) is found only in the western Mojave Desert of California. Although it is listed as Threatened by the State of California, there is little published information regarding its current distribution and status. I have assembled a comprehensive database covering unpublished field studies, surveys, and incidental observations conducted over the 10-year period from 1998-2007. This database contains records of 1140 trapping sessions, only 102 of which were successful in capturing ≥1 Mohave ground squirrels. In addition, there are 96 incidental observations in which the species was detected. An analysis of these 198 positive records identifies 4 core areas that continue to support relatively abundant Mohave ground squirrel populations and 4 other areas in which there are multiple recent records of the species. Although the southern portion of the range has been most intensively sampled, the only recent occurrences there are from a single core population on Edwards Air Force Base plus an additional 4 detections from Victor Valley. There are extensive areas within the geographic range where the status of the species is unknown, especially on the China Lake Naval Air Weapons Station and Fort Irwin. I present recommendations for surveys in areas where no recent studies have been carried out. I also identify potential corridors between known populations and recommend studies to determine if these connections are actually occupied by the species. Finally, I indicate conservation measures needed to ensure that known populations and corridors are adequately protected from habitat loss and degradation.

TRANSACTIONS OF THE WESTERN SECTION OF THE WILDLIFE SOCIETY 44:11-29

Key words: Mohave ground squirrel, *Spermophilus mohavensis*, California, Mojave Desert, threatened species, core populations, corridors, conservation

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The Mohave ground squirrel (*Spermophilus mohavensis*) is found only in the western Mojave Desert of California (Best 1995). Its historic range (Figure 1) totaled about 20,000 km^2 (Gustafson 1993). It has been found from the area of Palmdale and Victorville in the south to Owens Lake in the north. The eastern escarpment of the Sierra Nevada forms much of the western boundary of its range, while in the east its distribution extends to the Mojave River Valley and to the Fort Irwin military reservation. This region has experienced rapid growth over the past few decades. Urban development in the Antelope Valley, Indian Wells Valley, and along the Mojave River from Victorville to Barstow has resulted in a human population in excess of 700,000. Three large military bases conduct extensive training and testing operations. Much of the western Mojave Desert is used for motorized outdoor recreation, mining, and livestock grazing. There is an expanding transportation infrastructure, including highways, railroads, airports, pipelines, and electric transmission lines. Recent government policies have stimulated great interest in siting renewable energy facilities in this region, especially wind farms and solar installations.

Because of these multiple development pressures, there has been significant and on-going loss of wildlife habitat in the western Mojave Desert as well as widespread habitat degradation and fragmentation. There has been concern about the conservation status of the Mohave ground squirrel since 1971, when it was first listed as Rare under the California Endangered Species Act (CESA). After the reauthorization of CESA in 1984, the species was classified as Threatened. Its subsequent regulatory history has been highly controversial. In 1993, the California Fish and Game Commission acted to remove it from the list of threatened species, a decision that was set aside in 1997 following judicial review. A petition to list the Mohave ground squirrel under the federal Endangered Species Act (ESA) was rejected by the US Fish and Wildlife Service in 1995. The US Fish and Wildlife Service is currently (2008) reviewing a new petition to list the species as endangered under the ESA.

In 2006, the US Bureau of Land Management (BLM) approved the West Mojave Plan, which was designed to conserve a number of sensitive species throughout the western Mojave Desert, with special emphasis on the desert tortoise (*Gopherus agassizii*) and Mohave ground squirrel (Bureau of Land Management 2006). The alternative version of the plan as adopted established a Mohave Ground Squirrel Conservation Area consisting of 6,988 km^2 of public lands managed by the BLM. (Fig. 1) These conservation measures do not apply to private and military lands within the historic range of the species.

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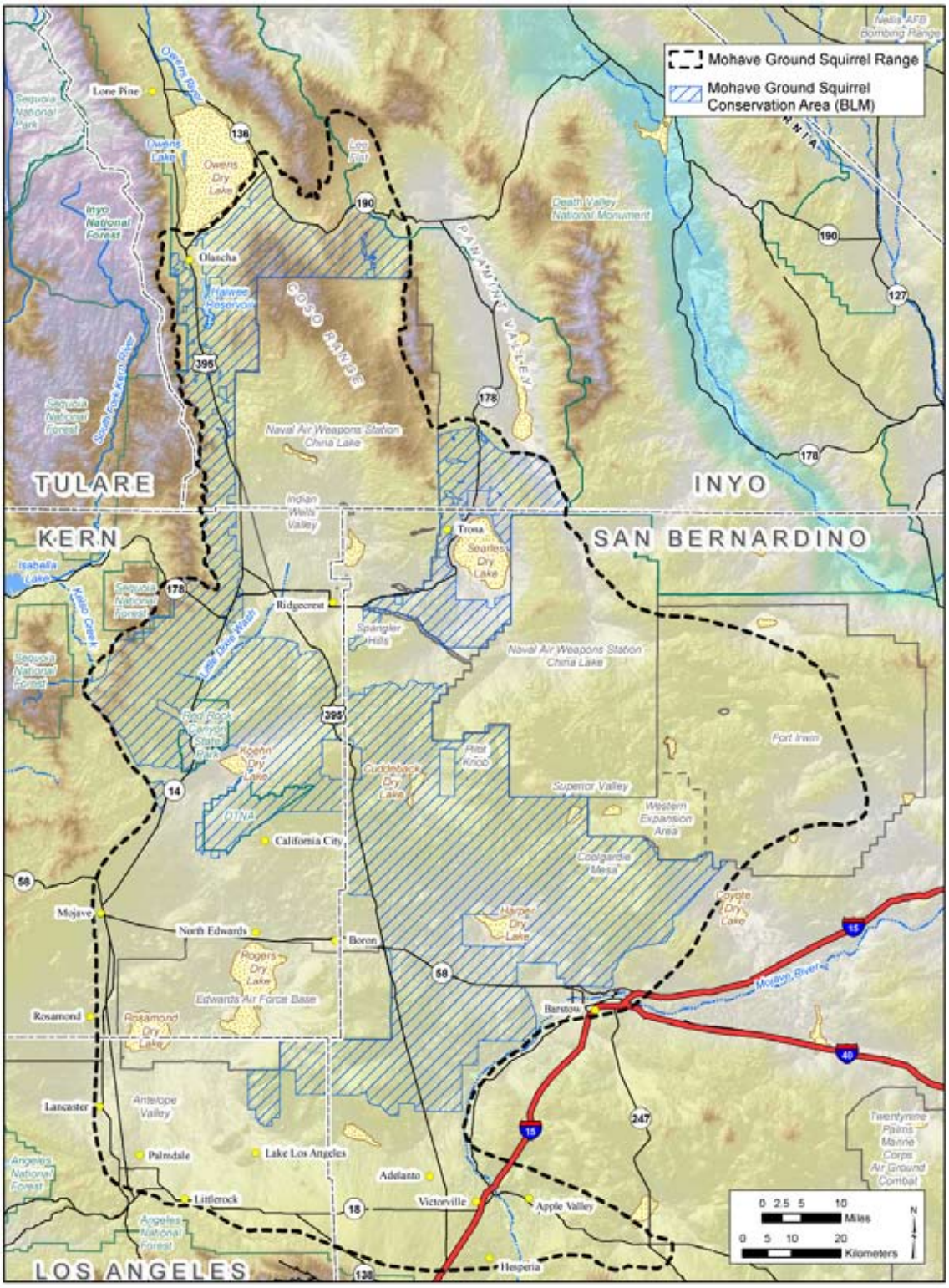

Figure 1. The historic range of the Mohave ground squirrel in the western Mojave Desert of California, with important place names indicated. The Mohave Ground Squirrel Conservation Area is shown as established in the West Mojave Plan (U.S. Bureau of Land Management (2005).

Although the Mohave ground squirrel has been designated as a state-listed species since 1971 and has been the focus of a major conservation planning effort by the BLM, there is still little published information on its distribution, abundance, and population trends. Brooks and Matchett (2002) reviewed 19 reported studies of the species, covering the period from 1918 to 2001. Only 2 of these studies were published in scientific journals. Since this review by Brooks and Matchett, a great deal of new information has become available, most of it unpublished. Two radiotelemetry studies describing home range dynamics and juvenile dispersal were recently published in peer-reviewed journals (Harris and Leitner 2004, 2005). Several state and federal agencies, as well as private conservation groups, have sponsored field research designed to determine the status of the species in particular areas. In addition, the California Department of Fish and Game (CDFG) requires trapping surveys at proposed development sites according to a prescribed protocol (CDGF 2003).

This paper brings together the data from unpublished field studies and surveys conducted during the 10-year period from 1998-2007. I have obtained reports for all sponsored research surveys and have received information on protocol trapping surveys from many consulting biologists. The information presented here includes both positive records documenting Mohave ground squirrel occurrence and negative results from trapping surveys in which the species was not detected. The objectives of this review are to:

1. Document the geographic distribution of Mohave ground squirrel occurrences,
2. Summarize the distribution and relative intensity of survey efforts,
3. Identify important areas and corridors for conservation based on available occurrence data, and
4. Recommend areas where additional survey effort is needed.

METHODS

I utilized 4 sources of information regarding the distribution and occurrence of the Mohave ground squirrel during the period 1998-2007: the California Natural Diversity Database, regional field studies, protocol trapping at proposed development sites, and incidental observations as reported by field biologists.

The California Natural Diversity Database (CNDDB) is a state-wide inventory of the status and locations of rare species and natural communities. The CDFG produces and regularly updates this computerized catalog, which contains records of occurrence submitted by state and federal agencies, consulting firms, and individual biologists. It contains positive records of occurrence only and generally does not include data documenting the absence of a species from a particular locality.

The CNDDB contained a total of 293 occurrence records for the Mohave ground squirrel as of August 4, 2007 (CNDDB 2007). Twenty-eight new occurrences were submitted during the period from 1998-2007 and there were also 2 new records at previously known locations for the species. These records were obtained from regional field studies, protocol trapping, and incidental observations. I incorporated these 30 records into the data base used in this analysis.

A number of regional field studies have been conducted during the past 10 years, many of them funded by public agencies and private conservation groups. I have reviewed 19 unpublished reports that describe the results of such trapping surveys and have also obtained data from several biologists whose surveys have not been documented in formal reports (Appendix A).

The third source of data was trapping surveys carried out at proposed development sites, as required by the CDFG (CDFG 2003). The CDFG guidelines specify that surveys be conducted on proposed project sites that support desert scrub vegetation and are within or adjacent to the Mohave ground squirrel geographic range. The surveys must be carried out by a qualified biologist operating under authority of a Memorandum of Understanding (MOU) with CDFG. The protocol mandates an initial visual survey of the project site. If no Mohave ground squirrel is detected visually, live-trapping is required for up to 3 sessions of 5 consecutive days each. The trapping sessions must be conducted during the periods March 15-April 30, May 1-31, and June 15-July 15. Trapping grids normally consist of 100 traps arranged in a 4x25 array (linear projects) or in a 10x10 array (other projects).

If a Mohave ground squirrel is detected on the site, the project proponent must apply to CDFG for an Incidental Take Permit and provide compensation, usually in the form of mitigation lands. If no Mohave ground squirrel is observed or captured, it is not necessarily evidence that the site is unoccupied or is not potential habitat. Nonetheless, CDFG will stipulate for a period of 1 year that the project site harbors no Mohave ground squirrels. Most protocol surveys carried out in recent years have not resulted in detection of the species.

In order to obtain the results of protocol trapping surveys for the period 1998-2007, I contacted all biologists who were known to possess an MOU authorizing take of Mohave ground squirrels. The great majority responded by providing their survey data, including dates of trapping sessions, coordinates of grid centers, number of trap-days of sampling effort, and

whether or not Mohave ground squirrels were detected. Although I have not obtained data for all protocol trapping efforts, I have collected a total of 943 records that represent 426,615 trap-days of sampling. I estimate that I obtained records for >95% of the total protocol trapping effort for the period 1998-2007.

I have classified as incidental observations all reports by biologists who observed or captured Mohave ground squirrels incidental to other field studies. This category includes visual and auditory detections, captures made while trapping for other species, and highway mortalities.

For regional and protocol surveys, a record is defined as a single trapping session, usually consisting of 5 successive days. Records from trapping surveys can be negative, with no Mohave ground squirrel captures, or positive, indicating a session with at least 1 capture. On the other hand, records from incidental observations were always positive, indicating the detection of at least 1 Mohave ground squirrel at a specific location. Table 1 lists the number of records obtained for this review from regional surveys, protocol trapping, and incidental observations. The regional and protocol trapping surveys provided a total of 1,038 negative records, as compared to only 102 trapping sessions in which at least 1 Mohave ground squirrel was captured. Although the regional studies involved only 21.6% of the total trapping effort, they accounted for 69.6% of the positive records. On the other hand, the protocol surveys made up 78.4% of trapping effort, but contributed only 30.4% of Mohave ground squirrel detections.

Table 1. A summary of the data sources used for this review. For regional and protocol surveys, a record is defined as a single trapping session (usually 5 days) at a specific grid location. If no Mohave ground squirrels were detected, such records were considered negative, while a positive record was a trapping session in which >1 Mohave ground squirrels were captured. For incidental observations, all records are positive. Each record indicates the detection of >1 Mohave ground squirrels at a particular location. The sampling effort for regional and protocol surveys is calculated as the number of traps operated per day times the number of days per trapping session summed over all trapping sessions.

Type of Data	Total	Positive Records	Trap-days
Regional Surveys	197	71	111,710
Protocol Surveys	943	31	426,615
Incidental Observations	96	96	N/A
Totals	1,236	198	538,325

I entered data from all sources into an Excel spreadsheet and then imported that into an Access database. This permitted data to be manipulated and extracted through the query process. A series of base maps covering the geographic range of the Mohave ground squirrel was developed using Geographic Information System (GIS) techniques. All records, both positive and negative, were plotted on these digital maps for visual analysis. In this way, the distribution of Mohave ground squirrel occurrences for the last 10 years could be visualized in relation to the distribution of sampling effort.

RESULTS

General Distribution of Mohave Ground Squirrel Records

The geographic distribution of both positive and negative Mohave ground squirrel records over the period 1998-2007 is shown in Figure 2. There has been no attempt at either systematic or random range-wide sampling and the records tend to be concentrated in certain well-defined regions. The great majority of trapping effort has been conducted in the southern part of the geographic range, south of State Route 58. In spite of this very intensive sampling, Mohave ground squirrels have been detected in only 2 areas south of State Route 58, one on Edwards Air Force Base and the other in the vicinity of Victorville. The northern part of the geographic range is in Inyo County, where almost all trapping has been conducted in the Coso region on China Lake Naval Air Weapons Stations (China Lake NAWS) and in the vicinity of Olancha and Haiwee Reservoir. Outside of these 2 areas, there have been only 5 widely scattered detections in the entire northern part of the range over the past 10 years. In the central part of the range, from Ridgecrest south to State Route 58, most positive records have been concentrated in 6 distinct regions. Trapping in the vicinity of Ridgecrest has resulted in the capture of a number of Mohave ground squirrels and there are abundant records for the extensive valley (Little Dixie Wash) between Inyokern and Red Rock Canyon State Park. To the south, there is a cluster of detections associated with the Desert Tortoise Natural Area (DTNA) and another in the Pilot Knob region east of Cuddeback Dry Lake. There are many records from the broad plateau that lies north of Barstow (Coolgardie Mesa and Superior Valley) and there are also several detections in the area just north of Boron.

It is clear that there are extensive areas within the range of the Mohave ground squirrel that have not been

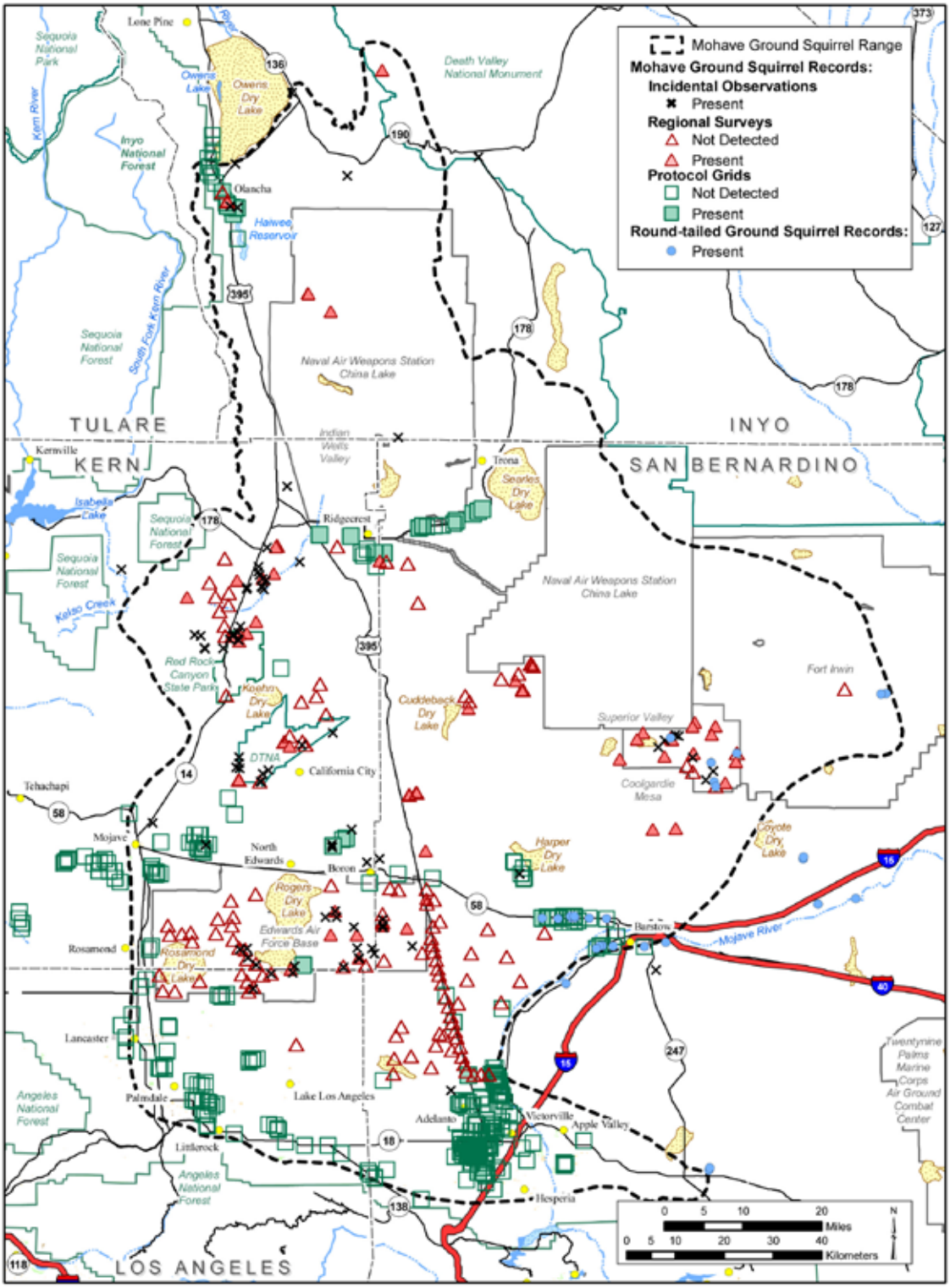

Figure 2. The geographic distribution of all Mohave ground squirrel records for the period 1998-2007. A total of 1,236 records are plotted, which include 1,140 trapping sessions conducted for regional and protocol surveys and 96 incidental observations. Solid triangles and squares represent locations of trapping grids at which >1 Mohave ground squirrels were captured. Crosses show sites of the 96 incidental observations at which >1 Mohave ground squirrels were detected.

effectively sampled. Figure 3 shows a 10x10 km sampling frame superimposed on the geographic range, with the sampling units color-coded to indicate the number of records (both positive and negative) for each unit during the period 1998-2007. It can be seen that sampling efforts have been heavily concentrated in the southern part of the range, especially to the west and north of Victorville, in the Palmdale-Lancaster area, around Barstow, and in the vicinity of the town of Mojave. Approximately 67% of all trapping efforts have been located in the region from State Route 58 south. The lack of recent data on Mohave ground squirrel occurrence in the northern part of the range is obvious, but there are also large gaps in our knowledge in the central part of the range. Except for the Coso area, there have been no surveys on either the north or south ranges of China Lake NAWS during the past 10 years. The Western Expansion Area of Fort Irwin has been well sampled using a randomized method of selecting trapping sites. However, only 1 trapping attempt has been recorded elsewhere on Fort Irwin over the period 1998-2007. In contrast, Edwards Air Force Base has sponsored extensive surveys on a randomized sampling basis, so that the distribution of the species is known there in great detail.

Regional Analysis of Mohave Ground Squirrel Records

In this section, I present detailed information on Mohave ground squirrel distribution and abundance during the period 1998-2007 for a number of regions within the geographic range. This regional analysis is supported by a series of 7 maps that are available as Supplemental Online Material at the website of The Western Section of The Wildlife Society: http://tws-west.org/transactions/TWSWS_Transactions_directory.htm

Inyo County.—Inyo County includes the northernmost region occupied by Mohave ground squirrels. Records are concentrated in the area between Olancha and Haiwee Reservoir and in the Coso Range, within the China Lake NAWS. The species has been detected at 5 protocol trapping grids to the south of Olancha, beginning in 2002. Mohave ground squirrel populations at 2 sites in the Coso Range have been monitored by regular spring trapping sessions. Animals have been captured on both grids at every trapping occasion. In 2007, a Mohave ground squirrel was captured at Lee Flat just inside the boundary of Death Valley National Park, which marks the northernmost record for the species. The other 4 records for Inyo County are incidental observations, including an individual that was stuck by a vehicle in northern Panamint Valley, several kilometers east of the generally-accepted limits of the range.

Ridgecrest Area.—Trapping has been conducted at 10 grids in the vicinity of Ridgecrest, with Mohave ground squirrels detected at 5 of these sites. In addition, protocol trapping at 10 grids along State Route 178 east of Ridgecrest in 2006 yielded captures at 6 locations. However, no Mohave ground squirrels were captured in 2002 at 2 sites in the Spangler Hills southeast of Ridgecrest.

Little Dixie Wash.—The Little Dixie Wash region is a broad valley extending from Inyokern southwest to Red Rock Canyon State Park. Two extensive trapping studies have detected Mohave ground squirrels throughout this region. In 2002, the species was captured at 6 of 7 grids widely scattered across this valley. There have been more than 20 incidental observations as well, suggesting that Mohave ground squirrels are widely distributed here. In 2007, a visual sighting established the first record to the west of the mountain crest in the Kelso Creek drainage.

Fremont Valley to Edwards Air Force Base.—The Fremont Valley extends northeast from the vicinity of Cantil toward Garlock and Johannesburg. No Mohave ground squirrels have been detected here during the past 10 years, despite trapping efforts at 6 grids. There are 13 positive records around the periphery of the DTNA and out a few kilometers to the east. No trapping has been carried out in the interior of the DTNA, but it is likely that Mohave ground squirrels are present there as well. Two incidental records exist for the area just to the north and east of the town of Mojave, but repeated protocol trapping efforts here have been unsuccessful. Finally, there are 10 trapping records and incidental observations in the area to the north of Boron and Kramer Junction. These records suggest a fairly widespread population across this region.

Wind Farm Area Southwest of Mojave.—Protocol trapping surveys have been conducted at 24 grids located on wind energy development sites southwest of the town of Mojave. Although this area is outside the generally-accepted boundaries of the geographic range, much of the habitat here seems suitable for the species. To date, no Mohave ground squirrels have been detected during these trapping efforts. Two recent visual observations are listed in the CNDDB, but confirmation through trapping is needed.

Edwards Air Force Base.—Edwards Air Force Base has been carrying out an extensive monitoring program to document the distribution of Mohave ground squirrels within the military reservation. From 2003 through 2007, trapping has been conducted at 40 randomly-located grids across the base, resulting in detection of the species at 6 of these sites. In combination with other trapping efforts and incidental observations, this program has clearly defined the area in which Mohave ground squirrel populations are present.

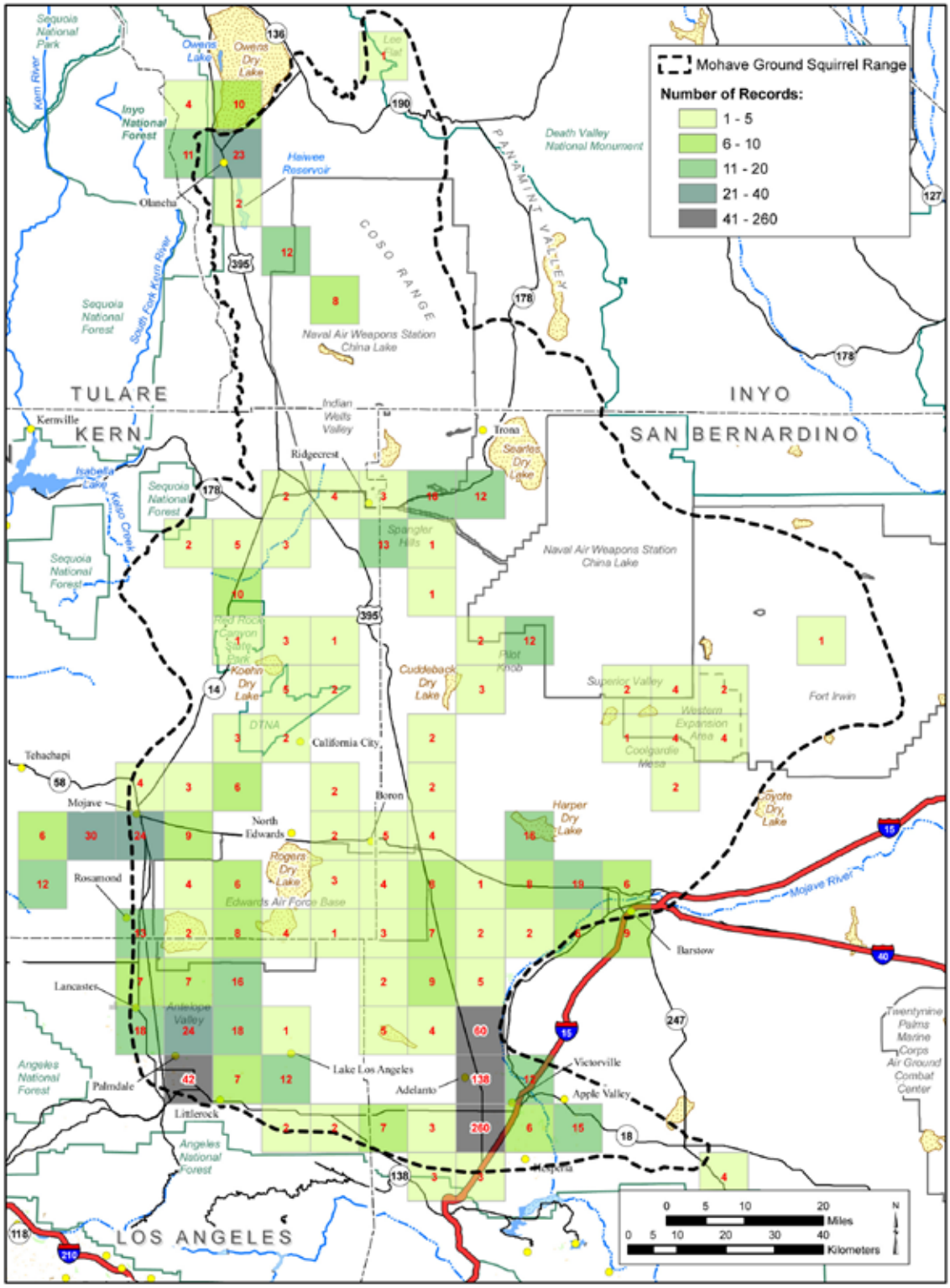

Figure 3. The distribution of sampling effort throughout the historic range of the Mohave ground squirrel for the period 1998-2007. A 10 x 10 kilometer sampling frame is set over the region and the total number of records (both positive and negative) are indicated for each 10 x 10 km block. These records are the trapping sessions conducted for regional and protocol surveys. Incidental observations are not plotted here.

Los Angeles County.—Protocol trapping has been conducted at 52 grid locations in the desert portion of Los Angeles County during the period 1998-2007, but no Mohave ground squirrels have been detected by this method. The only positive records in Los Angeles County have been 4 detections in a small area near Rogers Dry Lake on Edwards Air Force Base.

Victor Valley to Barstow.—Intensive protocol trapping has been conducted in the Adelanto area and on the western outskirts of Victorville, resulting in the capture of Mohave ground squirrels at 3 separate locations. The 2 trapping records north of Adelanto plus a visual sighting just to the west suggest the presence of a residual population in this area. Capture of a juvenile female well to the south near the intersection of US 395 and I-15 indicates that another population may exist here as well. There have been no records east of the Mojave River since 1955 but, as shown in Figure 2, this area has not been effectively sampled in the last 10 years. Three major trapping studies have been conducted from El Mirage Dry Lake north and east toward Barstow. There have been no detections of Mohave ground squirrels over this extensive area.

Barstow Area.—There were only 3 Mohave ground squirrel records in the Barstow area during the period 1998-2007. In 2005, a Mohave ground squirrel was observed about 6 km south of Barstow near the city landfill, in an area outside the generally-accepted range boundary. Two other occurrences were documented in 2007 to the west of Barstow. Mohave ground squirrels were detected at the edge of an alfalfa field near Harper Dry Lake and 1 was trapped about 10 km west of Hinkley near State Route 58.

Coolgardie Mesa and Superior Valley.—To the north of Barstow is a broad, gently-sloping plateau that extends from Coolgardie Mesa in the south to Superior Valley in the north. Three trapping studies have been conducted in this region over the past 10 years and all have documented Mohave ground squirrel occurrences. There have also been at least 7 incidental observations.

Pilot Knob Area.—Trapping studies in the Pilot Knob area, from Cuddeback Dry Lake east to the boundary of China Lake NAWS, have detected Mohave ground squirrels at 5 different sites.

Contact Zone with Round-tailed Ground Squirrel

The Mohave ground squirrel and the round-tailed ground squirrel (*Spermophilus tereticaudus*) are closely related (Hafner and Yates 1983). The 2 species are very similar in general appearance, the most obvious difference being the much longer tail of the round-tailed ground squirrel. The round-tailed ground squirrel is found throughout the eastern Mojave Desert of California and its geographic range adjoins that of the Mohave ground squirrel. The contact zone between the 2 species extends from Lucerne Valley along the Mojave River to Barstow and then northeast through Fort Irwin (Fig. 4). During the period 1998-2007, a total of 30 round-tailed ground squirrel occurrences have been recorded in this contact zone. Round-tailed ground squirrels are common in the area around Barstow, especially in disturbed habitats. The species has also been observed in Lucerne Valley, near Hodge on the Mojave River, near Coyote Dry Lake, and on the eastern side of Fort Irwin. In addition, round-tailed ground squirrels have been detected in 2 areas well within the historic range of the Mohave ground squirrel. There have been 5 reports from the Western Expansion Area of Fort Irwin, as much as 24 km inside the generally-accepted boundary of the Mohave ground squirrel range. The other area of interest is west of Barstow along State Route 58, where round-tailed ground squirrels were trapped at 8 sites in 2006 and 2007. Individuals of both species were captured on a grid about 20 km west of the range boundary. Lack of historical baseline data makes it impossible to determine if the round-tailed ground squirrel is actively extending its distribution at the expense of the Mohave ground squirrel.

DISCUSSION

General Distribution of Mohave Ground Squirrel Records

It is important to be clear about the significance of positive records that indicate Mohave ground squirrel presence during the past 10 years. These positive records are highly concentrated in just 8 distinct areas, in which 93.4% (185/198) of all Mohave ground squirrel occurrences have been documented (Fig. 5). It is of interest that there are at least some Mohave ground squirrel records prior to 1998 in each of these 8 areas, suggesting that recent trapping effort has focused on areas with historic records. However, much of the Mohave ground squirrel range has never been surveyed. This is especially true in Inyo County, which includes large areas where no surveys or protocol trapping have ever been carried out. The situation is similar, although not as extreme, in the central part of the range. There are 6 areas here where recent evidence indicates the presence of Mohave ground squirrel populations. However, little trapping has been conducted outside the areas that support these known populations. In the southern part of the range, south of State Route 58, there has been much greater trapping effort and the sampling has been much more widely distributed. Even here, there are still a few relatively restricted areas that have not been surveyed since 1998. In all 3 sections of the Mohave ground squirrel range, additional populations may well

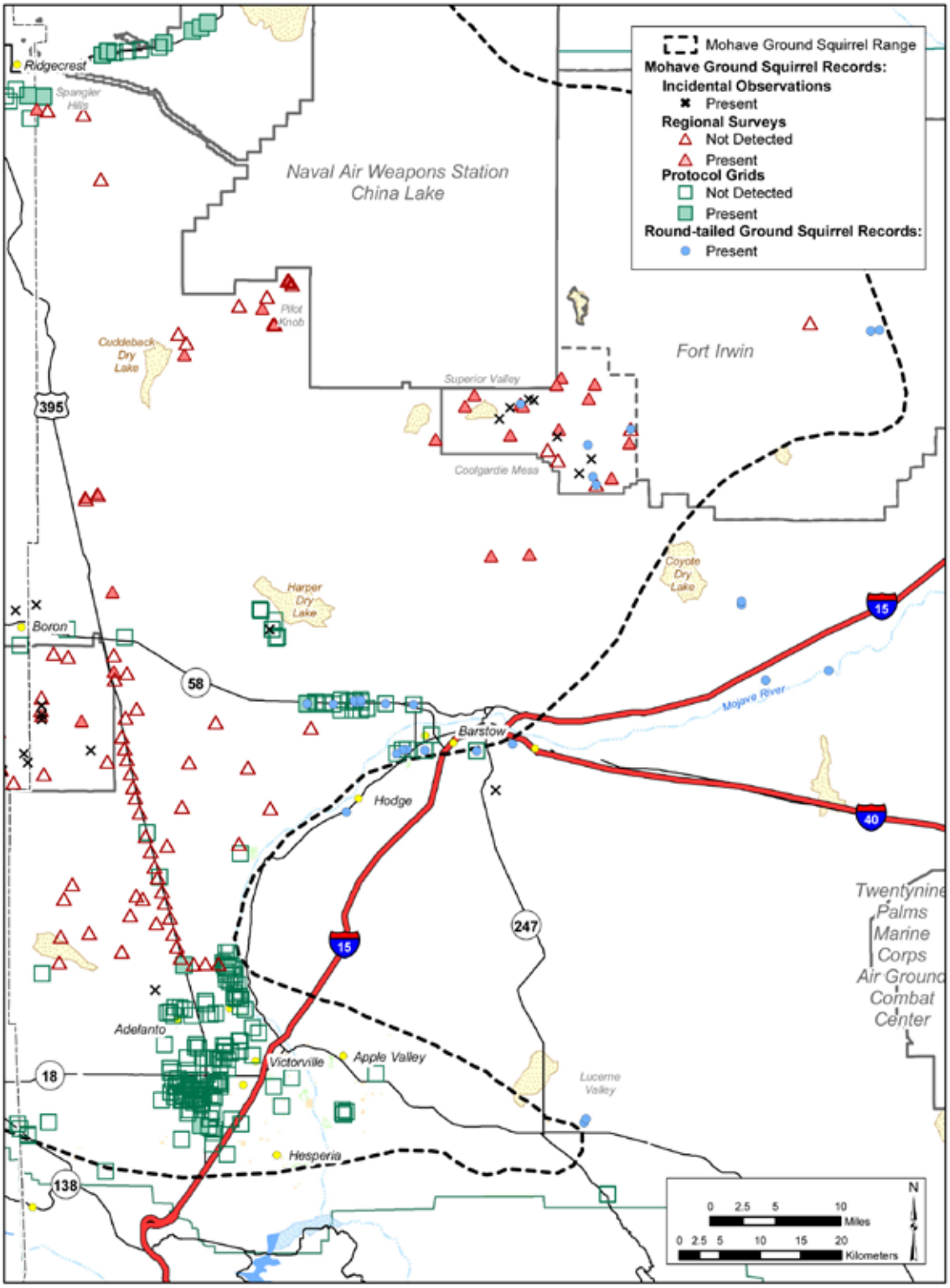

Figure 4. The contact zone between the Mohave ground squirrel and the round-tailed ground squirrel. This shows the distribution of trapping sessions conducted for regional and protocol surveys, as well as incidental observations of Mohave ground squirrels. Circles show sites where round-tailed ground squirrels have observed or captured. These data cover the period 1998-2007.

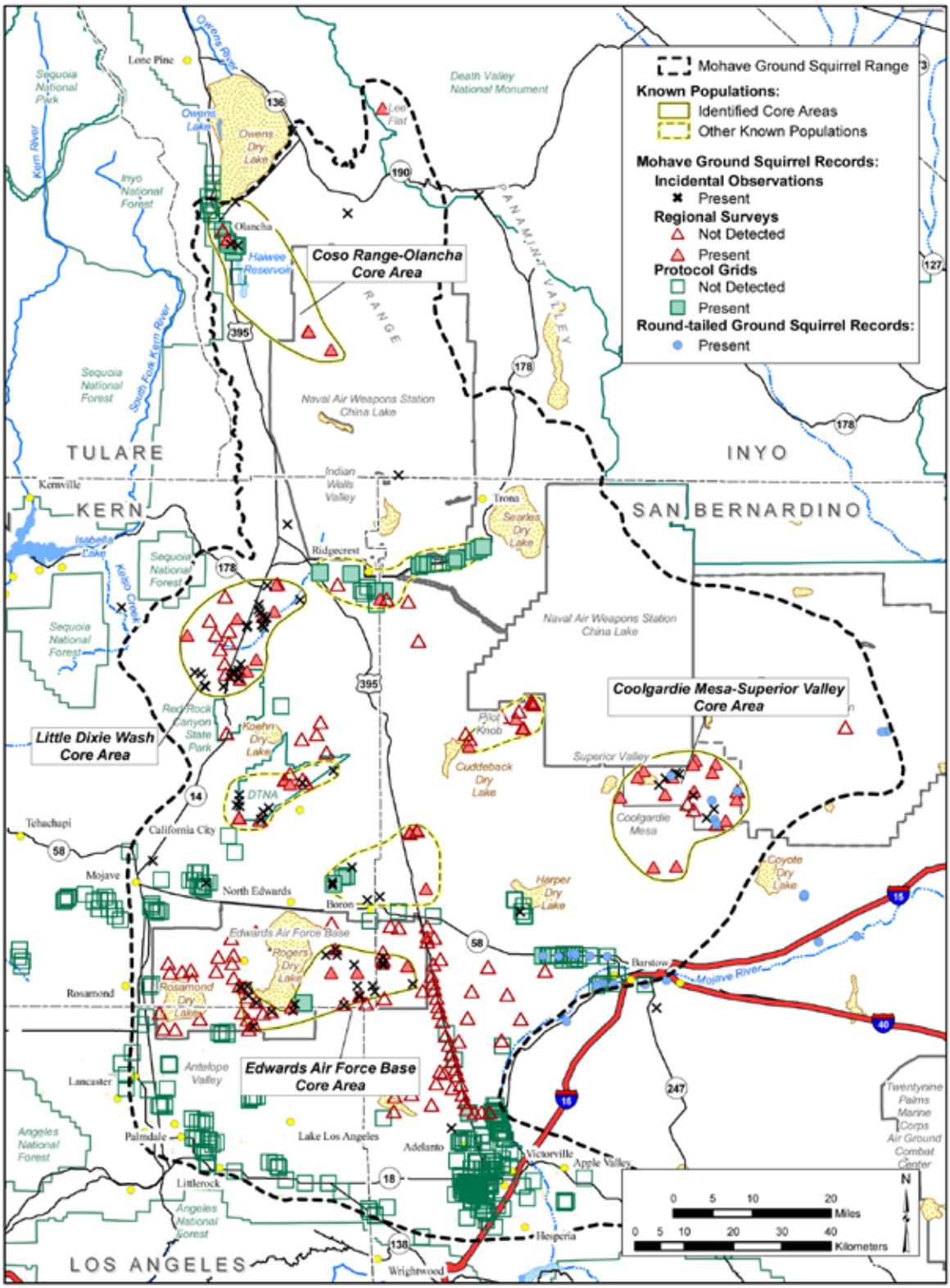

Figure 5. The geographic locations of currently known Mohave ground squirrel populations, including 4 identified core populations and 4 other populations.

exist outside the 8 areas in which recent positive records are concentrated.

The significance of negative records must be interpreted carefully as well. When regional surveys or protocol trapping fail to detect Mohave ground squirrels, it is important to keep in mind that this in itself cannot be used as evidence that the species is absent or that the area does not provide habitat for the species. There are a number of other circumstances that could result in lack of captures, such as locating a trapping grid in a small patch of marginal or unsuitable habitat, abundance of natural foods that reduce the attractiveness of the bait, low population density due to a series of dry years, or trapping early in the season before juveniles begin their dispersal movements. If trapping grids are not randomly sited, it is not valid to infer from a lack of captures at the grid sites that Mohave ground squirrels are absent in the surrounding habitat. Any conclusions would apply only to the grid sites themselves. In general, the most that can be concluded from lack of captures is that the negative results provide no evidence that the species is present. However, if repeated trapping efforts over a period of several years fail to detect Mohave ground squirrels, it becomes more and more probable that the species is very rare, if not absent, from the study area.

The distribution of trapping effort among private, military, and public land ownerships has been distinctly uneven over the past 10 years. Almost all protocol trapping surveys have been conducted on private lands or on highway rights-of-way, because of the regulatory requirement to determine presence or absence of the Mohave ground squirrel on proposed project sites. Military lands make up about 37% of the land surface within the range boundaries, but have been the locations for only 7.4% of all trapping records (Table 2). While Edwards Air Force Base and the Western Expansion Area of Fort Irwin have been sampled intensively, very little trapping effort has been expended on the remainder of Fort Irwin or on China Lake NAWS.

Core Areas

Data collected over the past 10 years has made it possible to identify 4 areas within the range of the Mohave ground squirrel that still support relatively abundant and widespread populations. These core areas are defined by 3 criteria. First, there must be evidence that Mohave ground squirrel populations have persisted for a substantial period of time, on the order of 2-3 decades. Second, the species must be currently found at a minimum of 6 locations throughout the area. Third, the total number of individuals detected since 1998 must be $\geq$30. The 4 areas that are currently known to satisfy these criteria are Coso/Olancha, Little Dixie Wash, Coolgardie Mesa/Superior Valley, and Edwards Air Force Base (Fig. 5). These 4 core areas total about 1,672 km^2, or about 8.4% of the entire historic range (Table 3). During the period 1998-2007, there have been 135 positive records in core areas, accounting for 68.2% of the total 198 positive records. It is important to emphasize that these identified core areas are simply the only important population centers that have been identified thus far. There are very likely to be other core areas in parts of the geographic range that have not been adequately sampled in the last 10 years.

Coso/Olancha Core Area.—China Lake NAWS sponsored field studies of the Coso Hot Springs area

Table 2. An analysis of trapping effort on military lands within the range of the Mohave ground squirrel (MGS) during the period 1998-2007. The number of sites refers to the number of distinct trapping grid locations, while the number of records is the total number of trapping sessions at all sites, regardless of whether Mohave ground squirrels were captured.

Military Base	Area (km^2)	% MGS Range	No. Sites	No. Records	% Records
China Lake NAWS	4400	22%	2	20	1.8%
Fort Irwin	1800	9%	18	19	1.7%
Edwards AFB	1200	6%	43	43	3.9%
Totals	7400	37%	63	82	7.4%

in 1978 that detected 35 Mohave ground squirrels at a number of sites through trapping and visual observations (Zembal and Gall 1980). In the following year, trapping was carried out at 8 sites throughout the Coso Range and in Rose Valley to the west (Leitner 1980). A total of 124 individual Mohave ground squirrels were captured at 7 of the 8 trapping grids. A monitoring program in the Coso Range and Rose Valley from 1988 through 1996 resulted in the capture of over 1400 juvenile and adult Mohave ground squirrels (Leitner and Leitner 1998). Aardahl and Roush (1985) failed to trap the species at a site near Olancha in 1980, but did observe several individuals in the same general area.

During each of the past 7 years (2001-2007), Mohave ground squirrels have been trapped at 2 permanent grids in the Coso Range (Leitner 2001, 2006, 2008). A total of 89 adults have been captured over this period. The species has also been detected regularly in the Olancha area, where 29 adult captures were recorded at 5 sites from 2002 to 2005. The Coso/Olancha area clearly qualifies as an important core area, based upon the persistence of Mohave ground squirrel populations here for 30 years, the presence of the species at many sites, and the number of animals detected.

Little Dixie Wash Core Area.—Mohave ground squirrels were first recorded in the Little Dixie Wash region in 1931 and 1932, when specimens were collected at Freeman Junction and on the east side of Walker Pass (CNDDB Occ. #21 and #52). Trapping surveys by the BLM in 1974 and 1975 resulted in 17 captures at 7 localities in Dove Springs Canyon and Bird Spring Canyon (CNDDB Occ. #84, #174, #175, and #191-194). Aardahl and Roush (1985) reported capturing a total of 94 individuals (both adults and juveniles) at 6 grids in the Little Dixie Wash area from April-July 1980. Finally, trapping at 2 sites in 1994 yielded a total of 12 Mohave ground squirrels (Scarry et al. 1996). Additional occurrences were documented at 10 other locations in this region during the period 1974-1990. Thus, Mohave ground squirrels were recorded at 27 locations in the Little Dixie Wash area from 1931 through 1996.

Recent field studies have been conducted in the Little Dixie Wash area during the period 2002-2007. In 2002, a total of 19 adult Mohave ground squirrels were captured at 6 of 7 grid locations (Leitner 2008). This was followed by more intensive studies at the Freeman Gulch site, with a total of 108 adults and 101 juveniles recorded from 2003 through 2007. Pit-fall trapping for reptiles in the Dove Springs Open Area resulted in the incidental capture of 6 Mohave ground squirrels at 4 different locations. Finally, a trapping survey in 2007 yielded 7 adults at 4 grids near the northern boundary of Red Rock Canyon State Park (Leitner 2008). The Little Dixie Wash core area has supported Mohave ground squirrel populations for over 70 years and recent records confirm that the species is abundant and widespread here.

Coolgardie Mesa/Superior Valley Core Area.—Mohave ground squirrels were first discovered in 1977 north of Barstow on the plateau that stretches from Coolgardie Mesa north to Superior Valley (Wessman 1977). The species was detected at 9 locations, with 1-3 individuals reported at each site. In 1980, Aardahl and Roush (1985) trapped 2 grids in Superior Valley, capturing 24 individuals (both adults and juveniles). A total of 24 Mohave ground squirrels were subsequently recorded at 5 sites in 1981 and 1982 (CNDDB Occ. #206-210). In 1994, 4 individuals were captured at 2 trapping grids in this area (Scarry et al. 1996).

Two recent surveys have been carried out in the Coolgardie Mesa/Superior Valley area. Trapping at 4 sites in 2002 yielded Mohave ground squirrel captures at each location for a total of 14 adults. A more extensive survey of the Western Expansion Area of Fort Irwin in 2006 and 2007 resulted in 36 individuals captured at 10 of 12 trapping grids. There is clear evidence that Mohave ground squirrels have persisted here for at

Table 3. The estimated sizes of the 4 identified core areas, as measured in square kilometers and in acres. The number of positive Mohave ground squirrel records for the period 1998-2007 is given for each core area.

Core Area Name	Area (km^2)	Area (acres)	Number of Positive Records
Coso / Olancha	452	111,690	33
Little Dixie Wash	393	97,172	44
Coolgardie Mesa / Superior Valley	516	127,450	23
Edwards Air Force Base	311	76,761	35

least 30 years. Recent surveys have documented that the species was present at 14 of 16 trapping sites and in several cases a substantial number of individuals was captured. This core area is at the eastern edge of the range and several captures or observations of animals that appear to be round-tailed ground squirrels have been recorded here. The potential for hybridization in this area between these 2 closely related species should be carefully investigated.

Edwards Air Force Base Core Area.—A number of surveys have documented the past occurrence of Mohave ground squirrels on Edwards Air Force Base, with most records located to the north, east, and south of Rogers Dry Lake. The earliest observations were made during the period 1973-1977 in the area south of Rogers Dry Lake (CNDDB Occ. #265). Seventeen Mohave ground squirrels were trapped in 1988 at 3 sites northeast of Rogers Dry Lake (ERC Environmental and Energy Services Company 1989). Additional trapping in 1993 in this same area resulted in captures of many adults and juveniles (Deal et al. 1993, Mitchell et al. 1993). Surveys at Mt. Mesa to the southeast of Rogers Dry Lake yielded 9 Mohave ground squirrels in 1992 (U.S. Fish & Wildlife Service 1993) and over 30 individuals in 1993 (Deal et al. 1993, Mitchell et al. 1993). A total of 13 Mohave ground squirrels were trapped in 1994 at 4 sites in halophytic saltbush scrub to the south and southwest of Rogers Dry Lake (Buescher et al. 1995). The species was recorded at 4 additional locations to the east of Rogers Dry Lake during the period 1981-1991.

Recent field studies have clearly delineated a core area on Edwards Air Force Base, with all Mohave ground squirrel records since 2000 localized to the east and south of Rogers Dry Lake. Trapping surveys were conducted at 19 grids in this area during the period 2000-2005, with a total of 29 adults and 4 juveniles captured at 8 of the study sites (Vanherweg 2000, Leitner 2003, Air Force Field Test Center 2004 and 2005, Leitner 2008). Although no captures were recorded at the 8 grids south of Rogers Dry Lake in 2005, Mohave ground squirrels are known to be present here, based upon 6 incidental observations. Mohave ground squirrel populations have been known in this core area for over 30 years and the large numbers of recent records demonstrate that the species is still well-distributed here. To date, this is the only core area known to exist in the southern part of the range.

Connectivity between Core Areas

The 4 core areas are isolated from each other by distances ranging from 48-80 km. It will be an important conservation goal to ensure sufficient connectivity between them to allow gene flow. Figure 6 shows the locations of the core areas with possible habitat corridors illustrated.

The potential corridor between the Coso/Olancha core area and Little Dixie Wash follows a narrow strip of public land between the Sierra escarpment and the boundary of China Lake NAWS. It is not clear that this corridor is effective because of its minimal width (1-4 km) and because there is no firm evidence that it is currently occupied. There may well be an alternative corridor through China Lake NAWS, but the U.S. Navy cannot guarantee permanent protection and, again, there is no proof that continuous Mohave ground squirrel populations exist here.

Connectivity between the Little Dixie Wash core area and Edwards Air Force Base is most likely to be achieved by protection of a north-south habitat corridor along US Highway 395. This linkage appears to provide the highest quality habitat connection between these 2 core areas. It would also help to provide connectivity among other known populations in the Ridgecrest area, the DTNA, Pilot Knob, and the Boron region. There are no recent Mohave ground squirrel records along much of this corridor, so it is not clear that it is currently occupied.

The most effective corridor linking the Coolgardie Mesa/Superior Valley core area with other populations is probably thorough the Pilot Knob region. This connection is relatively short and crosses apparently good quality habitat. Although the most direct route is across a corner of the China Lake NAWS, public lands just to the south could also provide connectivity. An alternative linkage would be to the southwest toward Edwards Air Force Base across the broad valley centered on Harper Dry Lake. However, this route is lower in elevation, receives less rainfall, and habitat here is of lesser quality.

The lack of data concerning the existence or status of Mohave ground squirrel populations in these potential corridors is a serious problem. While these routes may seem geographically appropriate in providing linkages between populations, it will be important to conduct field studies to determine whether or not they are actually occupied.

MANAGEMENT RECOMMENDATIONS

The database of Mohave ground squirrel records that has been assembled for this analysis should be maintained by CDFG or another suitable public agency and made available for on-line access by interested researchers, agency staff, consultants, and conservation organizations. An interactive mapping system should be developed in conjunction with the database, so that

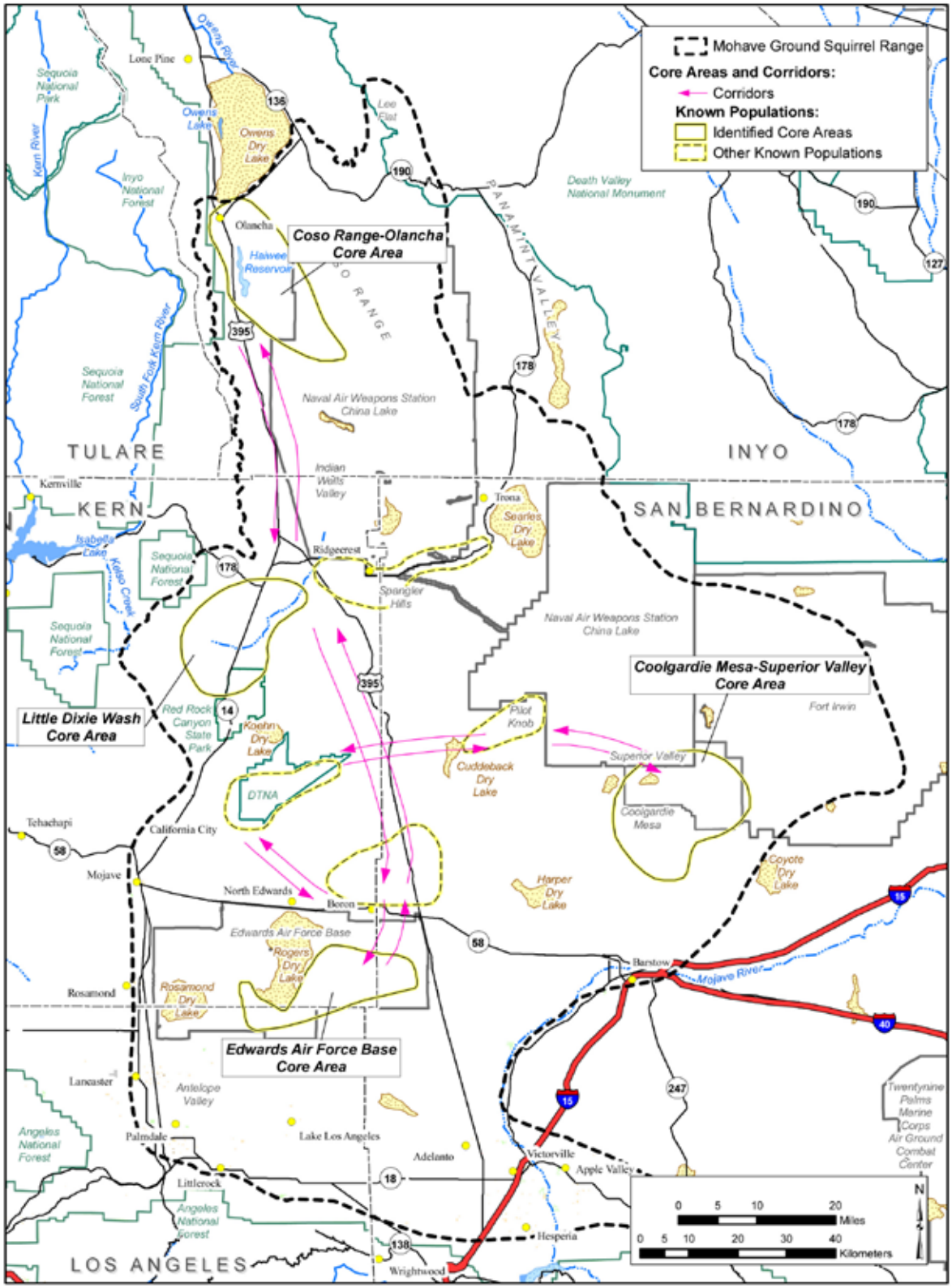

Figure 6. Map of potential habitat corridors that may provide connectivity between identified core areas and other known Mohave ground squirrel populations.

users could obtain map displays of areas of interest. As recommended by Brooks and Matchett (2002), a system should be developed to collect both positive and negative data on a continuing basis from biologists, agency staff, and consultants. It would be desirable to issue an annual report with appropriate maps to provide updated information on Mohave ground squirrel occurrences.

It is clear that additional field surveys are urgently needed to provide a more comprehensive picture of Mohave ground squirrel occurrence and status throughout its range. It is also clear that surveys to date have been seriously inadequate in documenting patterns of Mohave ground squirrel distribution because trapping sites have for the most part not been selected according to a randomized scheme. In the absence of a randomized sampling procedure, the results of such surveys apply only to the trapping site and cannot be extrapolated to the general region. It is recommended that a range-wide survey be conducted, with sampling locations determined on a randomized basis. Since this would be an expensive and logistically difficult undertaking, it may be more realistic to develop a survey plan that could be implemented gradually over several years as funding becomes available. The first step could be to establish a sampling frame covering the entire Mohave ground squirrel range, with the area divided into sampling units, perhaps 10 x 10 km or smaller. When a survey is planned for a particular region, trapping grids could be sited in sampling units chosen at random. This system would be quite flexible, since it could be implemented at different scales as appropriate for the purposes of the sponsoring organization. It is recommended that the Mohave Ground Squirrel Technical Advisory Group develop such a range-wide randomized sampling plan and submit it to the CDFG, BLM, and military installations for consideration.

It appears to be of critical importance to acquire more data concerning the status of the species in the northern and central parts of its range (Fig. 7). Surveys should be carried out on both the north and south ranges of China Lake NAWS, on Fort Irwin, and along the corridor north from EAFB to Ridgecrest. There has

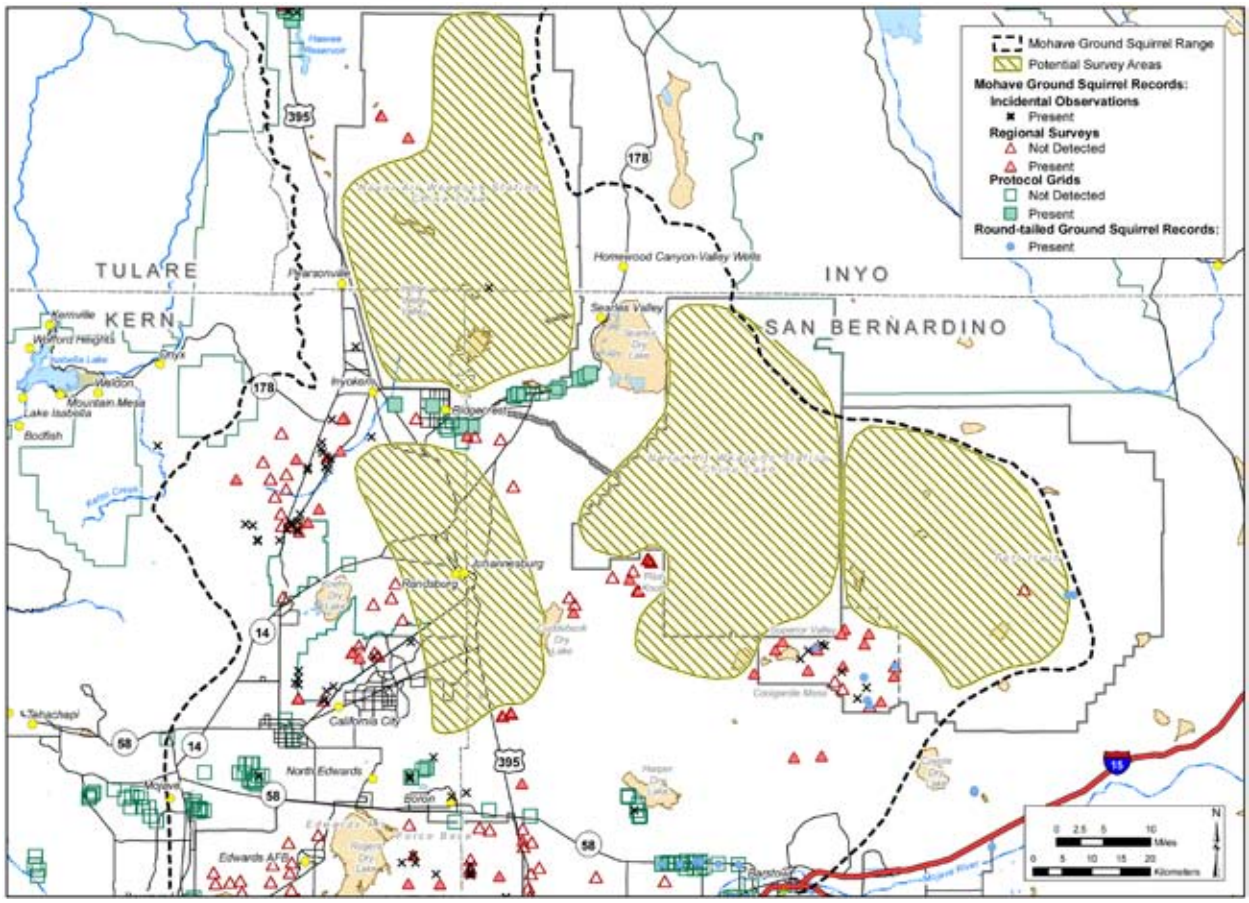

Figure 7. Potential survey areas in the northern and central portions of the Mohave ground squirrel range, showing their geographic relationship to survey efforts during the period 1998-2007.

been little or no sampling during the period 1998-2007 in these 4 extensive areas. A careful study plan should be developed to ensure adequate survey coverage within each area.

It is also recommended that field surveys be conducted in key areas within the southern range of the species in order to determine whether viable populations still remain outside of EAFB (Fig. 8). The trapping surveys could focus on public lands, but a serious attempt should be made to obtain permission for surveys on private lands as well. Because of the pace of development within the southern portion of the Mohave ground squirrel range, this exploratory work needs to be carried out with urgency.

The region southwest of the town of Mojave was identified in the West Mojave Plan (BLM 2003) as the Kern County Study Area. The West Mojave Plan recommended that Mohave ground squirrel trapping surveys be conducted here on public lands. The possibility was left open that the boundary of the Mohave Ground Squirrel Conservation Area could be modified to include these public lands if justified by survey results. A number of protocol trapping surveys have recently been carried out on private land in this area in connection with proposed wind energy projects. Although no Mohave ground squirrels have been trapped thus far, there have been 2 reported visual detections. It is recommended that additional trapping surveys be authorized on both public and private property, especially in areas that have not yet been investigated.

More information is needed about the relationship between the Mohave ground squirrel and its sibling species, the round-tailed ground squirrel. There are recent reports of round-tailed ground squirrel occurrences well inside the historic Mohave ground squirrel range to the west of Barstow and in the Western Expansion Area of Fort Irwin. Round-tailed ground squirrels seem well-adapted to land disturbance in agricultural areas and on the outskirts of towns. It is possible that hybridization is occurring where the 2 species come in contact. It is

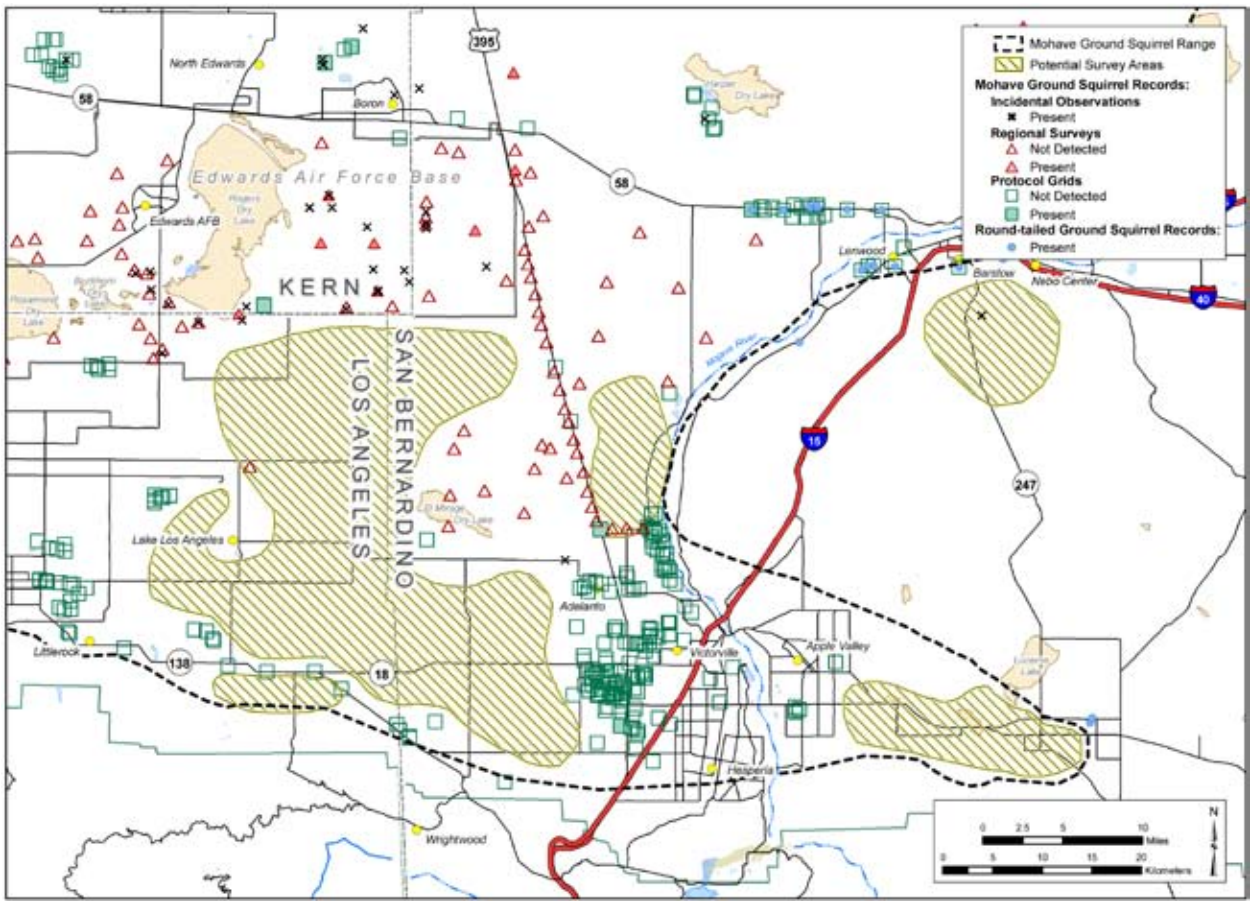

Figure 8. Potential survey areas in the southern portion of the Mohave ground squirrel range, showing their geographic relationship to survey efforts during the period 1998-2007.

recommended that surveys be carried out to determine the current eastern limits of the Mohave ground squirrel range and establish a baseline so that future westward movement of round-tailed ground squirrels could be detected. It is also recommended that genetic studies be undertaken in the contact zone to investigate the extent of hybridization where the 2 species co-occur.

Although trapping is the most effective method of identifying areas that support Mohave ground squirrel populations, it is recommended that certain modifications of current trapping procedures be tested. Trained wildlife dogs could be used to screen large areas and help focus trapping efforts on the most promising sites. Most trapping efforts to date have used large 100-trap grids. It would be of interest to try other trap configurations, such as more numerous small grids (for example, arrays of 20 traps) and long (>1000 meter) linear transects. Finally, such alternative trap configurations could be used in combination with adaptive cluster sampling (Thompson et al. 1998), which would allow for increased effort adjacent to a sampling unit where a Mohave ground squirrel is detected.

It is essential to protect BLM lands within the Mohave Ground Squirrel Conservation Area by enforcing the 1% limitation on ground disturbance (Fig. 1) called for under the West Mojave Plan (BLM 2005). In addition, acquisition of private lands that are included within the boundaries of the Conservation Area should be pursued aggressively, especially land that is included within known core areas. Finally, there may be important Mohave ground squirrel populations outside the Conservation Area that could protected by acquisition of private lands and careful management of BLM lands. The area stretching from the DTNA southeast toward Boron may be a good example of such a conservation opportunity.

ACKNOWLEDGMENTS

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APPENDIX 1
UNPUBLISHED REPORTS OF REGIONAL TRAPPING STUDIES CONDUCTED DURING THE PERIOD 1998-2007

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HOME-RANGE SIZE AND USE OF SPACE BY ADULT MOHAVE GROUND SQUIRRELS, *SPERMOPHILUS MOHAVENSIS*

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Using radiotelemetry we studied home range and movements of 32 adult female and 16 adult male Mohave ground squirrels (*Spermophilus mohavensis*) in the western Mojave Desert of California during 1990 and from 1994 to 1997. In 3 of the 5 years of study (1990, 1994, and 1996), early winter precipitation (October–January) was <30 mm, and no reproduction occurred at the study site. Postmating home ranges of females varied considerably among years, with annual medians for minimum convex polygons ranging from 0.29 to 1.90 ha. Females used the largest home ranges both during years of ample rainfall and reproduction (1995 and 1997) and during the year of most extreme drought and no reproduction (1990). We hypothesize that variation in home-range size among drought years may result from varying levels of food availability. In 1997, we also studied movements of adults during the mating season, from mid-February to mid-March. During this period, adult males made extensive movements, resulting in median minimum convex polygons much larger (6.73 ha) than those of females (0.74 ha). Such movements would have made it possible for males to locate adult females soon after their emergence from hibernation. Patterns of variation in home-range size and movements observed during this study may reflect adaptive responses of this small herbivore to a highly variable, arid environment.

Key words: home range, Mohave ground squirrel, Mojave Desert, movements, productivity, radiotelemetry, *Spermophilus mohavensis*

The size of an animal's home range may reflect its resource needs, distribution and abundance of resources, or population density. McNab (1963) showed that home-range size varies among mammal species as a function of body mass and trophic level. Harestad and Bunnell (1979) argued that differences in habitat productivity (e.g., between seasons or years) should affect home-range size: as habitat productivity increases, a smaller area is required to meet resource needs, resulting in a smaller home range. Food supplementation experiments (reviewed by Boutin 1990) have shown the expected inverse relationship between increased food availability and decreased home range for a variety of vertebrates, including reptiles, birds, and mammals. However, increased intruder pressure, attraction of competing species to supplemental food, or clumped distribution of resources may lead to results differing from the predicted inverse relationship (Kodric-Brown and Brown 1978; McShea and Schwede 1993; Slade et al. 1997). Studies examining the relationship between seasonal variation in resource availability (Beier and McCullough 1990; Bobek 1977; Singer et al. 1981) or spatial variation in resource abundance (Relyea et al. 2000) and home range are less common.

The Mohave ground squirrel (*Spermophilus mohavensis*) is found only in the western Mojave Desert of California, where it occurs in desert scrub habitats, usually on flat to gently sloping terrain with alluvial soils (Best 1995). Because of habitat loss and fragmentation, it currently is listed as threatened under the California Endangered Species Act. Mohave ground squirrels, like other mammals in arid environments, must survive and ?2 reproduce not only when habitat productivity is very low and highly seasonal but also when it varies greatly from year to year. Therefore, home-range size and use of space by Mohave ground squirrels might change in response to annual variations in resource availability.

Foliage and seeds of native shrubs and forbs make up most of the Mohave ground squirrel's diet. During the mating season, shrub foliage is the most important dietary component (Best 1995). In years with sufficient winter rainfall, forbs dominate the diet during the subsequent late spring and early summer. During drought years, production of forbs is much reduced, and shrub foliage remains the predominant food resource throughout the active period. Winter drought makes it particularly difficult for

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adult females to meet energy demands of reproduction and then accumulate fat reserves needed for dormancy. In years with low winter rainfall, female Mohave ground squirrels do not produce offspring and may enter hibernation as early as the end of April.

We predicted that adult home-range size in this species should decrease in years of high winter rainfall and habitat productivity, increasing in size when rainfall and productivity are low, in accordance with the habitat-productivity hypothesis. Size of home ranges of adult female should increase during reproductive years because of energy requirements of reproduction. Home ranges of adult males should be larger in the mating season to increase access to receptive females (Dobson 1984; Schwagmeyer 1988).

We studied postmating home range and movements of adult Mohave ground squirrels in 1990 and from 1994 through 1997 and movements during the mating season in 1997. In 3 of these years, winter rainfall and primary productivity were low, and we observed no evidence of production of young. In the 2 other years, winter rainfall and food production were sufficient to support recruitment of young. Thus, this 5-year study allowed us to assess home-range size and movements relative to considerable variation in habitat productivity and in energy requirements of reproductive females.

Materials and Methods

Study site and subjects.—Mohave ground squirrels are small (100–150 g adult posthibernation mass) diurnal rodents that are usually active aboveground from February through July but spend the rest of the year in dormancy (Bartholomew and Hudson 1960). The single annual mating season occurs immediately after emergence from hibernation in February and early March (Best 1995). Young are usually born in late March and early April, and lactation continues through mid-May (Pengelley 1966). Litters generally appear aboveground in early to mid-May.

We conducted our study in the northwestern Mojave Desert, Inyo County, California (36°04′N, 117°48′W). The 47-ha study site was a small valley within the rugged uplands of the Coso Range, a desert mountain range about 20 km east of the Sierra Nevada. Elevation of the study site was 1,400–1,500 m, and slopes ranged from 2–15%. Deep alluvial soils were classified as loamy coarse sands. Vegetation was a mixed desert scrub community. Important shrub species included spiny hopsage (*Grayia spinosa*), fourwing saltbush (*Atriplex canescens*), shadscale (*A. confertifolia*), cheesebush (*Hymenoclea salsola*), Cooper's boxthorn (*Lycium cooperi*), and winterfat (*Krascheninnikovia lanata*). This community is typical of the transition between Mojave and Great Basin desert biomes (Beatley 1975). Mean annual precipitation (1949–1999) was 163 mm at Haiwee Power Plant (elevation 1,160 m), 15 km to the northwest of the study site. Winter rainfall predominated, with 79% of annual precipitation received between 1 October and 31 March during the 51-year period of record. Primary productivity in the western Mojave Desert occurs mainly from March through May and is closely related to winter rainfall (Beatley 1974), which is highly variable from year to year. We maintained a rain gauge on the study site and collected precipitation data monthly.

A 22-ha portion of the study site, with trap stations placed at 50-m intervals, was used exclusively for radiotelemetry studies in 1990 and 1994–1997. The remaining 25-ha portion of the site, with trap stations at 25-m intervals, was used primarily for demographic studies from 1988 to 1996. We also carried out radiotelemetry in this portion of the study area in 1990 and 1997.

Capture procedures.—Ground squirrels were captured with Pymatuning (10 × 11 × 39 cm, Warren Grieser, Pymatuning, Pennsylvania) or Sherman (8 × 9 × 30 cm, H. B. Sherman, Tallahassee, Florida) traps placed under shrubs at each trap station and baited with commercial horse feed composed of corn, oats, barley, and molasses. Traps were set in early morning, checked at midday and late afternoon, and then closed for the night. Weight, sex, age, and reproductive condition were recorded for all captured ground squirrels. We marked ground squirrels for permanent identification with passive integrated transponder tags implanted subcutaneously between the scapulae with a hypodermic needle. Adults could be distinguished from juveniles by body mass and pelage. Adults that had been captured and marked previously as juveniles could be assigned to a specific age class. Reproductive condition of adult males was based on position of the testes (abdominal or scrotal). Adult females were examined for swelling of the vulva and nipple size and condition and palpated for evidence of pregnancy. They were then categorized as nonreproductive, receptive, pregnant, lactating, or postlactating.

Radiotracking.—We equipped 56 adult ground squirrels (36 females and 20 males) with radiotransmitters (Model SM-1, AVM Instrument Co., Livermore, California) mounted on flexible collars. The numbers of each sex equipped with radiocollars reflected the sex ratio of captured animals. Six adult females were radiocollared during more than 1 year of study, including 2 individuals that were studied during 4 consecutive years. Radiocollars weighed 5 g and were less than 5% of adult body mass. We located radiocollared individuals during daylight hours using portable receivers (AVM Instrument Co.) and handheld, 2-element Yagi antennas (Telonics Inc., Mesa, Arizona). We followed radio signals on foot until a ground squirrel was either seen or located underground to within 5 m by signal strength and direction. Locations were recorded using compass bearing and distance from the nearest trap station.

We attempted to recapture radiocollared animals at various times to collect data on mass and reproductive condition before their immergence into hibernation. This allowed us to monitor their condition and examine the fit of radiocollars. We attempted to retrieve radiocollars after emergence from hibernation the following spring by trapping in the vicinity of know hibernation locations. Although no radios were transmitting after this time interval, we recovered 39% of radios by this method.

Radiotracking was conducted periodically during the active season (February–July). For analysis, we divided radiotelemetry data into 2 categories: mating season, the period between emergence from dormancy in February through 15 March, and postmating season, the period from 16 March through 30 June. The end of the mating season was established by working backward from the emergence of young from their natal burrows, using data on gestation and development of young (Pengelley 1966). We collected data from the postmating period in all 5 years of the study and from the mating season in 1997. Adults generally were trapped and equipped with radiocollars during an intensive sampling period in late March and early April. During this period, we attempted to locate each animal 2–3 times daily (morning, midday, and evening if possible). Another period of intensive radiotracking occurred from mid-May to mid-June. Between these intensive sampling periods, we made shorter visits to the study area, during which we typically located animals 1–2 times daily over a 1–3-day period. Radiotelemetry studies continued until animals entered hibernation, the timing of which varied considerably among years. The study was expanded in 1997 by adding intensive sampling during the mating season. Seven males and 6 females were equipped with radio

transmitters beginning on 14 February. During the 1997 mating season, we usually obtained locations for each individual 1–3 times per day.

Data analysis and home-range estimation.—Home-range size was estimated for adult Mohave ground squirrels by using all map locations derived both from radiotelemetry and live-trap captures. We calculated postmating home ranges for those adult Mohave ground squirrels for ?3 which we had $\geq$12 locations and radiotelemetry data in $\geq$3 weeks. Forty-eight Mohave ground squirrels (32 females and 16 males) met our criteria for calculating home ranges. The mean number of locations per individual was 27.1 ($\pm$11.5 *SD*). We found no relationship between number of locations and postmating 100% minimum convex polygons (MCP—White and Garrott 1990; $r^2 = 0.005$, $P = 0.628$). To compare postmating home ranges among years, we eliminated records from before 16 March and after 30 June. Home ranges for the mating season of 1997 were calculated for 13 Mohave ground squirrels (7 males and 6 females) for which there were $\geq$10 locations. The mean number of locations per individual was 30.6 ($\pm$12.9). We found no relationship between number of locations and mating season MCP for either males ($r^2 = 0.009$, $P = 0.837$) or females ($r^2 = 0.417$, $P = 0.144$).

The mean time difference between locations, for those locations that fell on the same day, was 234 min ($\pm$59 min, n = 1,213) for the postmating period and 214 min ($\pm$18 min, n = 385) for the mating season of 1997. We excluded the few locations that were determined <2 h apart. These resulted from having checked the location of an animal more than once during a sampling period. White and Garrott (1990) suggest that locations could be considered independent if the ?4 time interval were sufficient for the animal to traverse its home range. Maximum observed rates of travel were lowest for females in the postmating season (maximum of 260 m/h) and highest for males in the mating season (maximum of 1 km/h). These rates of travel were such that animals were capable of traversing their home ranges within a 2-h period.

Location data for radiocollared Mohave ground squirrels were plotted on maps of the study area, and home-range size was calculated with the software program CALHOME (Kie et al., 1996). Two estimates of home range were made for each individual: the 100% MCP and the 95% adaptive kernel. Because no males were radiocollared in 1995 and only 1 in 1994, males and females were analyzed separately for differences among years. Differences were tested initially using Kruskal–Wallis 1-way nonparametric analysis of variance, followed by Dunn's test for multiple pairwise comparisons (Zar 1984) when the analysis of variance indicated significant variation among years. We compared sexes within years using the Mann–Whitney *U*-test and between seasons in 1997 using paired Wilcoxon rank-sign tests. The 100% MCP has the advantage of simplicity and long historical use in the literature. However, it includes unused space, gives no indication of relative intensity of use, and is very sensitive to small sample size and extreme outlying locations (White and Garrott 1990; Worton 1987). Kernel methods use a sample of locations to create a probability density estimate that may be interpreted as a utilization distribution (Van Winkle 1975; Worton 1989, 1995) and is not dependent on parametric assumptions. The bandwidth, a smoothing parameter, was selected by the least squares cross-validation method (Worton 1995).

Unusually long movements by adult males were observed during the 1997 mating season. Therefore, in addition to comparing home-range sizes between seasons, we compared movement distances of males and females between mating and postmating seasons, and we compared males and females within each season. We used 2 measures of movement: maximum movement (straight-line distance between 2 points) for each individual within 1 day and the proportion of all within-day movements that were >200 m, a distance that exceeded the diameter of the postmating home ranges of most females. Within-day movements were calculated for each case in which $\pm$2 locations existed ?5 for an animal within 1 day and at least 1 of the locations was not a nocturnal burrow site. Maximum movements were compared for sexes between seasons using paired Wilcoxon rank-sign tests and for seasons between sexes using Mann–Whitney *U*-tests. Proportions of within-day movements >200 m were analyzed with logistic regression using generalized estimating equations (Liang and Zeger 1986), which allowed the incorporation of variation in proportions among individuals.

Results

Winter rainfall and reproduction.—Rainfall totals in winter (1 October–31 March) at the study site varied greatly, ranging from only 13.7 mm in 1989–1990 to 197.8 mm in 1994–1995 (Table 1). In 3 years (1990, 1994, and 1996) we found no evidence of pregnancy, lactation, or presence of young, whereas in 1995 and 1997 all radiocollared females appeared to have produced litters. In general, low rainfall was associated with reproductive failure, but the timing of precipitation also may have been important. Although total winter rainfall preceding the 1997 active season was only slightly higher than that preceding the 1994 and 1996 seasons, all winter rainfall was received by the end of January and therefore may have been more effective in promoting germination of annual plants. In contrast, the 3 years in which squirrels failed to produce litters had had <30 mm of rainfall by the end of January. Two of the years (1994 and 1996) had significant rainfall in February and March, yet Mohave ground squirrels did not produce litters. The 2 years in which reproduction was observed differed in total and spring rainfall, with no spring rainfall in 1997.

Postmating home ranges of females.—Size of postmating home ranges varied considerably among years for adult females (Fig. 1). The 3 females captured in 1995 were individuals that were also captured in other years, and 3 of the 4 largest home ranges in 1997 corresponded to individuals that were captured in other years. To ensure independence of observations, we restricted our analysis to 1990, 1994, and 1996, all of which were drought years with no reproduction. Size of home ranges differed among drought years for adult female MCP ($H = 13.29$, $d.f. = 2$, $P < 0.01$) and adaptive kernels ($H = 12.41$, $d.f. = 2$, $P < 0.01$) (Fig. 1). MCP in 1994 were significantly smaller ($Q = 3.61$, $P < 0.001$) than those in 1990, and 1996 MCP were also significantly smaller than those in 1990 ($Q = 2.43$, $P < 0.05$). Adaptive kernels in 1994 ($Q = 3.50$, $P < 0.001$) and in 1996 ($Q = 2.42$, $P < 0.05$) were significantly smaller than those in 1990.

Postmating home ranges of males.—Because no males were captured in 1995 and only a single male in 1994, only 3 years were available for comparison (1990, 1996, and 1997). Postmating home ranges did not differ significantly among years for MCP ($H = 4.84$, $d.f. = 3$, $P > 0.05$) or adaptive kernels ($H = 7.14$, $d.f. = 3$, $P > 0.05$). No significant differences in MCP between males and females were found during postmating seasons of 1990 ($U = 3.0$, $P > 0.05$) or 1996 ($U = 9.0$, $P > 0.05$), but male postmating MCP were larger than those of females in 1997 ($U = 11.0$, $P < 0.05$) Similarly, adaptive kernels did not differ between sexes in 1990 ($U = 3.0$, $P > 0.05$)

TABLE 1.—Monthly rainfall (mm), annual winter rainfall totals, and occurrence of reproduction for the Mohave ground squirrel, Coso Range, Inyo County, California. Years in which no evidence of pregnancy, lactation, or weaning of litters was detected are indicated as years of no reproduction. In years for which reproduction is indicated, virtually all adult females were lactating and juveniles were produced.

	October	November	December	January	February	March	Total	Reproduction
1989–1990	6.0	0.0	4.0	3.7	0.0	0.0	13.7	No
1993–1994	0.0	8.6	1.0	0.0	26.5	26.5	59.1	No
1994–1995	1.2	4.1	9.4	135.8	7.4	39.9	197.8	Yes
1995–1996	0.0	0.0	11.8	14.9	0.0	24.8	51.5	No
1996–1997	13.6	12.2	31.0	10.0	0.0	0.0	66.8	Yes

or 1996 ($U = 12.0, P > 0.05$) but was different in 1997 ($U = 8.0$, $P < 0.05$).

Mating season home ranges of males and females.—Male Mohave ground squirrels had very large MCPs during the 1997 mating season (median 6.73 ha, range 4.26–40.14 ha, $n = 7$) compared to those of adult females during the same season (median 0.74 ha, range 0.29–0.93 ha, $n = 6$). Male adaptive kernels (median 12.80 ha, range 5.13–44.28 ha, $n = 7$) were also larger than those of females (median 0.95 ha, range 0.58–1.43 ha, $n = 6$). Both MCPs ($U = 42, P < 0.01$) and adaptive kernels ($U = 42, P < 0.01$) were different. MCPs for males were larger ($z = 2.37$, $n = 7$, $P < 0.05$) during the mating season than postmating season (Fig. 1c), even though the postmating period was considerably longer in duration. However, adaptive kernels in the postmating season (Fig. 1d) did not differ ($z = 1.52, P > 0.05$) from mating season home ranges. For females, both MCP (Fig. 1a; $z = 2.21, P < 0.05$) and adaptive kernel (Fig. 1b; $z = 1.99, P < 0.05$) home ranges were larger during the postmating season than during the mating season for the 6 individuals that were present in both seasons.

The maximum distance moved within days for males during the mating season (median 391 m, range 274–1,491 m) was greater than for the postmating season, (median 130 m, range 46–427 m; $z = 2.37$, $n = 7$, $P < 0.05$). Maximum within-day movements by females during the mating season (median 138 m, range 96–213 m) did not differ ($z = 0.314$, $n = 6$, $P > 0.5$) from postmating movements (median 205 m, range 24–371 m). Maximum within-day movements for males and females were different for the mating season ($U = 42, P < 0.01$) but not for the postmating season ($U = 20.0$, $P > 0.05$).

During the mating season, 40.2% of within-day movements by males ($n = 7$) were >200 m, and this proportion dropped to 13.8% during the postmating period ($\chi^2 = 6.06$, $d.f. = 1$, $P < 0.05$). Females had a much lower proportion (1.5%) of within-day movements >200 m in the mating season. Although this proportion increased to 6.1% during the postmating season, this difference was not significant ($\chi^2 = 2.11$, $d.f. = 1$, $P > 0.10$). The proportion of movements >200 m differed between males and females for the mating season ($\chi^2 = 13.51$, $d.f. = 1$, $P < 0.001$) but not for the postmating season ($\chi^2 = 0.65$, $d.f. = 1$, $P > 0.40$).

Site fidelity of female ground squirrels.—In 9 cases, representing 5 individual females, a radiocollared female from 1 year of the study was found in the subsequent year. Mean proportional overlap of home ranges across years was 0.41 ± 0.16 *SD*, and home ranges overlapped between years for all possible cases. In 4 cases, the home range from 1 year was contained entirely within the home range occupied during another year. Two individuals were studied for 4 years; in both cases, portions of their home ranges were used during all 4 years.

DISCUSSION

Home-range size should reflect the balance of energy demands and resource availability. The habitat-productivity hypothesis (Harestad and Bunnell 1979) predicts that home-range size should decline with increased habitat productivity because a smaller area should meet resource needs when productivity increases. This hypothesis has been tested experimentally by food supplementation (Boutin 1990) and observationally by comparing home range in areas of different productivity. Food supplementation has led to smaller home ranges in a number of small mammals, including *Tamias townsendii* (Sullivan et al. 1983), *Microtus californicus* (Ostfeld 1986), *M. townsendii* (Taitt and Krebs 1981, 1983), *Peromyscus maniculatus* (Taitt 1981), *Sciurus carolinensis* (Kenward 1985), and *Tamiasciurus hudsonicus* (Hurly and Robertson 1987). However, Slade et al. (1997) found increased movements in *M. ochrogaster* on supplemental food areas and also found that movements of reproductive voles were greater than those of nonreproductive individuals for both sexes. These authors invoked increased intruder pressure due to increased density to explain the greater movement on supplemental food grids. Mares et al. (1976, 1982) controlled population density of *Tamias striatus*, and hence intruder pressure, during a food supplementation experiment that resulted in smaller home ranges. Observational studies have also supported the general relationship between habitat productivity and home-range size (e.g., Beier and McCullough 1990; Jones 1990; Relyea et al. 2000; Rusch and Reeder 1978). However, patchy resource distribution may lead to conflicting results. For example, McShea and Schwede (1993) found that animals might expand their home ranges to include productive oaks during mast years.

Female Mohave ground squirrels varied among years in the size of their postmating home ranges. Male home-range size did not differ from that of females in 2 drought years but was greater in a year (1997) in which reproduction occurred. Because we lacked data from 2 years (1994 and 1995) for males, we did not see significant variation among years. Variation in home-range size of postmating females was associated with variation in precipitation, which in turn is related to forage availability for these small herbivores. The pattern of variation in home-range

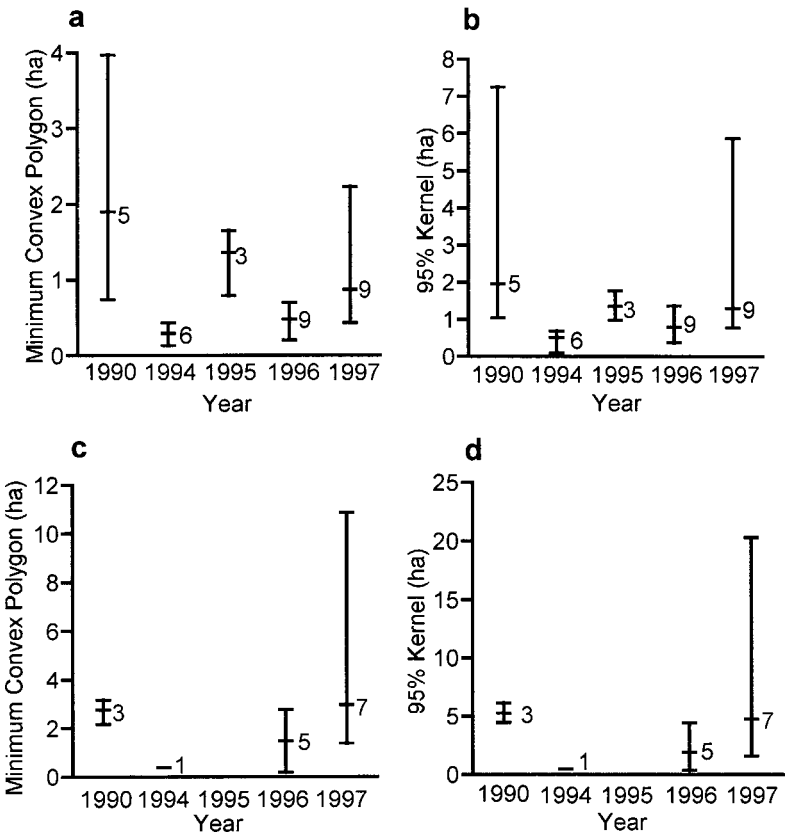

Fig. 1.—Home-range size for postmating Mohave ground squirrels. Sizes for females are given as a) minimum convex polygons and b) 95% adaptive kernels; sizes for males as c) minimum convex polygons and ?6 d) 95% adaptive kernels. Range, median, and number of individuals are shown for each sample.

size during drought years showed an inverse relation to precipitation, as one might expect based on the habitat-productivity hypothesis. During drought years, no reproduction occurred; thus, energy demands were similar among years: female ground squirrels had to obtain sufficient food to prepare for hibernation. Home ranges in 1990 (the 2nd of 2 consecutive drought years and the year with lowest precipitation during the study) were larger than those of 1994 and 1996, the 2 years of moderate drought. The size of home ranges during drought years thus fits the pattern predicted by the habitat-productivity hypothesis: a larger home range is required to meet energy needs. A few individuals during the extreme drought year 1990 were observed making movements >200 m from nocturnal burrow locations to daily foraging areas, suggesting that they had located patches of habitat with higher food availability. Also, some individuals entered hibernation earlier in 1994 and 1996 than any of those that hibernated in 1990, suggesting that higher food availability allowed animals to prepare for hibernation at an earlier date. The contraction of home range during the years of moderate drought, in combination with the lack of reproduction, may represent a strategy of reducing energy expenditures and entering dormancy as soon as possible, a strategy also employed by other desert vertebrates (Duda et al. 1999).

Comparison of home ranges between years of moderate drought and years of higher precipitation was not possible because of a lack of independent samples. However, relatively large home ranges were observed among 3 adult females in 1995 and 4 in 1997, years of the highest precipitation and resource availability. Reproduction occurred in both of these years, which would significantly increase the energy required by reproductive females for gestation and lactation. Energy demands for lactation in ground squirrels and other small mammals may equal or exceed the mother's own metabolic requirements (Michener 1998; Michener and McLean 1996; Millar 1978; Rickart 1982). The increase in home-range size of females from the mating season to the postmating season in 1997 suggests that the increased energy demand is associated with costs of producing a litter rather than with potential costs of mating. We hypothesize that these costs associated with reproduction should result in larger home ranges, even though habitat productivity is relatively high.

Although females exhibited considerable variation in home-range size, those that were followed for >1 year showed a high degree of site fidelity. Overlap between years was considerable, and we observed no cases of nonoverlap between any 2 home ranges, even for the 2 females that were followed for 4 years.

Behavior of males during the mating season was strikingly different from that of females. Home ranges of males in the mating season were very large, several times larger than the largest female home ranges. Large home ranges in the mating season were associated with long-distance movements. Movements within 1 day were sometimes such that a male could have traversed home ranges of several females. The proportion of

movements >200 m was much greater for males in the mating than in the postmating season, and females rarely made such movements. Although long-distance movements declined in the postmating season, males continued occasionally to make such movements early in the postmating period, resulting in large home ranges.

Increase in home-range size of males during the mating season has been reported for at least 6 other ground squirrel species (Dobson 1984). This behavior occurs in ground squirrels with territorial defense polygyny, such as *S. richardsonii* (Michener 1979, 1983) or *S. columbianus* (Murie and Harris 1978), and those with nondefense polygyny, such as *S. tereticaudus* (Dunford 1977) or *S. tridecemlineatus* (Schwagmeyer 1988). Nondefense polygyny, or scramble competition, may be favored when female density is so low that the cost of traveling between females is prohibitive or when population density is so high that the cost of defense is prohibitive (Dobson 1984). The former situation appears to apply for Mohave ground squirrels, in which female home ranges may be separated by distances >100 m and males cover large areas, making territorial defense impossible. Interactions between males or evidence of wounding by other ground squirrels were not observed during our study, an observation perhaps related to the relative scarcity of males compared to females (sex ratio of 0.27:1.0, males to females). Other anecdotal evidence supports the model of scramble competition for mates. On 1 occasion, we captured 3 different scrotal males at the burrow of a hibernating female on 3 consecutive trapping periods early in the mating season. None of these males were observed again on the study area. They may have been investigating the female's hibernation site in an attempt to mate immediately after she emerged. Male mating success is associated with mobility in *S. tridecemlineatus* (Schwagmeyer 1988), and the high degree of mobility observed in *S. mohavensis* may be associated with mate-searching behavior.

Altering size of the home range appears to be 1 mechanism by which this small herbivore adapts to an arid, variable environment. Size of female home ranges in years of no reproduction appears to vary in response to food availability. Females show a high degree of site fidelity and occupy home ranges that may be separated from one another by distances exceeding the diameter of a typical home range. Extensive male movements may be an appropriate strategy for mate searching in populations with patchy distribution and low density.

Acknowledgments

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MOHAVE GROUND SQUIRREL SURVEY, 1972 1/

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ABSTRACT

A search of literature revealed a scarcity of knowledge concerning the Mohave ground squirrel (Citellus mohavensis). Based on knowledge gained from museums and interviews and contact with the few informed scientists, areas of known species occurrence were live trapped. Eight localities sampled resulted in the trapping and/or sighting of 33 Mohave ground squirrels in 4 locations. Further search of the Mohave Desert was discontinued because of lack of information regarding sites historically occupied by this rare mammal.

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George Bartholomew

The Mohave ground squirrel is distinguished from the Antelope ground squirrel by its larger size, uniform-grizzled grayish brown back and lack of white stripe on each side. The round-tailed ground squirrel resembles the Mohave ground squirrel but has a round uniformly colored tail and does not normally hold its tail over its back.

INTRODUCTION

In addition to its value as an endemic California species, the Mohave ground squirrel (Citellus mohavensis) is of interest to scientists for several reasons. It has one of the most restricted distributions of any species of ground squirrels. A satisfactory explanation of this fact is still lacking, but is of interest to zoogeographers and population ecologists alike. Its strategy for survival in a severe environment and in the face of competition with one of the most successful species of ground squirrels, the antelope ground squirrel (Ammospermophilus leucurus) has been partially elucidated, but is of potential further interest to ecologists, physiologists and behaviorists. As a member of a vast complex of variously related species of ground squirrels, the Mohave ground squirrel is of potential interest to scientists studying physiological and haemotological correlates of evolution and hibernation, and to population ecologists. Numerous local investigators have recently noticed an increasing scarcity of this species in areas where, previously, it has been moderately easy to trap. Accordingly, on May 21, 1971, the California Fish and Game Commission officially designated the Mohave ground squirrel a rare species.

DESCRIPTION

The Mohave ground squirrel is somewhat larger than the antelope ground squirrel and shorter, but heavier, than the round-tailed ground squirrel (Cittelus tereticaudus). These are the two species with which it is most likely to be confused. The Mohave ground squirrel averages 224 mm. total length as opposed to 247 mm. for the round-tailed ground squirrel and 213 mm. for the antelope ground squirrel (Howell, 1938). Adults captured in the course of this study averaged 140 grams; but one individual weighing 198 grams was captured, and under artificial conditions weights of nearly 300 grams have been reported (Pengelley and Kelley, 1966). Antelope ground squirrels are reported to average 104 grams (Hall and Kelson, 1959), and the round-tailed ground squirrel is reported to average 120 grams (Hudson, 1964). The Mohave ground squirrel is colored a uniformly-grizzled grayish brown above and a soiled white below. When clearly seen, it is easily distinguished from the antelope ground squirrel which has a white stripe on each side of its body. The round-tailed ground squirrel is uniformly brown colored, much like the Mohave ground squirrel. Both the antelope and Mohave ground squirrels have short, flat tails which are brown above and whitish below. The tail of the round-tailed ground squirrel is longer, round, and uniformly colored. Both the antelope and Mohave ground squirrels usually hold their tails up over their backs, thereby displaying the white ventral side, while the round-tailed ground squirrel normally does not do so. The antelope ground squirrel is said to flick its tail nervously back and forth much more frequently than the Mohave ground squirrel.

SCOPE OF STUDY

The present study was undertaken to: (1) Determine the distribution and abundance of the Mohave ground squirrel; and (2) Evaluate its current status and factors threatening its survival.

RESULTS

Library Search

A complete literature search was conducted using the Zoological Record and Science Citation Index. The following 10 articles comprise the entire scientific literature on Citellus mohavensis:

Adest, Gary. 1972. Intraspecific and interspecific behavior of Ammospermophilus leucurus and Citellus mohavensis. Masters Thesis, California State College at Los Angeles. (Mohave ground squirrels exhibit greater Interspecific and Intraspecific Agression.)

Bartholomew, G.A. and Hudson, J.W. 1960. Aestivation in the Mohave ground squirrel Citellus mohavensis. Bull. Mus. Comp. Zool. 124:193. (The Physiology of hypothermia.)

Bartholomew, G.A. and Hudson, J.W. 1961. Desert ground squirrels. Sci. Am. 205:107 (Summary of role of thermoregulation and behavior in reducing competition between Mohave ground squirrel and antelope ground squirrel.)

Burt, W.H. 1936. Notes on the habits of the Mohave ground squirrel. J. Mammalogy 17:221. (Only published observations of behavior under natural conditions. Based on 2-3 animals.)

Grinnell, J. and Dixon, J. 1918. Natural history of the ground squirrels of California. Monthly Bull. of the State Commission of Horticulture 7:667. (An early description of distribution and taxonomy.)

Howell, A.H. 1938. A revision of the ground squirrels of North America. North American Fauna #56:30. (Taxonomic characteristics and relationships.)

Merriam, C.H. 1889. Description of a new spermophile from Southern California. North American Fauna 2:15. (Original description of species.)

Pengelley, E.T. 1966. Differential developmental patterns and their adaptive value in various species of the genus Citellus. Growth 30:137-142. (Reproductive information; length of gestation, time and size of litter, growth rate.)

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Pengelley, E.T. and Kelley, K.H. 1966. A "Circannian" rhythm in hibernating specie of the genus Citellus with observations on their physiological evolution. Comp. Biochem. Physiol. 19:603. (Demonstration of endogenous annual rhythms of torpor and weight.)

Museum Survey

Fifteen American museums with the largest mammal collections were surveyed for specimens of the Mohave ground squirrel. Fifty-five specimens were reported from

collections. None of the curators knew of any other collections which might contain additional specimens of this species. The data collected is summarized in Table 1:

TABLE 1

Mohave Ground Squirrel Collections

Museum	Specimen No.	Locality Collected
D.R. Dickey Collection	18,645	Palmdale
University of California	18,646	
Los Angeles	18,661	
	18,669	
Los Angeles County Museum	---	Palmdale
	---	Walker Pass-East Side
	---	Ridgecrest - 6 Mi. West
Museum of Vertebrate Zoology	31,515	Oro Grande
University of California	99,826	Kramer Jct. - 2 Mi. West
Berkeley	81,813	Barstow - 15 Mi. West
	125,679	Palmdale - 18 Mi. East
	31,158	Palmdale - 2 Mi. North
	31,160	Palmdale - 2 Mi. North
	31,960	Palmdale - 1 Mi. North
	44,285	Lovejoy Spr. - 1 Mi. North
	31,967	Lancaster - 2 Mi. S & 1/2 Mi. E.
	28,674	Little Lake
	28,675	Little Lake
University of Michigan	77,651	Palmdale - 2 Mi. North
San Diego Natural History Museum	402	Mohave Desert
	403	Rabbit Spr.
	404	Mohave R.
	9,381	Trona - 10 Mi. North
	9,516	Freeman
	9,629	Palmdale - 1 Mi. East
	9,623	Palmdale - 2 Mi. East
	9,624	Palmdale - 2 Mi. East
	9,708-9,710	Palmdale - 2 Mi. East
	9,726	Palmdale - 2 Mi. East
U. S. National Museum	28,740	Haiwee Meadows
	135,838	Mohave Desert
	192,752	Mohave Desert
	192,753	Mohave Desert
	15,974	Mohave River
	15,975	Mohave River
	192,754-192,756	Rabbit Spr.
	186,469	Rabbit Spr.
	---	Victorville
	28,741-28,747	Salt Wells Valley

TABLE 1 (Continued)

Museum	Specimen No.	Locality Collected
University of Kansas	63,589	Victorville - 15 Mi.
American Museum of Natural History	1,177-1,181 13,844	Mohave River Sears Cattle Ranch, K

Scientists and Trappers

The following scientists and trappers were interviewed to discover localities where the animals have been trapped in recent years:

George A. Bartholomew
Department of Biology
University of California
Los Angeles, California 90024

Eric T. Pengelley
Department of Zoology
University of California
Riverside, California

Richard E. MacMillen
Department of Population and Environmental Biology
University of California
Irvine, California 92644

William Wertz
Department of Zoology
Pomona College
Claremont, California 91711

Bruce Kenyon
3177 Tapa Canyon
Simi Valley, California

Carl Tegan
38639 33rd Street
Palmdale, California

All localities suggested by these individuals were trapped in the course of the study.

Trapping

Eight different localities were visited within the area of distribution reported in Hall and Kelson (1959). An average of 100 Serman Live Traps were set for two days at each location. A combination of peanut butter, shredded coconut, and coconut extract appeared to be the most effective bait; but, one animal was trapped using

bird seed, and other workers have been successful using bird seed, bacon, or oranges. Mohave ground squirrels were trapped at four locations. At two locations sightings of several animals augmented the trapping record, but at the other locations only three animals were trapped and no others were sighted. The trapping record is summarized below:

Location	Number Trapped	Number Sighted (Approx.)
Shadow Mountains	1	0
Boron County Dump	2	0
China Lake	5	5-10
Keel's Ranch	1	10-15

(The exact locations and trapping records are detailed in the appendix.) At two of the four localities where no animals were trapped, populations were known to have existed in the past but to have declined in recent years. Populations at these localities may no longer exist.

Preferred Habitat

A conscious effort was made to evaluate the habitat at each trapping location in order to gain more specific information about the animals' habitat preference. All animals were located within or immediately adjacent to Creosote Scrub. With the exception of areas immediately associated with dry lake beds, this plant community is nearly ubiquitous in the Mohave Desert; but, it shows considerable variability in its composition and density. The localities where the Mohave ground squirrels were trapped represented the same range in composition and density of the Creosote Scrub Community as the Western Mohave Desert as a whole. It is not possible, therefore, to specify any distinctive habitat requirements other than the moderately variable Creosote Scrub.

Distribution and Abundance

Due to the extreme difficulty encountered in trapping the animals, it is not possible at this time to make any exact or quantitative statements about the animal's present distribution or abundance. However, a few qualitative generalizations can be made.

Adest's study of aggressive behavior indicates that the animals may be found at low densities due to intense intraspecific aggression and not declining population levels. Maintenance of low population densities may be part of the animal's strategy of optimal resource utilization.

While the significance of negative evidence is doubly questionable, due to the difficulty in trapping animals in an area where several have been sighted, it still appears that the population is very discontinuously distributed. One possible explanation of this might be that the species may be in the final stages of extinction due to competition with the closely related, more abundant, antelope ground squirrel. Such a natural occurrence would probably be happening

on such a long-time scale that it would be hard to detect. The effect of human disturbances would also be hard to determine and make the interpretation of any data more difficult.

An alternate hypothesis might be that the animal has an, as yet undetermined, stringent habitat requirement which is only discontinuously satisfied in the Mohave Desert. No direct evidence for this is presently available, but it remains a possibility.

It is not possible at this time to decide whether the species is truly endangered. Two of the known extant populations are in the immediate vicinity of human habitation. The population at China Lake is probably quite secure due to the Navy's protection of its land. The animals associated with alfalfa fields were seen to make frequent trips to the fields. They seem to be dependent on the fields and could be easily exterminated by the State Rodent Control Program. The population at Boron may be fairly secure if it occupies very much of the Edwards Air Force Base, Rocket Test Site. Both of the populations which have apparently recently gone extinct were in the southern end of the Mohave Desert. This appears to be the area of the Mohave Desert which is being most extensively developed, and this may mean the eventual loss of much favorable habitat.

RECOMMENDATIONS

1. The Mohave ground squirrel be retained on the rare species list.

2. A program be established whereby information is actively sought from people working in the Mohave Desert. This be done by providing field workers as well as local zoology departments with a survey form requesting that they report Mohave ground squirrel sightings to the Department of Fish and Game.

3. Studies be initiated immediately to more closely identify those areas reported to be populated by the Mohave ground squirrel and how these can best be preserved.

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APPENDIX

TRAPPING RECORD

Locality: Shadow Mountains, San Bernardino County. Three and one-half miles west of U. S. Highway 395, the Shadow Mountain Road is intersected by a small dirt road which runs to the south. Traps were set in a broad wash which crossed this road about 0.8 miles south of the Shadow Mountain Road.

Description: One animal was caught at the edge of the wash. Only a few plants of the Creosote Scrub Community were present and they were fairly stunted and widely spaced. Plants present in the desert immediately adjacent to the wash included: Creosote Bush, Joshua Tree, Atriplex canescens, Hymenoclea salsola. No plants grew in the bed of the wash, but several cacti and Atriplex canescens were on the edge of the wash and on small islands in the middle of the wash.

Date: March 29, 1972

Trap Days: 200

Results: 1 trapped, 0 sighted

Observations: When released, the animal entered a burrow under a Creosote bush.

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Locality: Boron County Dump, San Bernardino County. A dirt road extends into the desert south of the dump. Traps were set all around the perimeter of the dump. Two animals were caught south of the dump and east of the road, in an area currently being used for dirt and large debris.

Description: There was very little, if any, organic matter in the dump, so it probably does not represent an artificially augmented food source.

The desert appeared very productive. All of the major components of the Creosote Scrub Community were present and at least six different species of annuals were in bloom. The perennials were large, fairly closely spaced and very healthy in appearance.

Date: May 21, 1972

Trap Days: 80

Results: 2 trapped, 0 sighted

Observations: Burrows appeared to be located at the bases of Creosote bushes. One knowledgeable individual contacted in the area stated that the Mohave ground squirrels frequently climb the Joshua Trees.

.....

Location: China Lake, Naval Weapons Center, San Bernardino County. Traps were set running east of the dirt road on the eastern side of the golf-course, about 0.15 miles from its intersection with Knox Road. Traps were also set running North of the road at the northwest corner of the Stables. Information and permission to trap were provided by Mrs. Tilly C. Barling, Public Works Department, Code 70026, China Lake, California 93555, phone number (714) 939-2349.

Description: The desert was moderately productive with abundant, fairly large Creosote and a limited number of the other plants of the Creosote Scrub Community. No annuals were in bloom.

Date: June 14 and 15, 1972

Trap Days: 200

Results: 5 trapped, 10 sighted

Observations: One animal was observed sitting upright and motionless with its back to the sun for 45 minutes one morning. The air was cool, the sun quite warm, and a slight breeze was blowing. The back of the animal appeared darker than normal, and the animal may have been "basking."

.....

Location: Keels Ranch, Palmdale, California, Los Angeles County. Traps were set on the south and west sides of an alfalfa field located south of Avenue P and about 1 mile east of the road to El Mirage Soaring School. They were also set along another dirt road, about 1/4 mile east of the first field. This road bordered the land of a factory run by Anadite Inc.

Description: The Creosote Scrub Plant Community was moderately productive but the animals were closely associated with the alfalfa fields and probably were deriving their food from the fields, and not the desert.

Date: June 25, 1972

Trap Days: 80

Results: 1 trapped, 15 sighted

Observations: Numerous animals were noted running back and forth between the alfalfa fields, and their burrows on the desert side of the dirt road.

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Localities Where Populations Apparently No Longer Exist

Bob's Gap: 165th Street, Palmdale, California. George A. Bartholomew reported that a significant population existed in about 1960, just above and just below the place where 165th Street passed through Bob's Gap. On February 12th and 13th, 240 trap days yielded no Mohave ground squirrels.

Lovejoy Butte: E. T. Pengelley reported that a significant population had existed around the southern edge of Lovejoy Butte in the mid 1960's, but that recent attempts to trap in the same locality had been unsuccessful. On February 19th and 20th, 240 trap days yielded no Mohave ground squirrels.

CNPS Botanical Survey Guidelines

CALIFORNIA NATIVE PLANT SOCIETY
December 9, 1983
Revised June 2, 2001

The following recommendations are intended to help those who prepare and review environmental documents determine when a botanical survey is needed, who should be considered qualified to conduct such surveys, how surveys should be conducted, and what information should be contained in the survey report. The California Native Plant Society recommends that lead agencies not accept the results of surveys unless they are conducted and reported according to these guidelines.

1. Botanical surveys are conducted in order to determine the environmental effects of proposed projects on all botanical resources, including special status plants (rare, threatened, and endangered plants) and plant (vegetation) communities. Special status plants are not limited to those that have been listed by state and federal agencies but include any plants that, based on all available data, can be shown to be rare, threatened, or endangered under the following definitions:

   > A species, subspecies, or variety of plant is “endangered” when the prospects of its survival and reproduction are in immediate jeopardy from one or more causes, including loss of habitat, change in habitat, over-exploitation, predation, competition, or disease. A plant is "threatened" when it is likely to become endangered in the foreseeable future in the absence of protection measures. A plant is "rare" when, although not presently threatened with extinction, the species, subspecies, or variety is found in such small numbers throughout its range that it may be endangered if its environment worsens.[1]

   Rare plant (vegetation) communities are those communities that are of highly limited distribution. These communities may or may not contain special status plants. The most current version of the California Natural Diversity Database's *List of California Terrestrial Natural Communities*[2] should be used as a guide to the names and status of communities.

   Consistent with the California Native Plant Society’s goal of preserving plant biodiversity on a regional and local scale, and with California Environmental Quality Act environmental impact assessment criteria[3], surveys should also assess impacts to locally significant plants. Both plants and plant communities can be considered significant if their local occurrence is on the outer limits of known distribution, a range extension, a rediscovery, or rare or uncommon in a local context (such as within a county or region). Lead agencies should address impacts to these locally unique botanical resources regardless of their status elsewhere in the state.

2. Botanical surveys must be conducted to determine if, or to the extent that, special status or locally significant plants and plant communities will be affected by a proposed project when any natural vegetation occurs on the site and the project has the potential for direct or indirect effects on vegetation.

3. Those conducting botanical surveys must possess the following qualifications:
   a. Experience conducting floristic field surveys;
   b. Knowledge of plant taxonomy and plant community ecology and classification;
   c. Familiarity with the plants of the area, including special status and locally significant plants;

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[1] California Environmental Quality Act Guidelines, §15065 and §15380.
[2] List of California Terrestrial Natural Communities. California Department of Fish and Game Natural Diversity Database. Sacramento, CA.
[3] California Environmental Quality Act Guidelines, Appendix G (Initial Study Environmental Checklist).

d. Familiarity with the appropriate state and federal statutes related to plants and plant collecting; and,
e. Experience with analyzing impacts of a project on native plants and communities.

4. Botanical surveys should be conducted in a manner that will locate any special status or locally significant plants or plant communities that may be present. Specifically, botanical surveys should be:

   a. Conducted in the field at the proper times of year when special status and locally significant plants are both evident and identifiable. When special status plants are known to occur in the type(s) of habitat present in the project area, nearby accessible occurrences of the plants (reference sites) should be observed to determine that the plants are identifiable at the time of survey.

   b. Floristic in nature. A floristic survey requires that every plant observed be identified to species, subspecies, or variety as applicable. In order to properly characterize the site, a complete list of plants observed on the site shall be included in every botanical survey report. In addition, a sufficient number of visits spaced throughout the growing season is necessary to prepare an accurate inventory of all plants that exist on the site. The number of visits and the timing between visits must be determined by geographic location, the plant communities present, and the weather patterns of the year(s) in which the surveys are conducted.

   c. Conducted in a manner that is consistent with conservation ethics and accepted plant collection and documentation techniques[4,5]. Collections (voucher specimens) of special status and locally significant plants should be made, unless such actions would jeopardize the continued existence of the population. A single sheet should be collected and deposited at a recognized public herbarium for future reference. All collections shall be made in accordance with applicable state and federal permit requirements. Photography may be used to document plant identification only when the population cannot withstand collection of voucher specimens.

   d. Conducted using systematic field techniques in all habitats of the site to ensure a thorough coverage of potential impact areas. All habitats within the project site must be surveyed thoroughly in order to properly inventory and document the plants present. The level of effort required per given area and habitat is dependent upon the vegetation and its overall diversity and structural complexity.

   e. Well documented. When a special status plant (or rare plant community) is located, a California Native Species (or Community) Field Survey Form or equivalent written form, accompanied by a copy of the appropriate portion of a 7.5-minute topographic map with the occurrence mapped, shall be completed, included within the survey report, and separately submitted to the California Natural Diversity Database. Population boundaries should be mapped as accurately as possible. The number of individuals in each population should be counted or estimated, as appropriate.

5. Complete reports of botanical surveys shall be included with all environmental assessment documents, including Negative Declarations and Mitigated Negative Declarations, Timber Harvesting Plans, Environmental Impact Reports, and Environmental Impact Statements. Survey reports shall contain the following information:

   a. <u>Project location and description</u>**,** including:

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[4] Collecting Guidelines and Documentation Techniques. California Native Plant Society Policy (adopted March 4, 1995).

[5] Ferren, W.R., Jr., D.L. Magney, and T.A. Sholars. 1995. The Future of California Floristics and Systematics: Collecting Guidelines and Documentation Techniques. *Madroño* 42(2):197-210.

1) A detailed map of the location and footprint of the proposed project.
2) A detailed description of the proposed project, including one-time activities and ongoing activities that may affect botanical resources.
3) A description of the general biological setting of the project area.

b. Methods, including:
1) Survey methods for each of the habitats present, and rationale for the methods used.
2) Description of reference site(s) visited and phenological development of the target special status plants, with an assessment of any conditions differing from the project site that may affect their identification.
3) Dates of surveys and rationale for timing and intervals; names of personnel conducting the surveys; and total hours spent in the field for each surveyor on each date.
4) Location of deposited voucher specimens and herbaria visited.

c. Results, including:
1) A description and map of the vegetation communities on the project site. The current standard for vegetation classification, *A Manual of California Vegetation*[6], should be used as a basis for the habitat descriptions and the vegetation map. If another vegetation classification system is used, the report must reference the system and provide the reason for its use.
2) A description of the phenology of each of the plant communities at the time of each survey date.
3) A list of all plants observed on the project site using accepted scientific nomenclature, along with any special status designation. The reference(s) used for scientific nomenclature shall be cited.
4) Written description and detailed map(s) showing the location of each special status or locally significant plant found, the size of each population, and method used to estimate or census the population.
5) Copies of all California Native Species Field Survey Forms or Natural Community Field Survey Forms and accompanying maps.

d. Discussion**,** including:
1) Any factors that may have affected the results of the surveys (*e.g*., drought, human disturbance, recent fire).
2) Discussion of any special local or range-wide significance of any plant population or community on the site.
3) An assessment of potential impacts. This shall include a map showing the distribution of special status and locally significant plants and communities on the site in relation to the proposed activities. Direct, indirect, and cumulative impacts to the plants and communities shall be discussed.
4) Recommended measures to avoid and/or minimize direct, indirect, and cumulative impacts.

e. References cited and persons contacted.

f. Qualifications of field personnel including any special experience with the habitats and special status plants present on the site.

[6] Sawyer, J.O. and T. Keeler-Wolf. 1995. *A Manual of California Vegetation*. California Native Plant Society. Sacramento, CA. 471 pp.

DESERT RESTORATION: DO SOMETHING OR WAIT A THOUSAND YEARS

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UNDERSTANDING DISTURBANCE

Impacts to the desert can be loosely divided into local and widespread impacts. There is rarely a complete distinction between the two but in general the local impacts include such things as mining, pipelines, roadways, off-highway vehicle impacts, military operations and localized ranching impacts. Widespread impacts to the Mojave Desert include overgrazing, feral animal grazing and trailing, the invasion of non-native plant species, urbanization and its related affects, and the atmospheric deposition of nitrogen from pollution related dryfall. It is unfortunate, but adverse impacts usually lead to further impacts. For example, the increase in surface nitrogen on the desert's surface favors the establishment of exotic plant species, and exotic plant species may increase fire frequencies and intensities with very detrimental effects on native plant communties.

While historical photos, written descriptions and air photos can provide a good first look at above ground disturbance patterns, some of the most important impacts of human activities are the often unseen effects at and below ground level. There are physical, hydrologic, chemical and biological changes after disturbance which make conditions much less favorable for soil microbes and plants. These changes include reduced infiltration and fertility, increased compaction and soil strength, increased erosion and reduced biological activity.

Physical Changes

Construction activities, equipment operation, agriculture, animal trampling and off-road vehicle operation can remove soil surface armor including crusts and gravel mulches. This can dramatically increase wind and water erosion. These activities also degrade soil structure. Even minimal activity can have significant adverse effects on soil structure. Loamy soils are more sensitive to compaction than sandy soil and wet soils are much more vulnerable than dry soils. The strength of soils that have been compacted increases much more quickly than undisturbed soil as the soil dries out. Penetrometer resistance, a measure of soil strength, is as much as 155% higher in single tank tracks than in adjacent, undisturbed soils, and most desert military camp

roads from WWII remain extremely compacted even after 40 years. This increase in soil strength inhibits root growth and limits water and air exchanges at the soil/air interface.

Increasing soil strength reduces root growth and survival and adversely affects soil microbes. The changes in soil structure can reach much deeper than might be expected. Significant adverse changes were observed at 25 cm depth from as little as three passes with a four wheel drive vehicle over moist soil. In some cases soil strength can be significantly increased by one pass, but more commonly the soil strength increases with repeated passes. Values of soil strength after 10 passes of a four wheel drive vehicle on one test day all exceeded 67 kg/cm2, more than three times the minimum amount causing serious reduction in root growth.

Hydrologic Changes

Compaction leads to the destruction of larger soil pores with related, detrimental changes in infiltration. Compaction and tracks also reduce surface storage and often increase the rate of runoff and gully initiation. Soil compaction and modification of the ground surface by tracked vehicle movement and roads leads to long-term changes in drainage patterns and infiltration. Infiltration rates were reduced 56% in a former vehicle parking lot at one desert military camp after more than 30 years.

The removal of vegetation can also reduce infiltration as the plant mediated infiltration benefits (stem flow, litter, etc.) are eliminated. Infiltration in dry creosote bush soil was double that of dry bare soil and infiltration in wet creosote bush soil was almost five times higher than wet bare soil. During intense summer rains these changes in infiltration are accentuated. Areas with good plant cover may hold and save much of the rain that falls in intense storms while areas that have been disturbed experience sheet flow, flash floods and severe erosion. This suggests that fine soil particles and organic matter accumulating beneath the plant canopies improve the water and nutrient retention capacity of desert soils.

Disturbance most commonly limits water infiltration into the soil, reduces surface roughness and surface retention, reduces soil moisture storage for water that makes it into the soil and increases runoff intensity and flood frequency. These can increase gully or stream cutting and lower water tables over extensive areas. Disturbance that removes plants affects soil development and changes soil moisture and structure for soil microbes and plants.

Chemical Changes

Disturbance can also dramatically change soil chemistry. Construction activity or severe erosion can remove the often very thin layer of fertile topsoil, leaving subsoil that is nutrient limited. Disturbance can also add nitrogen, changing the competitive balance between perennials and annuals, exotics and native species. These, in turn, affect soil microbes.

Chemicals that are poisonous to many species may also be introduced. Contamination of agricultural soils and illegal dump-sites with biocides is common. Farmlands may also have excessive nitrate levels. Available phosphorous and other biologically mediated nutrients may be depressed by disturbance and this may limit establishment and growth.

Biological Changes

Disturbance commonly decreases soil organic matter. In plowed field agriculture, repeated tillage, increased soil temperatures and added nitrogen tend to burn off soil organic matter. Less dramatic but equally important changes occur with lower intensity disturbance. Disturbance also eliminates or reduces populations of soil burrowing organisms. Ants, burrowing lizards and mammals may be particularly important for recovery of degraded areas. Compaction and disturbance can also reduce soil organism populations. Total numbers of fungi, bacteria, nematodes and arthropods are much lower on compacted soils. Pathogens were common on the compacted soils and rarely isolated on control plots.

Removal of plants can remove symbiotic soil organisms critical for plant survival. Compaction can also limit infection by mycorrhizae which are unable to extend hyphae into the compacted soil. Changes in soil moisture caused by reduced infiltration and lower moisture holding capacity may make nodulation by rhizobia difficult or impossible. Changes in soil structure and elimination of soil burrowing organisms can limit movement of inocula in the soil.

Surface disturbances also remove cryptobiotic crusts which, when in place, reduce wind and water erosion and evaporative water loss. Crusts also form catchment sites for seed and safe-sites for seedling establishment.

UNDERSTANDING RECOVERY

Extreme temperatures, intense solar radiation, limited moisture and the low fertility of desert soils combine to make natural recovery of disturbed desert sites very slow after disturbance. In addition, conditions for plant establishment are rare and it may take 60 years to reach predisturbance biomass and 180 years for reasonable recovery of species diversity on non-compacted soils. Recovery times for compacted and severely disturbed soils may reach 1000 years or more.

RESTORATION DECISIONS

Often the most difficult step in restoration is removal of the source of the impact. This often means changes in current land use patterns and can include the removal of feral animals, grazing restriction or removal, route designation for off-highway vehicles and road closures.

Once the source of the impact has been removed, site rehabilitation can proceed. However, tough choices have to be made in most desert restoration projects. The cost of comprehensive rehabilitation including site preparation, seed collection, plant propagation and care, outplanting and site maintenance may well exceed $10,000 per acre. This far outweighs the value of the land ($300/acre). Except in rare cases, the best that can be done is a modest rehabilitation to facilitate natural recovery. This would typically include decompaction, adding weed free compost to some spots, it may also include pitting and surface roughening, seeding with site collected seeds, and very limited container planting with tree shelters and supplemental deep pipe irrigation (as a future seed source and resource island). For $500 - $2000 an acre these strategies can improve visual appearance and speed recovery.

Other restoration strategies include removal of exotic species with the use of herbicides and/or fire and visual restoration using an artificial surficial coloring compound. However, it should be recognized that with all rehabilitation efforts, even the most limited is costly, labor intensive and time consuming. It is also true that even after site rehabilitation is complete it may still take decades or longer for a site to recover all of its components and functions. For these reasons, it is always better to prevent disturbance than to attempt to restore a damaged site.

CHALLENGES IN RESTORATION

Many organizations in the Mojave Desert have demonstrated the desire and ability to restore damaged lands. However, desert restorationists face several significant challenges. First, there is no complete understanding of the extent and type of disturbances that exist in the desert. Without this information, it is difficult to assess the highest priority restoration needs. Second, there is very limited funding available for restoration projects. Third, there are currently only a few skilled restoration specialists in the desert either in private industry or in government employment. Fourth, the most affective and cost efficient restoration techniques have not been determined. Lastly, there is only a limited supply of appropriate seed and plant material for restoration projects. Two regional working teams, the Desert Lands Restoration Task Force and the Southern Nevada Restoration Team, are working collaboratively and across management boundaries to address these restoration needs.

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Tanya A. Gulesserian

From: Miriam Rodriguez [MRODRIGUEZ@dfg.ca.gov]
Sent: Thursday, May 27, 2010 4:05 PM
To: Lacy Bauer
Subject: PRA 10-05-152 Rosamond Wastewater Treatment
Attachments: content.pdf

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ES LOG

LOG NUMBER	19991113	OLD NUMBER	993893
LOG DATE	10/19/1999		
DATE RECEIVED	10/18/1999		
DATE DUE	11/8/1999		
DATE DUE TO ES			
LEAD AGENCY	R C S D		
COUNTY	KERN		
STAGE OF DEV.	IS		
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KEYWORD SEARCH

SHELF LABEL | BOX LABEL

KEYWOR
KER.ROSAMOND WW TREATMENT PLANT EXP

REVIEWER:

KEYWORD 2	APN 471-190-09, 27, 28, 32, 33	ACTION	NCNR
KEYWORD 3	(ROSAMOND COMMUNITY SERVICES DIST)	LOG OUT DATE	10/21/1999
KEYWORD 4	XREF:ROSAMOND WW TREATMNT EXPANSION	FILE LOCATION:	

LAST | NEW | TEMP TIME | CLERICAL TIME | ENV. SPEC.TIME:

Attention:

Action Take
( ) Comment
( ) No Comment
( ) Not Reviewed

Time:
ENV. SPEC
TEMP HELP:
CLERICAL:

Response:
( ) Letter
( ) Initial Study Form
( ) No Response

Reviewer:

Date:

Place File
( ) Shelf
( ) Box

4/3/06

Environmental Document Review

Project Coversheet

Tracking Number: CEQA 2006 0244 R4

Project Name: Rosamond Community Services District Wastewater Treatment Plant Expansion

Date Received: 3/6/2006 **Document Type:** NEG

Date Entered: 3/7/2006 **SCH Number:** 1999101037

Date Due: 4/3/2006 **File Location:** 5 .2 .18 .2006 .1 .993893

Date To ES: 3/23/2006 **Reviewer:** Tenneboe, Annette

Lead Agency: Rosamond Community Services District **Action Date:**

County: Kern **Action:**

Project Remarks: **Total Hours:** 0

The proposed project would entail the expansion of the Rosamond Community Services District Wastewater Treatment Plant. Improvements would include adding treatment capacity and effluent disposal facilities. The initial expansion will provide an additional 0.5 million gallons per day (MGD) of capacity; however, the facilities will be expandable to an

Attention:

Action Taken:
( ) Comment
( ) No Comment
(✓) Not Reviewed

Time: 2.5
ENV. SPEC: .5
TEMP HELP: .5 JK
CLERICAL: .15 KK + .15 DT

Reviewer: AT

Date: 6/20/06

Response:
( ) Letter
( ) Initial Study Form
(✓) No Response

Place File:
(X) Shelf
( ) Box

Proposal to expand Rosamond waste water treatment plant. Overlap w/ occurrence/range of Alkali mariposa lily. Close to snowy plover, Tricolor BB, Mohave ground squirrel, burrowing owl. Also, other occurrence of Alkali Mar. lily in vicinity

Wednesday, March 08, 2006

MITIGATION

- ☐ No Mitigation Needed
- ☐ Mitigation Adequate
- ☐ Mitigation Required

REVIEW ACTION

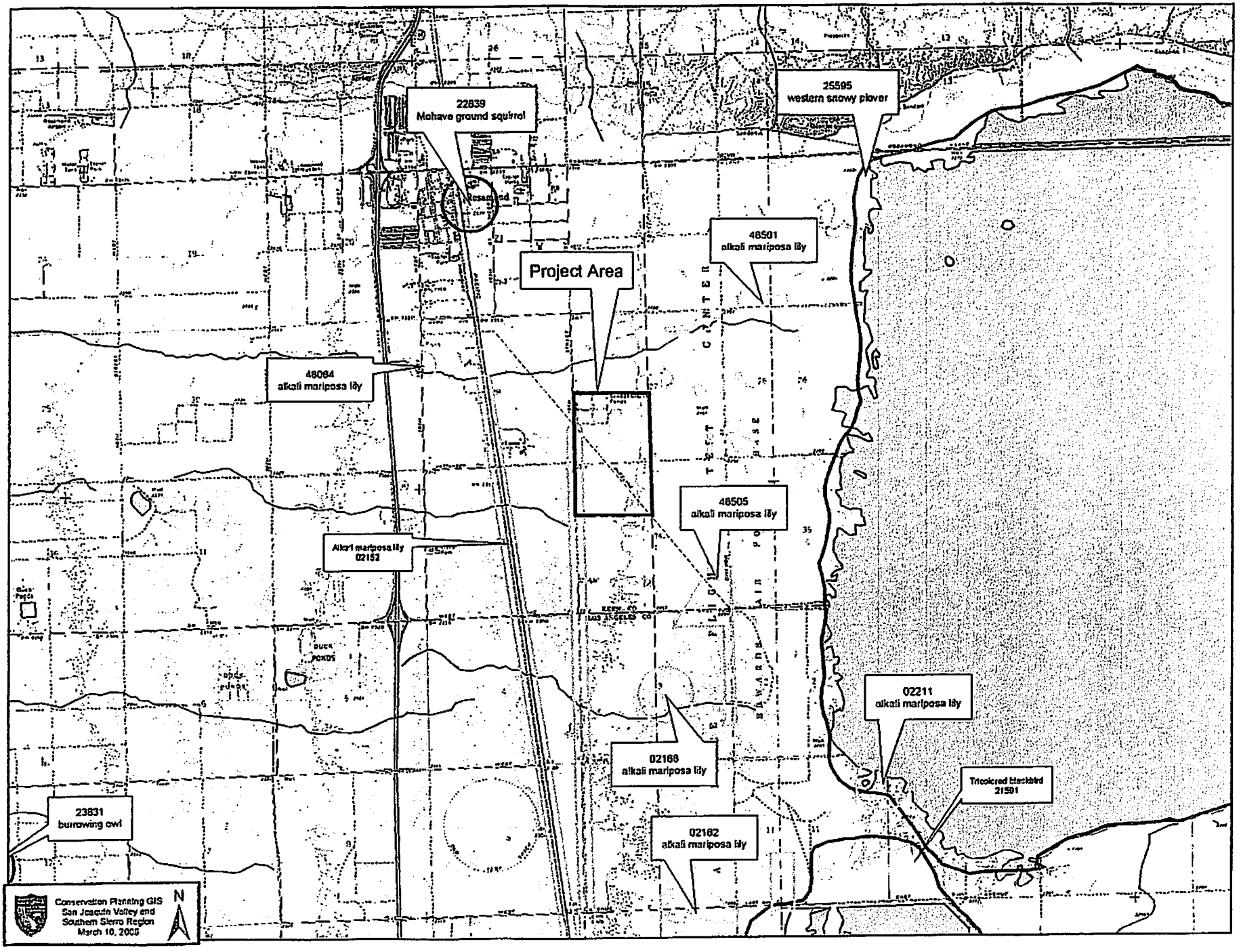
- ☐ Comments Sent
- ☐ De Minimis – Upheld
- ☐ De Minimis Overturned – General Knowledge of Area
- ☐ De Minimis Overturned – Initial Study/Checklist
- ☐ De Minimis Overturned – Legal Presumption Not Rebutted
- ☐ De Minimis Overturned – Previous Consultation/Comment
- ☐ Forwarded
- ☐ Handled by E-mail
- ☐ Handled by Phone
- ☐ Letter Sent
- ☐ Met with Applicant
- ☐ No Comment
- ☐ Not Reviewed – No Time
- ☐ Not Reviewed – Other
- ☐ Oral Testimony

REVIEW TYPE

- ☐ Cursory Review
- ☐ Desk Review
- ☐ Full Desk Review
- ☐ Field Review
- ☐ Public Hearing
- ☐ Meeting
- ☐ 3158 Audit

NOTES

CEQA 2006 0244 R4



Send To Printer Back To TerraServer Change to 11x17 Print Size Show Grid Lines Change to Landscape

USGS 14 km N of Lancaster, California, United States 02 Jun 1994

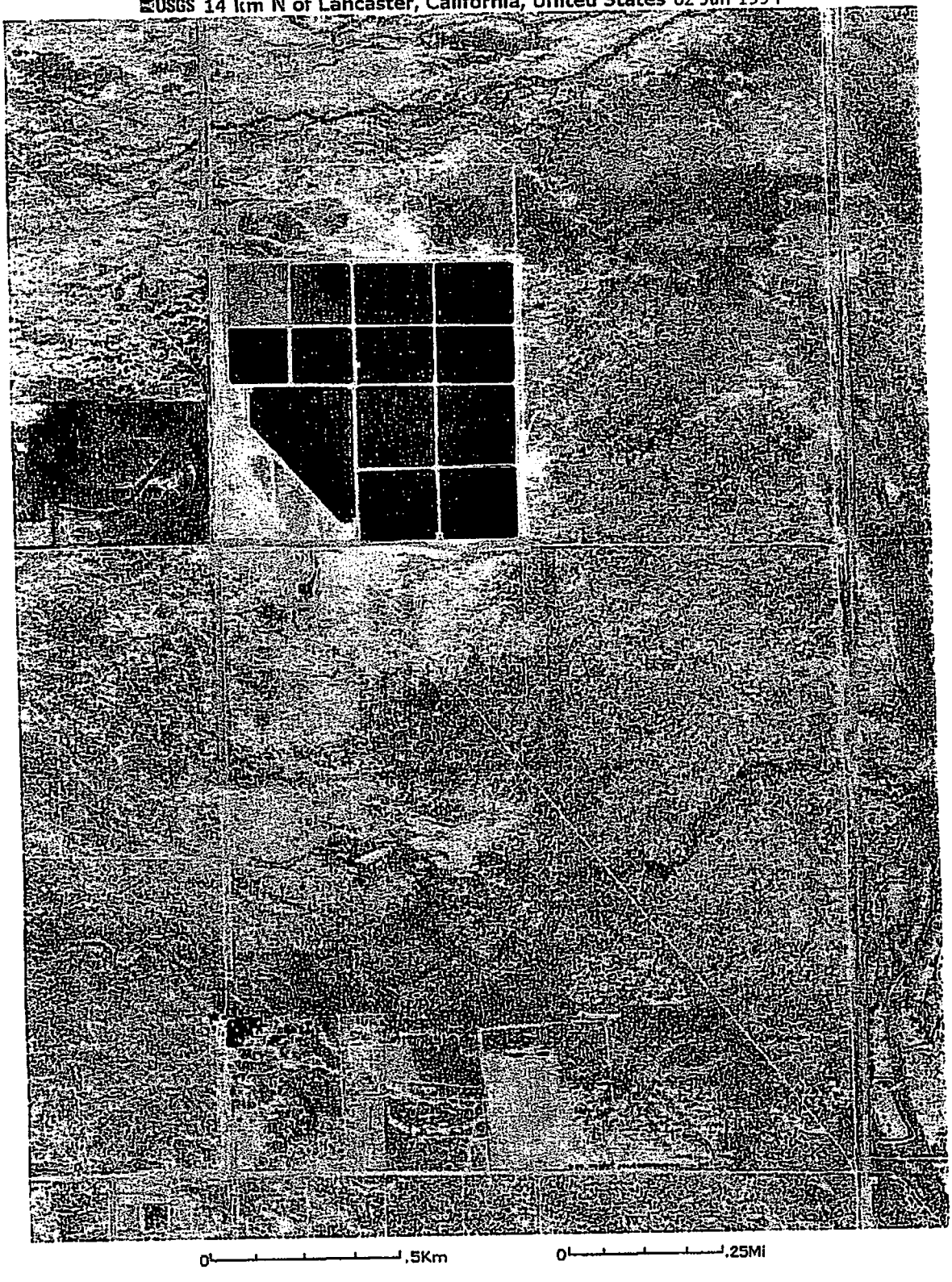


Image courtesy of the U.S. Geological Survey

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Agelaius tricolor

tricolored blackbird

Element Code: ABPBXB0020

Status
Federal: None
State: None

NDDB Element Ranks
Global: G2G3
State: S2

Other Lists
CDFG Status: SC

Habitat Associations
General: (NESTING COLONY) HIGHLY COLONIAL SPECIES, MOST NUMBEROUS IN CENTRAL VALLEY & VICINITY, LARGELY ENDEMIC TO CALIFORNIA.
Micro: REQUIRES OPEN WATER, PROTECTED NESTING SUBSTRATE, & FORAGING AREA WITH INSECT PREY WITHIN A FEW KM OF THE COLONY

Occurrence No. 205 Map Index: 21591 EO Index: 8777

Occ Rank: Good
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: CHICHESTER, M. 1992 (OBS)

Dates Last Seen
Element: 1995-05-20
Site: 1995-05-20
Record Last Updated: 2004-05-07

Quad Summary: ROSAMOND LAKE (3411871/166D), ROSAMOND (3411872/166C)
County Summary: LOS ANGELES

Lat/Long: 34.78832° / -118.11670°
UTM: Zone-11 N3850137 E397835
Area: 758.4 ac
Elevation: 2,281 ft

Mapping Precision: NON-SPECIFIC
Symbol Type: POLYGON

Township: 09N
Range: 12W
Section: 14 Qtr: XX
Meridian: S

Location: PIUTE MARSH, ON THE SW EDGE OF ROSAMOND LAKE (BED), EDWARDS AIR FORCE BASE, NORTH OF LANCASTER.

Ecological: FRESHWATER MARSH SURROUNDED BY SEMI-DESERT HABITAT. BIRDS NESTING IN CATTAILS. BIRDS FORAGING OVER A MILE AWAY IN FIELDS FOR RIGHT GREEN CATEPILLARS

General: 30 MAY 1992: NESTING COLONY OBSERVED BY CHICHESTER. NUMBER OF BIRDS UNKNOWN. 400 OBSERVED NESTING ON 23 APR 1995 BY HEATH. ON 20 MAY 1995 MANY FAMILY GROUPS OBSERVED FEEDING FLEDGLINGS.

Owner/Manager: DOD-EDWARDS AFB

Athene cunicularia

burrowing owl

Element Code: ABNSB10010

Status	NDDB Element Ranks	Other Lists
Federal: None	Global: G4	CDFG Status: SC
State: None	State: S2	

Habitat Associations

General: (BURROW SITES) OPEN, DRY ANNUAL OR PERENIAL GRASSLANDS, DESERTS & SCRUBLANDS CHARACTERIZED BY LOW-GROWING VEGETATION.

Micro: SUBTERRANEAN NESTER, DEPENDENT UPON BURROWING MAMMALS, MOST NOTABLY, THE CALIFORNIA GROUND SQUIRREL.

Occurrence No. 166 Map Index: 23831 EO Index: 17755

Occ Rank: Good
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: MALLORY, J. & I. ANDERSON 1993 (OBS)

Dates Last Seen
Element: 1993-05-28
Site: 1993-05-28
Record Last Updated: 1993-07-20

Quad Summary: ROSAMOND (3411872/166C)
County Summary: LOS ANGELES

Lat/Long: 34.79756° / -118.21941°
UTM: Zone-11 N3851271 E389450
Radius: 1/5 mile
Elevation: 2,360 ft

Mapping Precision: NON-SPECIFIC
Symbol Type: POINT

Township: 08N
Range: 13W
Section: 12 Qtr: SW
Meridian: S

Location: EAST SIDE OF 50TH STREET WEST, 0.5 MILE SOUTH OF WEST AVENUE B, 5 MILES SW OF ROSAMOND.

Location Detail: BURROW SITE LOCATED ALONG ROAD BETWEEN AGRICULTURAL FIELD AND SALTBUSH SCRUB HABITAT.

Ecological: HABITAT CONSISTS OF SALTBUSH SCRUB, SURROUNDED BY AGRICULTURAL FIELDS AND IRRIGATION RUN-OFF AREAS.

General: 10 FLEDGLINGS OBSERVED, SOME ROOSTING ON AN ATRIPLEX BUSH.

Owner/Manager: UNKNOWN

Calochortus striatus

alkali mariposa lily — Element Code: PMLIL0D190

Status	NDDB Element Ranks	Other Lists
Federal: None	Global: G2	CNPS List: 1B
State: None	State: S2.2	R-E-D Code: 2-2-2

Habitat Associations

General: CHAPARRAL, CHENOPOD SCRUB, MOJAVEAN DESERT SCRUB, MEADOWS

Micro: ALKALINE MEADOWS AND EPHEMERAL WASHES. 90-1595M.

Occurrence No. 19 Map Index: 02211 EO Index: 22109

Occ Rank: Fair
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: U.S. AIR FORCE 1984 (MAP)

Dates Last Seen
Element: 1998-05-01
Site: 1998-05-01
Record Last Updated: 1995-11-15

Quad Summary: ROSAMOND LAKE (3411871/186D)
County Summary: LOS ANGELES

Lat/Long: 34.80359° / -118.11369°
UTM: Zone-11 N3851827 E398129
Radius: 1/5 mile
Elevation: 2,275 ft
Mapping Precision: NON-SPECIFIC
Symbol Type: POINT
Township: 09N
Range: 12W
Section: 12 Qtr: NW
Meridian: S

Location: SW END OF ROSAMOND LAKE - EDWARDS AFB.

Ecological: IN SLIGHTLY ELEVATED BENCHES ABOVE ROSAMOND LAKE; WITHIN 100 FT OF LAKEBED IN MOST PLACES.

General: 5 PLANTS SEEN IN 1988.

Owner/Manager: DOD-EDWARDS AFB

Occurrence No. 20 Map Index: 02182 EO Index: 22106

Occ Rank: Good
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: U.S. AIR FORCE 1984 (MAP)

Dates Last Seen
Element: 1995-05-21
Site: 1995-05-21
Record Last Updated: 2002-08-08

Quad Summary: ROSAMOND LAKE (3411871/186D), ROSAMOND (3411872/186C)
County Summary: LOS ANGELES

Lat/Long: 34.79112° / -118.13424°
UTM: Zone-11 N3850465 E396234
Area: 121.6 ac
Elevation: 2,290 ft
Mapping Precision: SPECIFIC
Symbol Type: POLYGON
Township: 09N
Range: 12W
Section: 15 Qtr: NE
Meridian: S

Location: JUNCTION OF WEST AVE & DIVISION STREET - EDWARDS AFB.

Location Detail: THREE POLYGONS MAPPED WEST OF PIUTE PONDS.

Ecological: IN HALOPHYTIC PHASE SALTBUSH SCRUB.

Threat: LITTER AND SMALL AMOUNTS OF TRASH DUMPING ADJACENT TO ROAD. MILITARY OPERATIONS MAY THREATEN.

General: FEW DOZEN PLANTS SEEN IN 1978, 26 PLANTS COUNTED IN 1988, BUT MANY MORE SEEN. IN 1995 2633 PLANTS OBSERVED OVER 43 HECTARES.

Owner/Manager: DOD-EDWARDS AFB

Occurrence No. 21 Map Index: 02168 EO Index: 22108

Occ Rank: Excellent
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: U.S. AIR FORCE 1984 (MAP)

Dates Last Seen
Element: 1988-05-01
Site: 1988-05-01
Record Last Updated: 1995-11-15

Quad Summary: ROSAMOND (3411872/185C)
County Summary: LOS ANGELES

Lat/Long: 34.81275° / -118.13696°
UTM: Zone-11 N3852889 E395629
Radius: 1/5 mile
Elevation: 2,295 ft
Mapping Precision: NON-SPECIFIC
Symbol Type: POINT
Township: 09N
Range: 12W
Section: 03 Qtr: SE
Meridian: S

Location: 0.5 MI W OF DIVISION ST & 0.5 MI N OF WEST AVE - EDWARDS AFB.

General: FEW DOZEN PLANTS SEEN IN 1978, 289 SEEN IN 1988.

Owner/Manager: DOD-EDWARDS AFB

Calochortus striatus

alkali mariposa lily

Element Code: PMLIL0D190

Status	NDDB Element Ranks	Other Lists
Federal: None	Global: G2	CNPS List: 1B
State: None	State: S2.2	R-E-D Code: 2-2-2

Habitat Associations

General: CHAPARRAL, CHENOPOD SCRUB, MOJAVEAN DESERT SCRUB, MEADOWS

Micro: ALKALINE MEADOWS AND EPHEMERAL WASHES. 90-1595M

Occurrence No. 23 Map Index: 02152 EO Index: 29484

Occ Rank: Fair
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: BROWN, L. ET AL 1995 (OBS)

Dates Last Seen
Element: 2000-05-17
Site: 2000-05-17
Record Last Updated: 2002-06-06

Quad Summary: LANCASTER WEST (3411862/161B), ROSAMOND (3411872/165C)
County Summary: KERN, LOS ANGELES

Lat/Long: 34.77934° / -118.14915°
UTM: Zone-11 N3849174 E394655
Area: 773.2 ac
Elevation: 2,310 ft

Mapping Precision: SPECIFIC
Symbol Type: POLYGON

Township: 09N
Range: 12W
Section: 16 Qtr: E
Meridian: S

Location: ALONG THE SIERRA HIGHWAY NORTH OF LANCASTER, FROM JUST SOUTH OF AVENUE G NORTH PAST PATTERSON ROAD.

Location Detail: FREQUENT FOR ABOUT 8 MILES ALONG THE HIGHWAY, MOSTLY ALONG THE EAST SIDE OF THE SOUTHERN PACIFIC RAIL ROAD RIGHT OF WAY, WITH A FEW PLANTS TO THE WEST. ALSO FOUND ALONG AT&T RIGHT-OF-WAY (10TH STREET) FROM PATTERSON ROAD TO AVENUE G

Ecological: FOUND ON SILT/CAKED MUD, IN OPEN SPACES BETWEEN SHRUBS AND ON EDGES OF SALT PANS AND MINI ALKALI PLAYAS. ASSOCIATED WITH ANNUAL GRASSES, ATRIPLEX CANESCENS, CHRYSOTHAMNUS NAUSEOSUS, DISTICHLIS SPICATA, LASTHENIA CALIFORNICA, AND WEEDY SPP.

Threat: MOSTLY IN ROAD AND RR RIGHT OF WAY, SOME GRADING AND TRASH DUMPING, POSSIBLE DEVELOPMENT.

General: THOUSANDS OF PLANTS IN 1995. LEAVES OF SEVERAL HUNDRED PLANTS FREQUENT IN GROUPS. INCLUDES FORMER OCCURRENCE #24. 2500 PLANTS IN SMALL CLUMPS IN 1998 ALONG AT&T R-O-W. 25+ PLANTS IN 2000 AT SIERA HWY & AVE G AND 100+ ALONG AT&T R-O-W.

Owner/Manager: PVT, PVT-AT&T

Occurrence No. 45 Map Index: 48064 EO Index: 48064

Occ Rank: Unknown
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: LAPRE & CAMPBELL SN UCR (HERB)

Dates Last Seen
Element: 1988-XX-XX
Site: 1988-XX-XX
Record Last Updated: 2002-06-06

Quad Summary: ROSAMOND (3411872/165C)
County Summary: KERN

Lat/Long: 34.84534° / -118.16706°
UTM: Zone-11 N3856513 E393301
Radius: 1/10 mile
Elevation: 2,320 ft

Mapping Precision: NON-SPECIFIC
Symbol Type: POINT

Township: 09N
Range: 12W
Section: 28 Qtr: NW
Meridian: S

Location: ROSAMOND, EAST SIDE OF 20TH STREET WEST, 0.3 MILE SOUTH OF MARIE AVENUE

Location Detail: MAPPED ALONG 20TH STREET WEST, 0.3 MILE SOUTH OF MARIE AVENUE.

General: UNKNOWN NUMBER OF PLANTS SEEN IN 1988

Owner/Manager: UNKNOWN

Calochortus striatus

alkali mariposa lily

Element Code: PMLIL0D190

Status	NDDB Element Ranks	Other Lists
Federal: None	Global: G2	CNPS List: 1B
State: None	State: S2.2	R-E-D Code: 2-2-2

Habitat Associations

General: CHAPARRAL, CHENOPOD SCRUB, MOJAVEAN DESERT SCRUB, MEADOWS.

Micro: ALKALINE MEADOWS AND EPHEMERAL WASHES. 90-1595M

Occurrence No. 70 Map Index: 48501 EO Index: 48501

Occ Rank: Excellent
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: TETRA TECH 1995 (LIT)

Dates Last Seen
Element: 1995-05-12
Site: 1995-05-12
Record Last Updated: 2002-09-13

Quad Summary: ROSAMOND LAKE (3411871/186D), ROSAMOND (3411872/186C)
County Summary: KERN

Lat/Long: 34.84344° / -118.13809°
UTM: Zone-11 N3856272 E395947
Area: 51.0 ac
Elevation: 2,290 ft
Mapping Precision: SPECIFIC
Symbol Type: POLYGON
Township: 09N
Range: 12W
Section: 27 Qtr: E
Meridian: S

Location: 2 MILES SOUTHEAST OF ROSAMOND, EAST OF HIGHWAY 14 AND SOUTH OF ROSAMOND BLVD, EDWARDS AIR FORCE BASE.

Location Detail: 8 POLYGONS LOCATED EAST OF SEWAGE DISPOSAL PONDS AND PIPELINE. MAPPED WITHIN THE S 1/2 OF THE SW 1/4 OF SECTION 23, THE SW 1/4 OF THE SW 1/4 OF SECTION 26, AND THE E 1/2 OF SECTION 27.

Ecological: IN HALOPHYTIC PHASE SALTBUSH SCRUB

Threat: MILITARY OPERATIONS MAY THREATEN.

General: IN 1995 63,789 PLANTS OBSERVED BETWEEN THIS OCCURRENCE AND OCCURRENCE #79.

Owner/Manager: DOD-EDWARDS AFB

Occurrence No. 79 Map Index: 48505 EO Index: 48505

Occ Rank: Excellent
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: TETRA TECH 1995 (LIT)

Dates Last Seen
Element: 1995-XX-XX
Site: 1995-XX-XX
Record Last Updated: 2002-08-08

Quad Summary: ROSAMOND (3411872/186C)
County Summary: KERN, LOS ANGELES

Lat/Long: 34.82108° / -118.13358°
UTM: Zone-11 N3853787 E396331
Area: 96.8 ac
Elevation: 2,290 ft
Mapping Precision: SPECIFIC
Symbol Type: POLYGON
Township: 09N
Range: 12W
Section: 34 Qtr: SE
Meridian: S

Location: ALONG DIVISION STREET 0.3 MILE NORTH TO 0.8 MILE SOUTH OF KERN/LA COUNTY LINE, EAST OF HIGHWAY 14, SSE OF ROSAMOND.

Location Detail: MAPPED MOSTLY WITHIN THE SE 1/4 OF SECTION 34 AND THE NE 1/4 OF SECTION 3.

Ecological: IN HALOPHYTIC PHASE SALTBUSH SCRUB.

Threat: MILITARY OPERATIONS MAY THREATEN.

General: IN 1995 63,789 PLANTS OBSERVED BETWEEN THIS OCCURRENCE AND OCCURRENCE #78

Owner/Manager: DOD-EDWARDS AFB

Charadrius alexandrinus nivosus

western snowy plover

Element Code: ABNNB03031

Status	NDDB Element Ranks	Other Lists
Federal: Threatened	Global: G4T3	CDFG Status: SC
State: None	State: S2	

Habitat Associations

General: (NESTING) FEDERAL LISTING APPLIES ONLY TO THE PACIFIC COASTAL POPULATION.

Micro: SANDY BEACHES, SALT POND LEVEES & SHORES OF LARGE ALKALI LAKES. NEEDS SANDY, GRAVELLY OR FRIABLE SOILS FOR NESTING.

Occurrence No. 94 Map Index: 25595 EO Index: 5474

Occ Rank: Unknown
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: PAGE, G. & L. STENZEL 1981 (LIT)

Dates Last Seen
Element: 1978-XX-XX
Site: 1978-XX-XX
Record Last Updated: 1995-11-14

Quad Summary: ROSAMOND LAKE (3411871/188D)
County Summary: KERN, LOS ANGELES

Lat/Long: 34.83327° / -118.07261°
UTM: Zone-11 N3855078 E401922
Area: 14,100.0 ac
Elevation: 2,275 ft

Mapping Precision: NON-SPECIFIC
Symbol Type: POLYGON

Township: 09N
Range: 11W
Section: XX Qtr: XX
Meridian: S

Location: ROSAMOND LAKE, EDWARDS AIR FORCE BASE.

Location Detail: SIX PLOVERS SEEN ON THE UNVEGETATED EAST SHORELINE. THEY WERE BELIEVED TO BE BREEDING ALTHOUGH NO NESTS OR BROODS WERE FOUND.

Ecological: THE LAKE IS USUALLY DRY, BUT DURING THE SURVEY PERIOD 25% OF THE LAKEBED WAS FLOODED BY FRESH-TASTING, SILT-LADEN WATER.

General: SIX ADULTS OBSERVED SOMETIME BETWEEN APRIL 26 & JULY 13, 1978.

Owner/Manager: DOD-EDWARDS AFB

Spermophilus mohavensis

Mohave ground squirrel — Element Code: AMAFB05150

Status	NDDB Element Ranks	Other Lists
Federal: None	Global: G2G3	CDFG Status:
State: Threatened	State: S2S3	

Habitat Associations

General: OPEN DESERT SCRUB, ALKALI SCRUB & JOSHUA TREE WOODLAND. ALSO FEEDS IN ANNUAL GRASSLANDS. RESTRICTED TO MOHAVE DESERT.

Micro: PREFERS SANDY TO GRAVELLY SOILS, AVOIDS ROCKY AREAS. USES BURROWS AT BASE OF SHRUBS FOR COVER. NESTS ARE IN BURROWS.

Occurrence No. 281 Map Index: 22839 EO Index: 7874

Occ Rank: Unknown
Origin: Natural/Native occurrence
Presence: Presumed Extant
Trend: Unknown
Main Source: CLARK, D. 1992 (PERS)

Dates Last Seen
Element: 1973-XX-XX
Site: 1973-XX-XX
Record Last Updated: 1993-02-18

Quad Summary: ROSAMOND (3411872/166C)
County Summary: KERN

Lat/Long: 34.85094° / -118.16107°
UTM: Zone-11 N3858236 E393868
Radius: 1/5 mile
Elevation: 2,325 ft

Mapping Precision: NON-SPECIFIC
Symbol Type: POINT

Township: 09N
Range: 12W
Section: 21 Qtr: NW
Meridian: S

Location: ROSAMOND, APPROXIMATELY 100 METERS EAST OF SIERRA HIGHWAY.

General: UNKNOWN NUMBER OF SQUIRRELS DETECTED BY RECHT IN 1973 (DC239).

Owner/Manager: UNKNOWN

1999101037

5 2 18 993893

(2006) 0244

Mail to: State Clearinghouse, 1400 Tenth Street, Room 121, Sacramento, CA 95814 — 916/445-0613

Notice of Completion and Environmental Document Transmittal Form

See NOTE below
SCH # _____

1. Project Title: Rosamond Community Services District, Wastewater Treatment Plant Expansion
2. Lead Agency: Rosamond Community Services District
3. Contact Person: Sherry DeLong
3a. Street Address: 2700 - 20th Street West
3b. City: Rosamond
3c. County: Kern
3d. Zip: 93560
3e. Phone: (661) 256-3411

Project Location

4. County: Kern
4a. City/Community: Rosamond
4b. Assessor's Parcel No. 471-190-(09,27,28,32,33)
4c. Section: 27,34 Twp. 9N Range: 12W Base: SBBM
5a. Cross Streets: Barrerson Rd & Sierra Hwy
5b. For Rural, Nearest Community: Rosamond
6. Within 2 Miles: a. State Hwy #: 14
b. Airports: _____
c. Railways: Southern Pacific (SPRR)
d. Waterways: _____

7. Document Type

CEQA:
- ☐ 01. NOP
- ☐ 02. Early Cons
- ☒ 03. Neg Dec
- ☐ 04. Draft EIR
- ☐ 05. Supplement/Subsequent EIR (Prior SCH No.)_____
- ☐ 06. NOE
- ☐ 07. NOC
- ☐ 08. NOD

NEPA:
- ☐ 09. NOI
- ☐ 10. FONSI
- ☐ 11. Draft EIS
- ☐ 12. EA

Other:
- ☐ 13. Joint Document
- ☐ 14. Final Document
- ☐ 15. Other_____

8. Local Action Type

- ☐ 01. General Plan Update
- ☐ 02. New Element
- ☐ 03. General Plan Amendment
- ☐ 04. Master Plan
- ☐ 05. Annexation
- ☐ 06. Specific Plan
- ☐ 07. Community Plan
- ☐ 08. Redevelopment
- ☐ 09. Rezone
- ☐ 10. Land Division (Subdivision, Parcel Map, Tract Map, etc.)
- ☐ 11. Use Permit
- ☐ 12. Waste Mgmt Plan
- ☐ 13. Cancel Ag Preserve
- ☐ 14. Other_____

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9. Development Type

- ☐ 01. Residential: Units____ Acres____
- ☐ 02. Office: Sq.ft.____ Acres____ Employees____
- ☐ 03. Shopping/Commercial: Sq.ft.____ Acres____ Employees____
- ☐ 04. Industrial: Sq.ft.____ Acres____ Employees____
- ☐ 05. Water Facilities: Type_____ MGD____
- ☐ 06. Transportation: Type_____
- ☐ 07. Mining: Mineral _____
- ☐ 08. Power: Type_____ Watts____
- ☒ 09. Waste Treatment: Type Wastewater Treatment Plant
- ☐ 10. OCS Related _____
- ☐ 11. Other:_____

10. Total Acres: 16
11. Total Jobs Created: N/A

12. Project Issues Discussed in Document

- ☐ 01. Aesthetic/Visual
- ☐ 02. Agricultural Land
- ☐ 03. Air Quality
- ☐ 04. Archeological/Historical
- ☐ 05. Coastal Zone
- ☐ 06. Economic
- ☐ 07. Fire Hazard
- ☐ 08. Flooding/Drainage
- ☐ 09. Geologic/Seismic
- ☐ 10. Jobs/Housing Balance
- ☐ 11. Minerals
- ☒ 12. Noise
- ☐ 13. Public Services
- ☐ 14. Schools
- ☐ 15. Septic Systems
- ☐ 16. Sewer Capacity
- ☐ 17. Social
- ☐ 18. Soil Erosion
- ☐ 19. Solid Waste
- ☐ 20. Toxic/Hazardous
- ☒ 21. Traffic/Circulation
- ☐ 22. Vegetation
- ☐ 23. Water Quality
- ☐ 24. Water Supply
- ☐ 25. Wetland/Riparian
- ☐ 26. Wildlife
- ☐ 27. Growth Inducing
- ☐ 28. Incompatible Landuse
- ☐ 29. Cumulative Effects
- ☐ 30. Other _____

13. Funding (approx.): Federal $_____ State $_____ Total $_____

14. Present Land Use and Zoning: The property is part of the existing Rosamond Community Services District Wastewater Treatment Plant. The surrounding property consists of vacant land.

15. Project Description: The proposed project would entail the expansion of the Rosamond Community Services District Wastewater Treatment Plant. Improvements would include adding treatment capacity and effluent disposal facilities. The initial expansion will provide an additional 0.5 million gallons per day (MGD) of capacity; however, the facilities will be expandable to an ultimate capacity of 1.0 MGD. R. 7/1

MAR 2006
Received
Fish & Game
Region 4

State Clearinghouse Contact: (916) 445-0613 SL

State Review Began: 3 . 2 . 2006

SCH COMPLIANCE 4 . 3 . 2006

Please note State Clearinghouse Number (SCH#) on all Comments

SCH#: 1999101037

Please forward late comments directly to the Lead Agency

AQMD/APCD 11

(Resources: 3 / 4)

Project Sent to the following State Agencies

- X Resources
- ____ Boating & Waterways
- ____ Coastal Comm
- ____ Colorado Rvr Bd
- X Conservation
- X Fish & Game # 4
- ____ Delta Protection Comm
- ____ Forestry & Fire Prot
- ____ Historic Preservation
- X Parks & Rec
- ____ Reclamation Board
- ____ Bay Cons & Dev Comm
- X DWR
- ____ OES (Emergency Svcs)

Bus Transp Hous
- ____ Aeronautics
- X CHP
- X Caltrans # 9
- ____ Trans Planning
- ____ Housing & Com Dev
- ____ Food & Agriculture
- X Health Services

State/Consumer Svcs
- ____ General Services

Cal EPA
- ____ ARB - Airport Projects
- ____ ARB - Transportation Projects
- ____ ARB - Major Industrial Projects
- ____ Integrated Waste Mgmt Bd
- X SWRCB: Clean Wtr Prog
- ____ SWRCB: Wtr Quality
- ____ SWRCB: Wtr Rights
- X Reg. WQCB # 6V
- ____ Toxic Sub Ctrl-CTC

Yth/Adlt Corrections
- ____ Corrections

Independent Comm
- ____ Energy Commission
- X NAHC
- X Public Utilities Comm
- ____ State Lands Comm
- ____ Tahoe Rgl Plan Agency
- ____ _____ Conservancy

1999101037

Mail to: State Clearinghouse, 1400 Tenth Street, Room 121, Sacramento, CA 95814 — 916/445-0613

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2. Lead Agency: Rosamond Community Services District
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3a. Street Address: 2700 - 20th Street West
3b. City: Rosamond
3c. County: Kern
3d. Zip: 93560
3e. Phone: (661) 256-3411

Project Location

4. County: Kern
4a. City/Community: Rosamond
4b. Assessor's Parcel No. 471-190-(09,27,28,32,33)
4c. Section: 27,34 Twp. 9N Range: 12W Base: SBBM
5a. Cross Streets: Patterson Rd & Sierra Hwy
5b. For Rural, Nearest Community: Rosamond
6. Within 2 Miles: a. State Hwy #: 14
b. Airports: _____
c. Railways: Southern Pacific (SPRR)
d. Waterways: _____

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CEQA:
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- ☐ 07. Early Cons
- ☒ 03. Neg Dec
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- ☐ 10. FONSI
- ☐ 11. Draft EIS
- ☐ 12. EA

Other:
- ☐ 13. Joint Document
- ☐ 14. Final Document
- ☐ 15. Other_____

8. Local Action Type

- ☐ 01. General Plan Update
- ☐ 02. New Element
- ☐ 03. General Plan Amendment
- ☐ 04. Master Plan
- ☐ 05. Annexation
- ☐ 06. Specific Plan
- ☐ 07. Community Plan
- ☐ 08. Redevelopment
- ☐ 09. Rezoning
- ☐ 10. Land Division (Subdivision, Parcel Map, Tract Map, etc.)
- ☐ 11. Use Permit
- ☐ 12. Waste Mgmt Plan
- ☐ 13. Cancel Ag Preserve
- ☐ 14. Other_____

RECEIVED
MAR - 2 2006
STATE CLEARING HOUSE

9. Development Type

- ☐ 01. Residential: Units____ Acres____
- ☐ 02. Office: Sq.ft.____ Acres____ Employees____
- ☐ 03. Shopping/Commercial: Sq.ft.____ Acres____ Employees____
- ☐ 04. Industrial: Sq.ft.____ Acres____ Employees____
- ☐ 05. Water Facilities: Type_____ MGD____
- ☐ 06. Transportation: Type_____
- ☐ 07. Mining: Mineral_____
- ☐ 08. Power: Type_____ Watts____
- ☒ 09. Waste Treatment: Type Wastewater Treatment Plant
- ☐ 10. OCS Related _____
- ☐ 11. Other:_____

10. Total Acres: 16
11. Total Jobs Created: N/A

12. Project Issues Discussed in Document

☐ 01. Aesthetic/Visual	☐ 09. Geologic/Seismic	☐ 17. Social	☐ 25. Wetland/Riparian
☐ 02. Agricultural Land	☐ 10. Jobs/Housing Balance	☐ 18. Soil Erosion	☐ 26. Wildlife
☐ 03. Air Quality	☐ 11. Minerals	☐ 19. Solid Waste	☐ 27. Growth Inducing
☐ 04. Archeological/Historical	☒ 12. Noise	☐ 20. Toxic/Hazardous	☐ 28. Incompatible Landuse
☐ 05. Coastal Zone	☐ 13. Public Services	☒ 21. Traffic/Circulation	☐ 29. Cumulative Effects
☐ 06. Economic	☐ 14. Schools	☐ 22. Vegetation	☐ 30. Other _____
☐ 07. Fire Hazard	☐ 15. Septic Systems	☐ 23. Water Quality	
☐ 08. Flooding/Drainage	☐ 16. Sewer Capacity	☐ 24. Water Supply	

13. Funding (approx.): Federal $_____ State $_____ Total $_____

14. Present Land Use and Zoning: The property is part of the existing Rosamond Community Services District Wastewater Treatment Plant. The surrounding property consists of vacant land.

15. Project Description: The proposed project would entail the expansion of the Rosamond Community Services District Wastewater Treatment Plant. Improvements would include adding treatment capacity and effluent disposal facilities. The initial expansion will provide an additional 0.5 million gallons per day (MGD) of capacity; however, the facilities will be expandable to an ultimate capacity of 1.0 MGD. R. D.

MAR 2006 STATE CLEARINGHOUSE

State Clearinghouse Contact: (916) 445-0613 SL

State Review Began: 3 . 2 . 2006

SCH COMPLIANCE 4 . 3 . 2006

Please note State Clearinghouse Number (SCH#) on all Comments

SCH#: 1999101037

Please forward late comments directly to the Lead Agency

AQMD/APCD 11

(Resources: 3 , 4)

Project Sent to the following State Agencies

- X Resources
- ____ Boating & Waterways
- ____ Coastal Comm
- ____ Colorado Rvr Bd
- X Conservation
- X Fish & Game # 4
- ____ Delta Protection Comm
- ____ Forestry & Fire Prot
- ____ Historic Preservation
- X Parks & Rec
- ____ Reclamation Board
- ____ Bay Cons & Dev Comm
- X DWR
- ____ OES (Emergency Svcs)

Bus Transp Hous
- ____ Aeronautics
- X CHP
- X Caltrans # 9
- ____ Trans Planning
- ____ Housing & Com Dev
- ____ Food & Agriculture
- X Health Services

State/Consumer Svcs
- ____ General Services

Cal EPA
- ____ ARB – Airport Projects
- ____ ARB – Transportation Projects
- ____ ARB – Major Industrial Projects
- ____ Integrated Waste Mgmt Bd
- X SWRCB: Clean Wtr Prog
- ____ SWRCB: Wtr Quality
- ____ SWRCB: Wtr Rights
- X Reg. WQCB # 6U
- ____ Toxic Sub Ctrl-CTC

Yth/Adlt Corrections
- ____ Corrections

Independent Comm
- ____ Energy Commission
- X NAHC
- X Public Utilities Comm
- ____ State Lands Comm
- ____ Tahoe Rgl Plan Agency
- ____ _____ Conservancy

KERN COUNTY AIR POLLUTION CONTROL DISTRICT
DAVID L. JONES, APCO

May 10, 2010

City of California City / Wastewater
Greg Felding
21000 Hacienda Blvd
California City, CA 93505

Subject: Posting of Kern County APCD Permits to Operate: 0409001-003

Dear Permit Holder:

Enclosed is/are your Permit(s) To Operate air pollutant emitting equipment at your facility. If applicable, please forward a copy to your permitted site for posting.

Please be aware, a person who has been granted a Permit to Operate pursuant to KCAPCD Rule 201 is required by Subsection III of this rule to firmly affix such permit, an approved facsimile, or other approved identification bearing the permit number upon the article, machine, equipment or other contrivance covered by the permit, in such a manner as to be clearly visible and accessible.

In the event the equipment is so constructed or operated that the Permit to Operate cannot be so placed, the permit shall be mounted so as to be clearly visible in an accessible place within 25 feet of the equipment or maintained readily available at all times on the operating premises.

Thank you for your cooperation. Please let us know if you have any questions.

Sincerely,

David L. Jones
Air Pollution Control Officer

DLJ: dm
Attachment

Bakersfield Office: 2700 "M" Street, Suite 302, Bakersfield, CA 93301-2370
Phone (661) 862-5250 - Fax (661) 862-5251
www.kernair.org - kcapcd@co.kern.ca.us

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
~~MOJAVE: (661) 824-7085~~

PERMIT NUMBER: **0409001**
SERIAL NUMBER: **33046**

PERMIT TO OPERATE IS HEREBY GRANTED TO: **CITY OF CALIFORNIA CITY WASTEWATER**

FOR EQUIPMENT LOCATED AT: **NORTH OF NELSON DRIVE, CALIFORNIA CITY**

EQUIPMENT OR PROCESS DESCRIPTION: **EMERGENCY USE PISTON ENGINE WITH GENERATOR**

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 05-01-10 To 04-30-11

OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware compliance with all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Emergency Use Piston Engine with Generator, including following equipment:

A. Cummins, Model NTA855-G3, emergency use diesel piston engine rated at 535 bhp powering Onan, Model 350DFCC, electrical generator;
B. Turbocharger with intercooler/aftercooler; and
C. Positive Crankcase Ventilation of 90% efficient control device for crankcase emissions.

OPERATIONAL CONDITIONS:

1. Engine shall not operate more than 200 hours per year. (Rule 210.1)
2. Sulfur content of fuel shall not exceed 0.05%. (Rule 210.1 and BACT Requirement)
3. City of California City shall keep monthly records of dates and reason for use, fuel usage, sulfur content of fuel, and elapsed time.

COMPLIANCE TESTING REQUIREMENTS:

If visible emissions exceed 10% opacity or inspection reveals conditions indicative of non-compliance, compliance with hourly and concentration emission limits shall be verified pursuant to Rule 108.1 and KCAPCD Guidelines for Compliance Testing, within 30 days of District request. (Rule 108.1)

EMISSION LIMITS:

Maximum emission rate of each air contaminant from this emission unit shall not exceed following limits:

Oxides of Nitrogen:	9.91 lb/hr 7.2 gm/hp-hr
Particulate Matter (PM_{10}):	0.22 lbm/hr 0.1 gr/scf (Rule 404.1)
Sulfur Compounds (as SO_2):	0.70 lb/hr 0.59 gm/hp-hr
Carbon Monoxide:	1.77 lb/hr 1.50 gm/hp-hr
Hydrocarbons:	0.37 lb/hr (as NMHC) 0.31 gm/hp-hr

(Emission limits established pursuant to Rule 210.1, unless otherwise noted.)

Compliance with maximum daily emission limits shall be verified by source operator (with appropriate operational data and record keeping to document maximum daily emission rate) each day source is operated and such documentation of compliance shall be retained and made readily available to District for period of three years. (Rules 209 and 210.1)

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
~~MOJAVE: (661) 824-7085~~

PERMIT NUMBER: **0409002A**

PERMIT TO OPERATE IS HEREBY GRANTED TO: **CITY OF CALIFORNIA CITY WASTEWATER**

FOR EQUIPMENT LOCATED AT: **10835 NORTH NELSON DRIVE, CALIFORNIA CITY**

EQUIPMENT OR PROCESS DESCRIPTION: **WASTEWATER TREATMENT PLANT**

OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 05-01-10 To 04-30-11

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware compliance with all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Wastewater Treatment Plant, including following equipment:

A. Influent wet well with two Vaughn Chopper 2100 gpm, 40 hp, 480V, 3 phase submersible pumps equipped with VFD on each pump;
B. Two 1.42 million gallon aeration basins with two Aqua-Aerobic 40 hp, 480V, 3 phase surface aerators on each basin;
C. Two 45' diameter secondary clarifiers with sludge recycled back to aeration basins;
D. RAS/ WAS station equipped with:
   1. Three Vaughn Chopper 7.5 hp return activated sludge pumps equipped with VFD on each pump;
   2. Two Moyno 10 hp waste activated sludge pumps; and
   3. Two ½ hp submersible sump pumps.
E. Ten sludge drying beds;
F. Two 35 hp filter influent pumps for tertiary treatment facilities;
G. One 1.5 hp flash mix pump off secondary effluent line;
H. Flocculation tank with two10' x 10'compartments with 0.5 hp mixer pump in each compartment;
I. Chlorine contact tank, four 90' passes with chlorine injected at bottom of tank;
J. Two 300 lb chlorinators;
K. Residual chlorine analyzer;

L. Storage pond with two 30 hp effluent motors;
M. Chemical storage building equipped with emergency chlorine scrubber system capable of removing 99.99% of chlorine vapor in single pass; and
N. Mechanical bar screen with 2 hp and ½ hp motors.

OPERATIONAL CONDITIONS:

1. Facility shall not receive industrial effluent without prior District approval. (Rule 209)
2. Quarterly average process influent flow rate shall not exceed 2.0 mgd with peak flow of 3.0 mgd. (Rule 209)
3. Facility shall not have on location more than six – 1-ton chlorine cylinders. (Rules 209 and 419)
4. Chlorine cylinders shall be stored only in chlorine storage room. (Rules 209 and 419)
5. Chlorine shall not be stored on location unless chlorine gas detection system and emergency chlorine scrubber are fully operational. (Rules 209 and 419)
6. Chlorine shall be added using subsurface injectors and maximum dose of chlorine shall not exceed 15 mg/l unless necessary to maintain minimum required residual. (Rules 209 and 419)
7. Residual chlorine analyzer shall be in operation at all times. (Rule 209)
8. Facility shall not be the source of off-site objectionable odors. (Rule 419)

STATE OF CALIFORNIA AIR TOXICS HOT SPOTS REQUIREMENTS:

Facility shall comply with California Health and Safety Code, Sections 44300 through 44384. (Rule 208.1)

COMPLIANCE TESTING REQUIREMENTS:

Should inspection reveal conditions indicative of non-compliance, compliance with hourly and concentration emission limits shall be verified pursuant to Rule 108.1 and KCAPCD Guidelines for Compliance Testing, within 30 days of District request. (Rule 108.1)

EMISSION LIMITS:

Maximum emission rate of each air contaminant from this emission unit shall not exceed following limits:

Volatile Organic Compounds (VOC):	1.00	lbm/day
Chlorine:	0.00	lbm/day
	0.00	ton/yr

(Emission limits established pursuant to Rule 210.1, unless otherwise noted.)

Compliance with maximum daily emission limits shall be verified by source operator (with appropriate operational data and record keeping to document maximum daily emission rate) each day source is operated and such documentation of compliance shall be retained and made readily available to District for period of three years. (Rules 209 and 210.1)

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
~~MOJAVE: (661) 824-7085~~

PERMIT NUMBER: **0409003**

PERMIT TO OPERATE IS HEREBY GRANTED TO: **CITY OF CALIFORNIA CITY WASTEWATER**

FOR EQUIPMENT LOCATED AT: **10835 NORTH NELSON DRIVE, CALIFORNIA CITY**

EQUIPMENT OR PROCESS DESCRIPTION: **WASTEWATER DEWATERING\ DEHYDRATION OPERATION**

OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 05-01-10 To 04-30-11

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware compliance with all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Wastewater Sludge Dewatering/Dehydration Operation, including following equipment:

A. Hopper with 2-hp. motor;
B. Wet sludge feed conveyor from hopper with 2-hp. motor;
C. Centrifuge drive with 15-hp. motor;
D. Centrifuge back drive with 5-hp. motor;
E. Dehydrator disk drive with 10-hp. motor;
F. 2.0-MMBtu/hr boiler (thermal fluid heater);
G. Combustion fan with 3-hp. motor;
H. Thermal fluid circulation pump with 10-hp. motor;
I. Scrubber/condenser fan with 3-hp. motor;
J. Dried sludge exit conveyor with 2-hp. motor; and
K. Dried product surge bin with 7.5-hp motor.

OPERATIONAL CONDITIONS:

1. Boiler shall be fueled exclusively with propane or natural gas. (Rule 210.1 BACT Requirement)
2. Wet scrubber shall be equipped with operational liquid volumetric flow indicators. (Rule 210.1)
3. Visible emissions from boiler exhaust stack shall not exceed 5% opacity. (Rule 210.1 BACT Requirement)
4. Visible emissions from wet scrubber serving sludge dehydrator exhaust shall not exceed 5% opacity. (Rule 210.1 BACT Requirement)
5. Exhaust gas particulate matter concentration shall not exceed 0.1 grains/scf calculated to 12% CO2. (Rule 407.2)
6. Boiler exhaust concentration of sulfur oxides (calculated as SO2) shall not exceed 2000 parts per million on a volume basis (ppmv). (Rule 407)
7. Volume of propane used as fuel for boiler shall not exceed 7.0 million standard cubic feet per year (MMscf/yr). (Rule 210.1)
8. Operator shall maintain annual records of fuel use. (Rule 425.2)
9. Treated (dehydrated) sludge shall be stored in a manner to prevent dust entrainment into the atmosphere. (Rule 210.1)
10. Treated (dehydrated) sludge shall be classified as an A1 Organic, and shall comply with standards established by US EPA 40CFR 503 for unrestricted use and distribution. (Rule 419)
11. Equipment shall be maintained according to manufacturer's specifications to ensure compliance with emissions limitations. (Rules 209 and 210.1)
12. There shall be no odors detectable at or beyond the property boundary. (Rule 419)
13. No emission resulting from use of this equipment shall cause injury, detriment, nuisance, annoyance to or endanger comfort, repose, health or safety of any considerable number of persons or public. (Rule 419 and CH & SC 41700)

STATE OF CALIFORNIA AIR TOXICS HOT SPOTS REQUIREMENTS:

Facility shall comply with California Health and Safety Code Sections 44300 through 44384. (Rule 208.1)

COMPLIANCE TESTING REQUIREMENTS:

Should inspection reveal conditions indicative of non-compliance, compliance with any emission limitations shall be verified, within 60 days of District request. Test results shall be submitted to KCAPCD within 30 days after test completion. (Rule 108.1 and 210.1)

EMISSION LIMITS:

Emissions rate of each air contaminant from this unit shall not exceed following limits:

Boiler:

Particulate Matter (PM_{10}):	0.01	lb/hr
	0.31	lb/day
	0.06	ton/yr
Sulfur Oxides (SOx as SO_2):	0.01	lb/hr
	0.20	lb/day
	0.04	ton/yr
Oxides of Nitrogen (NO_2):	0.31	lb/hr
	7.34	lb/day
	1.34	ton/yr

Volatile Organic Compounds (VOC):	0.01	lb/hr
(as defined in Rule 210.1)	0.26	lb/day
	0.05	ton/yr
Carbon Monoxide:	0.04	lb/hr
	1.00	lb/day
	0.18	ton/yr
Wet Scrubber Exhaust:		
Particulate Matter (PM_{10}):	0.10	lb/hr
	2.51	lb/day
	0.46	ton/yr

(Emissions limits established pursuant to Rule 210.1, unless otherwise noted.)

Compliance with maximum daily emission limits shall be verified by source operator (with appropriate operational data and record keeping to document maximum daily emission rate) each day source is operated and such documentation of compliance shall be retained and made readily available to District for period of three years. (Rules 209 and 210.1)

FEE EXEMPT

Serving the World's
Environmental Needs

Tel. 818 796 9141
Fax 818 449 3741

301 North Lake Avenue
Suite 600
Pasadena, California 91101

JMM James M. Montgomery
Consulting Engineers, Inc.

1069.0032.3.1.6

February 18, 1993

Kern County Air Pollution Control District
2700 "M" Street, Ste. 275
Bakersfield, CA 93301

Attention: Mr. ~~Tom Goff~~

Subject: California City Wastewater Treatment Plant
Authority to Construct
Emergency Electric Generator

Dear ~~Mr. Goff~~:

On behalf of the California City Public Works Department, we would like to submit this application for authority to construct an emergency electric generator at the City's wastewater treatment plant. Emergency electric power is required at the plant since the City is proposing to expand and upgrade the existing facility from 0.2 to 1.0 mgd. The new plant will provide tertiary treatment and reuse of effluent for landscape irrigation at the City park and golf course. Information (including air emissions generation) from two generator manufacturers is included.

An application fee of $60 is also enclosed. Please contact me directly at (818) 568-6910 if any additional information is required in order to complete the application. Thank you.

Sincerely,

Sarah M. Kuss

Sarah M. Kuss

RECEIVED
FEB 22 1993
KERN COUNTY AIR
POLLUTION CONTROL DISTRICT

KERN COUNTY AIR POLLUTION CONTROL DISTRICT
DAVID L. JONES, APCO

May 10, 2010

Rosamond CSD
D Lamoreaux
3179 35th Street West
Rosamond, CA 93560

Subject: Posting of Kern County APCD Permits to Operate: 0398001-002, 004, and 006

Dear Permit Holder:

Enclosed is/are your Permit(s) To Operate air pollutant emitting equipment at your facility. If applicable, please forward a copy to your permitted site for posting.

Please be aware, a person who has been granted a Permit to Operate pursuant to KCAPCD Rule 201 is required by Subsection III of this rule to firmly affix such permit, an approved facsimile, or other approved identification bearing the permit number upon the article, machine, equipment or other contrivance covered by the permit, in such a manner as to be clearly visible and accessible.

In the event the equipment is so constructed or operated that the Permit to Operate cannot be so placed, the permit shall be mounted so as to be clearly visible in an accessible place within 25 feet of the equipment or maintained readily available at all times on the operating premises.

Thank you for your cooperation. Please let us know if you have any questions.

Sincerely,

David L. Jones
Air Pollution Control Officer

DLJ: dm
Attachment

Bakersfield Office: 2700 "M" Street, Suite 302, Bakersfield, CA 93301-2370
Phone (661) 862-5250 - Fax (661) 862-5251
www.kernair.org - kcapcd@co.kern.ca.us

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
FIELD OFFICE: (661) 823-9264

PERMIT NUMBER: **0398001**

PERMIT TO OPERATE IS HEREBY GRANTED TO: **ROSAMOND COMMUNITY SERVICES DISTRICT**

FOR EQUIPMENT LOCATED AT: **WASTEWATER LIFT STATION EAST OF SIERRA HWY. & PATTERSON ST., ROSAMOND**

EQUIPMENT OR PROCESS DESCRIPTION: **EMERGENCY USE PISTON ENGINE WITH GENERATOR**

OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 06-01-10 To 05-31-11

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Emergency Use Piston Engine with Generator, including following equipment:

One 1,053 bhp Caterpillar, Model G35216 SITA, propane-fired, turbocharged, aftercooled emergency use piston engine powering 525 kw electrical generator set with exhaust silencer and hour meter recording use.

OPERATIONAL CONDITIONS:

1. Engine shall only burn propane fuel. (Rule 210.1 BACT Requirement)
2. Engine operation shall not exceed 200 hours per calendar year. (Rule 210.1)
3. Visible emissions shall be less than 20 % opacity or Ringelmann No. 1 except for not more than three minutes in any one hour. (Rule 401)
4. Engine shall be equipped as listed in Equipment Description. (Rule 210.1 BACT Requirement)
5. Engine shall be used exclusively for emergency standby power generation and shall not be used in conjunction with any utility voluntary demand reduction program. (Rule 210.1 Offset Exemption)

6. Operator shall establish method of record keeping to demonstrate compliance with hours of operation (such as fuel use records, elapsed time meter, maintenance log, etc.). (Rule 209)
7. Exhaust gas particulate matter concentration shall be no more than 0.1 gr/scf. (Rule 404.1)
8. Sulfur compounds emissions shall be no more than 0.2% (2,000 ppmv) calculated as sulfur dioxide (SO_2). (Rule 407)

COMPLIANCE TESTING REQUIREMENTS:

Should inspection reveal conditions indicative of non-compliance, compliance with hourly and concentration emission limits shall be verified pursuant to Rule 108.1 and KCAPCD Guidelines for Compliance Testing, within 30 days of District request. (Rule 108.1)

EMISSION LIMITS:

Maximum emission rate of each air contaminant from this emission unit shall not exceed following limits:

Particulate Matter:	0.37 lb/hr
Sulfur Oxides:	0.09 lb/hr
Oxides of Nitrogen:	46.68 lb/hr
Volatile Organic Compounds (VOC): (as defined in Rule 210.1)	0.33 lb/hr
Carbon Monoxide:	2.34 lb/hr

(Emission limits established pursuant to Rule 210.1, unless otherwise noted.)

Compliance with maximum daily emission limits shall be verified by source operator (with appropriate operational data and record keeping to document maximum daily emission rate) each day source is operated and such documentation of compliance shall be retained and made readily available to District for period of three years. (Rules 209 and 210.1)

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
FIELD OFFICE: (661) 823-9264

PERMIT NUMBER: **0398002**

PERMIT TO OPERATE IS HEREBY GRANTED TO: **ROSAMOND COMMUNITY SERVICES DISTRICT**

FOR EQUIPMENT LOCATED AT: **EAST OF SIERRA HWY. & PATTERSON ST. ROSAMOND**

EQUIPMENT OR PROCESS DESCRIPTION: **WASTEWATER TREATMENT PLANT**

OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 06-01-10 To 05-31-11

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Wastewater Treatment Plant, including following equipment:

A. 16 evaporation ponds;
B. 6 aerators in pond #13, 65 hp total;
C. Lift station with two 150 hp pumps; and
D. Two drywell pumps with 5 hp motor.

OPERATIONAL CONDITIONS:

1. Aeration equipment shall be operated and maintained to prevent plant from becoming public nuisance. (Rules 209 and 419)
2. Ferric/ferrous chloride, sodium hypochlorite, or equivalent shall be used as necessary to control odors and control formation of hydrogen sulfide. (Rules 209 and 419)
3. Records of average daily influent amounts shall be kept. (Rule 209)
4. Treatment process shall be maintained as aerobic. (Rule 209)
5. Operation shall not endanger public health, nor cause public nuisance or annoyance. (Rule 419 and CH&SC, Sec 41700)
6. Roadways shall be maintained with gravel surface to prevent emission of dust past property line. (Rule 209)

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
FIELD OFFICE: (661) 823-9264

PERMIT NUMBER: 0398004
SERIAL NUMBER: 06R07451556063TK35R

PERMIT TO OPERATE IS HEREBY GRANTED TO: **ROSAMOND COMMUNITY SERVICES DISTRICT**

FOR EQUIPMENT LOCATED AT: **3179 35th STREET WEST ROSAMOND**

EQUIPMENT OR PROCESS DESCRIPTION: **EMERGENCY USE PISTON ENGINE WITH GENERATOR**

OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 06-01-10 To 05-31-11

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Emergency Use Piston Engine with Generator, including following equipment:

Detroit Diesel, Model 6063 TK 35, 550 bhp diesel fueled piston engine equipped with turbocharger (aftercooled) and crankcase ventilation control device.

OPERATIONAL CONDITIONS:

1. Engine shall have operational elapsed time meter indicating cumulative hours of engine operating time. (Rules 209 and 210.1)
2. Engine operation shall not exceed 200 hours per year without prior District approval. (Rule 427)
3. Fuel for diesel piston engine shall conform to California Air Resources Board standards for reformulated diesel fuel. (Rule 210.1 BACT Requirement)
4. Visible emissions shall not exceed Ringelmann No. ¼ or 5% opacity after engine achieves normal operating temperature. (Rule 210.1 BACT Requirement)
5. Emergency use engine shall not be operated as part of a voluntary power curtailment program. (Rule 210.1)
6. Sulfur compounds emissions shall be no more than 0.2% (2,000 ppmv) calculated as sulfur dioxide (SO_2). (Rule 407)

7. Equipment shall be maintained according to manufacturer's specifications to ensure compliance with emission limitations. (Rules 209 and 210.1)
8. Compliance with all operational conditions shall be verified by appropriate record keeping, including records of operational data needed to demonstrate compliance. Such records shall be kept on site in readily available format. (Rule 209)
9. Operating record of this equipment shall be maintained in format approved in writing by District, kept for minimum of two years, and made available upon request of District personnel. Record shall include, at minimum, days and hours of operation, amount of fuel oil supplied to this engine, and date(s), check(s) and certification(s) of injection timing. (Rules 209 and 210.1)
10. No emission resulting from use of this equipment shall cause injury, detriment, nuisance, annoyance to or endanger comfort, repose, health, or safety of any considerable number of persons or public. (Rule 419 and CH&SC Sec 41700)

STATE OF CALIFORNIA AIR TOXICS HOT SPOTS REQUIREMENTS:

Facility shall comply with California Health and Safety Code, Sections 44300 through 44384. (Rule 208.1)

COMPLIANCE TESTING REQUIREMENTS:

Should inspection reveal conditions indicative of non-compliance, compliance with hourly and concentration emission limits shall be verified pursuant to Rule 108.1 and KCAPCD Guidelines for Compliance Testing, within 30 days of District request. (Rule 108.1)

EMISSION LIMITS:

Maximum emission rate of each air contaminant from this emission unit shall not exceed following limits:

Particulate Matter:	0.10	grains/dscf (of PM) (Rule 404.1)
	0.11	lbm/hr (of PM_{10}) (Rule XXX)
	2.62	lbm/day (of PM_{10})
	0.01	ton/yr (of PM_{10})
Sulfur Oxides (as SO_2):	0.18	lbm/hr
	4.34	lbm/day
	0.02	ton/yr
Oxides of Nitrogen (as NO_2):	5.42	lbm/hr
	130.08	lbm/day
	0.54	ton/yr
Volatile Organic Compounds (VOC):	1.38	lbm/hr
	33.17	lbm/day
	0.14	ton/yr
Carbon Monoxide:	0.55	lbm/hr
	13.10	lbm/day
	0.06	ton/yr

(Emission limits established pursuant to Rule 210.1, unless otherwise noted.)

Compliance with maximum daily emission limits shall be verified by source operator (with appropriate operational data and record keeping to document maximum daily emission rate) each day source is operated and such documentation of compliance shall be retained and made readily available to District for period of three years. (Rules 209 and 210.1)

KERN COUNTY AIR POLLUTION CONTROL DISTRICT

PERMIT TO OPERATE

2700 "M" STREET, SUITE 302
BAKERSFIELD, CA 93301-2370
BAKERSFIELD: (661) 862-5250
FIELD OFFICE: (661) 823-9264

PERMIT NUMBER: **0398006**
SERIAL NUMBER: **32047742**

PERMIT TO OPERATE IS HEREBY GRANTED TO: **ROSAMOND COMMUNITY SERVICES DISTRICT**

FOR EQUIPMENT LOCATED AT: **5702 GASKELL ROAD ROSAMOND**

EQUIPMENT OR PROCESS DESCRIPTION: **EMERGENCY USE GENERATOR**
OPERATIONAL CONDITIONS LISTED BELOW.

THIS PERMIT BECOMES VOID UPON ANY CHANGE OF OWNERSHIP OR LOCATION, OR ANY ALTERATION. EQUIPMENT MODIFICATION REQUIRES AN APPLICATION FOR AUTHORITY TO CONSTRUCT.

TESTING: Permittee may be required to provide adequate sampling and testing facilities.

REVOCABLE: This permit does not authorize emission of air contaminants in excess of those allowed by Rules and Regulations of K.C.A.P.C.D.

DAVID L. JONES
AIR POLLUTION CONTROL OFFICER

By: _____

For Period: 06-01-10 To 05-31-11

CONDITIONS OF APPROVAL:

Pursuant to Rule 209, "conditional approval" is hereby granted. Please be aware all conditions of approval imposed by any applicable Authority to Construct remain in effect for life of project, unless modified by application.

EQUIPMENT DESCRIPTION: Emergency Use Generator, including following equipment:

200-kW Cummins electrical generator set, Model DSHAC, driven by 364-bhp Cummins, 8.9 liter Model QSL9-G2, diesel fueled piston engine.

OPERATIONAL CONDITIONS:

1. Engine crankcase vent shall be equipped with positive ventilation system or a 90% efficient control device for crankcase VOC emissions. (Rule 210.1 BACT requirement)
2. Engine shall be equipped with turbocharger and aftercooler. (Rule 210.1 BACT Requirement)
3. Elapsed time meter shall be installed and maintained indicating cumulative hours of engine operating time. (Rule 210.1)
4. Visible emissions from engine exhaust after engine has reached normal operating temperature shall not equal or exceed 5% opacity or Ringelmann No. ¼ for more than 3 minutes in any one hour. (Rule 210.1 BACT Requirement)
5. Exhaust gas particulate matter concentration shall not exceed 0.1 grains/ft3 of gas at standard conditions. (Rule 404.1)
6. Fuel for diesel piston engine shall conform to California Air Resources Board standards for reformulated diesel fuel (low sulfur, 0.0015% by weight and low aromatic hydrocarbon, 20% by weight). (Rule 210.1 BACT Requirement)
7. Equipment shall be maintained according to manufacturer's specifications to ensure compliance with emissions limitations. (Rule 210.1 and Rule 209)

8. Compliance with all operational conditions shall be verified by appropriate record keeping, including records of operational data needed to demonstrate compliance. Such records shall be kept on site in readily available format. (Rule 209)
9. No emission resulting from use of this equipment shall cause injury, detriment, nuisance, annoyance to or endanger comfort, repose, health or safety of any considerable number of persons or public. (Rule 419 and CH&SC 41700)
10. Engine operation shall not exceed 200 hours per year without prior District approval. (Rule 210.1)
11. Engine operation for maintenance and testing shall not exceed 50 hours per year without prior District approval. (Rule 210.1)

STATE OF CALIFORNIA AIR TOXICS HOT SPOTS REQUIREMENTS:

Facility shall comply with California Health and Safety Code Sections 44300 through 44384. (Rule 208.1)

COMPLIANCE TESTING REQUIREMENTS:

Should inspection reveal conditions indicative of non-compliance, compliance with any emission limitations shall be verified, within 60 days of District request. Test results shall be submitted to KCAPCD within 30 days after test completion. (Rule 108.1 and 210.1)

EMISSION LIMITS:

Emissions rate of each air contaminant from this unit shall not exceed following limits:

Particulate Matter (PM_{10}):	0.15	gm/bhp-hr
	0.12	lb/hr
	2.89	lb/day
	0.01	ton/yr
Sulfur Oxides (SOx as SO_2):	0.004	lb/hr
	0.09	lb/day
	0.0004	ton/yr
Oxides of Nitrogen (NOx as NO_2):	2.8	gm/bhp-hr
	2.25	lb/hr
	53.94	lb/day
	0.22	ton/yr
Volatile Organic Compounds (VOC):	0.2	gm/bhp-hr
(as defined in Rule 210.1)	0.16	lb/hr
	3.85	lb/day
	0.02	ton/yr
Carbon Monoxide:	2.09	lb/hr
	50.08	lb/day
	0.21	ton/yr

(Emissions limits established pursuant to Rule 210.1, unless otherwise noted.)

Compliance with maximum daily emission limits shall be verified by source operator (with appropriate operational data and record keeping to document maximum daily emission rate) each day source is operated and such documentation of compliance shall be retained and made readily available to District for period of three years. (Rules 209 and 210.1)

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. 6-95-107
WDID NO. 6B150112001

REVISED WASTE DISCHARGE REQUIREMENTS

FOR

ROSAMOND COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT FACILITY

Kern County

The California Regional Water Quality Control Board, Lahontan Region (Regional Board) finds:

1. Discharger

The Rosamond Community Services District (CSD) submitted a complete revised Report of Waste Discharge for the Rosamond CSD Wastewater Treatment Facility on March 23, 1995. For the purposes of this Order, the Rosamond CSD is referred to as the "Discharger."

2. Facility

The Rosamond CSD Wastewater Treatment Facility is the facility from which the discharge occurs. For the purposes of this Order, the Rosamond CSD Wastewater Treatment Facility is referred to as the "Facility". The Facility discharges domestic wastewater.

3. History of Previous Regulation by the Regional Board

The Regional Board previously established Waste Discharge Requirements (WDRs) for the Facility under Board Order No. 6-90-06, which was adopted on January 11, 1990. Board Order No. 6-90-06A1 was adopted on March 9, 1995, and amended the WDRs to include a fourteenth oxidation/percolation pond.

4. Reason for Action

The Regional Board is revising WDRs to reflect changes in the design flow of the Facility. The purpose of this Order is to establish WDRs which reflect recent modifications to the Discharger's treatment processes, and to incorporate recent changes in sludge regulatory policies.

5. Facility Location

The Facility is located approximately one mile southeast of the Community of Rosamond, Kern County within Section 27, T9N, R12W, SBB&M, as shown on Attachment "A", which is made part of this Order.

6. Description of Facility and Discharge

The Discharger currently discharges wastewater to thirteen existing clay-lined evaporation/oxidation ponds. The Discharger is constructing a fourteenth clay-lined pond which is proposed to receive wastewater overflow from evaporation/oxidation pond No. 11. Wastewater is conveyed to the Facility by a gravity interceptor sewer. An influent pump station, having a hydraulic capacity of 2.0 million gallons per day (mgd), expandable to 4.0 mgd, lifts the wastewater into clay lined evaporation/oxidation ponds. The Facility is designed to collect, treat and dispose of 2.0 mgd. The wastewater treatment pond layout and flow schematic is shown in Attachment "B".

7. Sludge Treatment and Disposal

The sludge is removed from the ponds every eight to ten years and disposed of on site. The sludge is spread evenly on the ground and wheel rolled within the area shown on Attachment "B".

8. Authorized Disposal Site

The fourteen evaporation/oxidation ponds are the only authorized disposal sites for wastewater. The land at the Facility is the only authorized disposal site for sludge. The authorized disposal sites are located on land owned by the Rosamond CSD.

9. Site Geology

A soils investigation by Buena Engineers Inc. conducted during August 1986 and amended in June 1989, found that soils underlying the Facility from a depth of 0-40 feet consist of sandy clays and clayey silt/sands. Permeability of these soils is very low and significant percolation of wastewater to underlying ground waters is not likely to occur.

10. Site Hydrogeology

Depth to ground water below the Facility was reported to be 21 feet in 1958 and 65 feet in 1989. The average ground water depth is expected to be 35 feet. Ground water is of excellent quality for most beneficial uses.

11. Receiving Waters

The receiving waters are the ground waters of the Antelope Valley Basin (Department of Water Resources Basin No. 6-44).

12. Lahontan Basin Plan

The Regional Board adopted a Water Quality Control Plan for the Lahontan Basin (Basin Plan) which became effective on March 31, 1995, and this Order implements the Basin Plan.

13. Beneficial Uses of Ground Water

The beneficial uses of the ground waters of the Antelope Valley Basin as set forth and defined in the Basin Plan are:

a. municipal and domestic supply;
b. agricultural supply;
c. industrial service supply; and
d. freshwater replenishment.

14. California Environmental Quality Act Compliance

A Negative Declaration was certified by the Rosamond CSD on February 22, 1995 under the California Environmental Quality Act, in accordance with Title 14 of the California Code of Regulations for the additional pond addressed in the amended WDR. No negative impacts to water quality are expected to occur as the result of the additional disposal site.

15. Notification of Interested Parties

The Regional Board has notified the Discharger and interested parties of its intent to revise WDRs for the discharge.

16. Consideration of Public Comments

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Discharger shall comply with the following:

I. DISCHARGE SPECIFICATIONS

A. Discharge/Effluent Limitations

The total flow of wastewater to the treatment and disposal facilities during a 24-hour period shall not exceed 2.0 million gallons.

B. Receiving Water Limitations

The discharge of waste shall not cause the presence of the following substances or conditions in ground waters of the Antelope Valley Basin:

1. Any perceptible color, odor, taste or foaming.

2. Coliform organisms attributable to human wastes.

3. Toxic substances in concentrations that individually, collectively, or cumulatively cause detrimental physiological responses in human, plants, animals, or aquatic life.

4. Identifiable chlorinated hydrocarbons, organophosphates, carbamates, and other pesticide and herbicide groups, in summations, in excess of the lowest detectable levels.

5. Concentrations of chemical constituents in excess of the maximum contaminant levels or secondary maximum contaminant levels based upon drinking water standards specified by the more restrictive of the California Code of Regulations, Title 22, Division 4, Chapter 15, or 40 CFR, Part 141.

C. General Requirements and Prohibitions

1. There shall be no discharge, bypass, or diversion of raw or partially treated sewage, sewage sludge, grease, or oils from the collection, transport, treatment, or disposal facilities to adjacent land areas or surface waters.

2. Surface flow or visible discharge of sewage or sewage effluent at, or from, the authorized disposal site to adjacent land areas or surface waters is prohibited.

3. The vertical distance between the liquid surface elevation and the lowest point of a pond dike or the invert of an overflow structure shall not be less than two (2) feet.

4. The discharge shall not cause a pollution as defined in Section 13050 of the California Water Code, or a threatened pollution.

5. Neither the treatment nor the discharge shall cause a nuisance as defined in Section 13050 of the California Water Code.

6. The discharge of wastewater except to the authorized disposal site is prohibited.

7. The integrity of any pond liners shall be maintained throughout the life of the ponds and shall not be diminished as the result of any maintenance or cleaning operation.

II. PROVISIONS

A. Rescission of Waste Discharge Requirements

Board Order Nos. 6-90-06 and 6-90-06A1 are hereby rescinded.

B. Standard Provisions

The Discharger shall comply with the "Standard Provisions for Waste Discharge Requirements," dated September 1, 1994, in Attachment "C", which is made part of this Order.

C. Monitoring and Reporting

1. Pursuant to Section 13267(b) of the California Water Code, the Discharger shall comply with the Monitoring and Reporting Program No. 95-107 as specified by the Executive Officer.

2. The Discharger shall comply with the "General Provisions for Monitoring and Reporting," dated September 1, 1994, which is attached to and made part of the Monitoring and Reporting Program.

D. Operator Certification

The Discharger's wastewater treatment plant shall be supervised by personnel possessing a wastewater treatment plant operator certificate of appropriate grade pursuant to *Regulations for Wastewater Treatment Plant Operator Certification and Plant Classification*, Title 23, California Code of Regulations, Division 4, Chapter 14, Section 3670 et. seq.

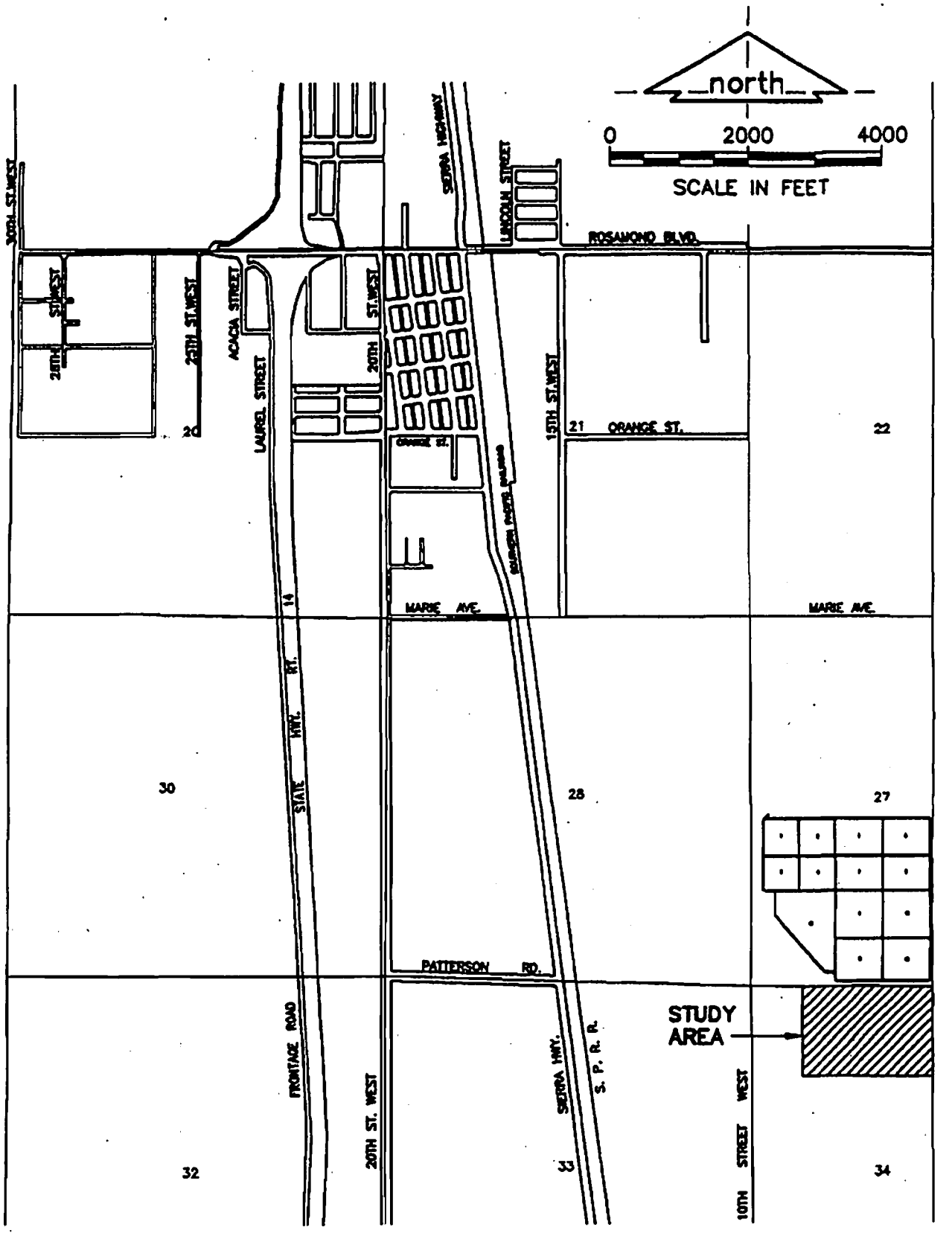
I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on September 14, 1995.

Harold J. Singer

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A. Location Map
B. WTF Pond Flow Schematic
C. Standard Provisions for Waste Discharge Requirements

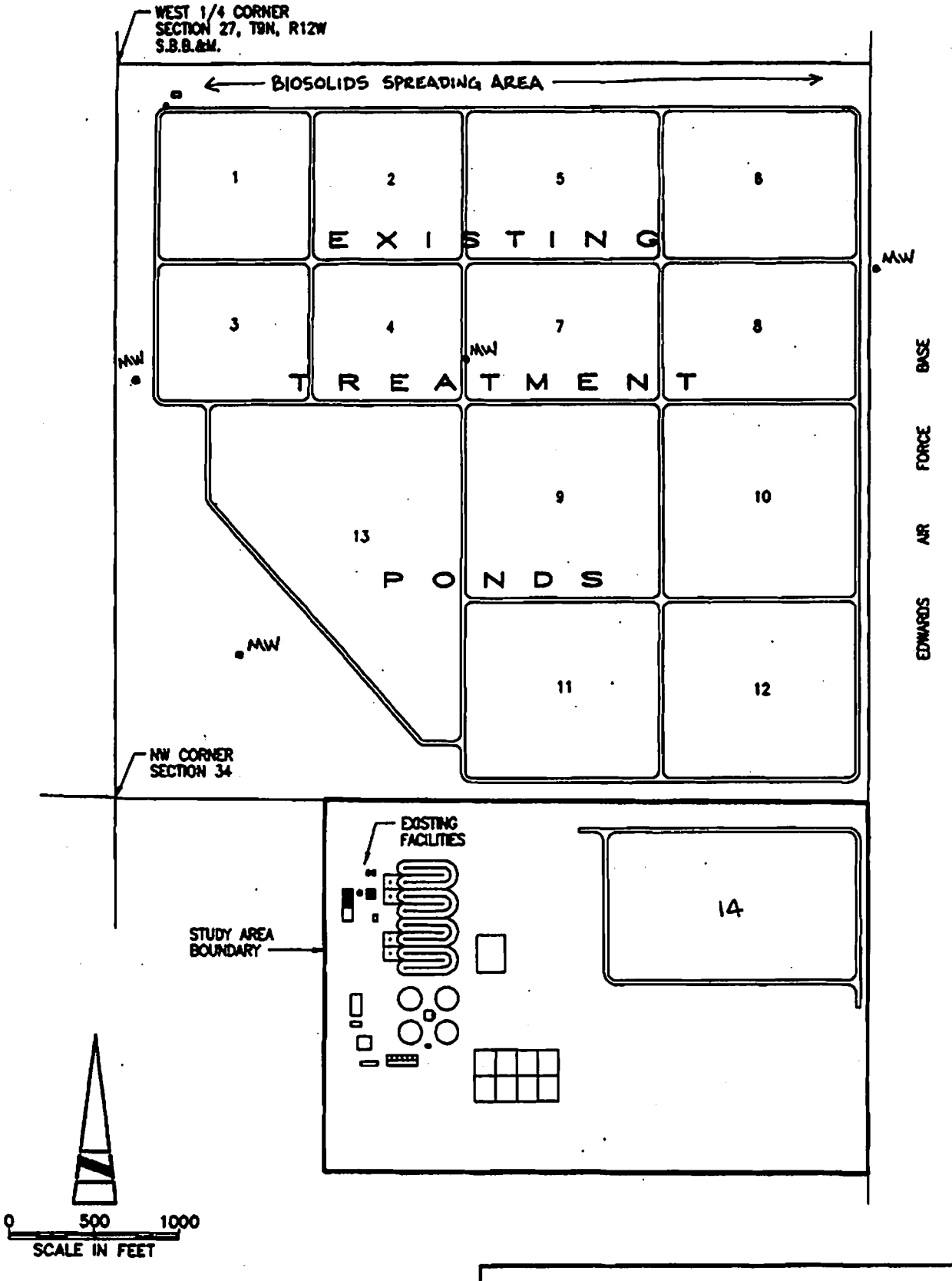
Attachment "A"



ROSAMOND COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT PLANT EXPANSION
STUDY AREA LOCATION MAP

BOWLUS ENGINEERING CORPORATION

Attachment "B"



ROSAMOND COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT PLANT EXPANSION

BOYLE ENGINEERING CORPORATION

L1572-1.DWG

ATTACHMENT "C"

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

STANDARD PROVISIONS
FOR WASTE DISCHARGE REQUIREMENTS

Inspection and Entry

The Discharger shall permit Regional Board staff:

a. to enter upon premises in which an effluent source is located or in which any required records are kept;

b. to copy any records relating to the discharge or relating to compliance with the Waste Discharge Requirements;

c. to inspect monitoring equipment or records; and

d. to sample any discharge.

2. Reporting Requirements

a. Pursuant to California Water Code 13267(b), the Discharger shall immediately notify the Regional Board by telephone whenever an adverse condition occurred as a result of this discharge; written confirmation shall follow within two weeks. An adverse condition includes, but is not limited to, spills of petroleum products or toxic chemicals, or damage to control facilities that could affect compliance.

b. Pursuant to California Water Code Section 13260(c), any proposed material change in the character of the waste, manner or method of treatment or disposal, increase of discharge, or location of discharge, shall be reported to the Regional Board at least 120 days in advance of implementation of any such proposal. This shall include, but not limited to, all significant soil disturbances.

c. The Owners/Discharger of property subject to Waste Discharge Requirements shall be considered to have a continuing responsibility for ensuring compliance with applicable Waste Discharge Requirements in the operations or use of the owned property. Pursuant to California Water Code Section 13260(c), any change in the ownership and/or operation of property subject to the Waste Discharge Requirements shall be reported to the Regional Board. Notification of applicable Waste Discharge Requirements shall be furnished in writing to the new owners and/or operators and a copy of such notification shall be sent to the Regional Board.

d. If a Discharger becomes aware that any information submitted to the Regional Board is incorrect, the Discharger shall immediately notify the Regional Board, in writing and correct that information.

e. Reports required by the Waste Discharge Requirements, and other information requested by the Regional Board, must be signed by a duly authorized representative of the Discharger. Under Section 13268 of the California Water Code, any person failing or refusing to furnish technical or monitoring reports, or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation.

f. If the Discharger becomes aware that their Waste Discharge Requirements (or permit) is no longer needed (because the project will not be built or the discharge will cease) the Discharger shall notify the Regional Board in writing and request that their Waste Discharge Requirements (or permit) be rescinded.

3. Right to Revise Waste Discharge Requirements

The Regional Board reserves the privilege of changing all or any portion of the Waste Discharge Requirements upon legal notice to and after opportunity to be heard is given to all concerned parties.

4. Duty to Comply

Failure to comply with the Waste Discharge Requirements may constitute a violation of the California Water Code and is grounds for enforcement action or for permit termination, revocation and reissuance, or modification.

5. Duty to Mitigate

The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of the Waste Discharge Requirements which has a reasonable likelihood of adversely affecting human health or the environment.

6. Proper Operation and Maintenance

The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Discharger to achieve compliance with the Waste Discharge Requirements. Proper operation and maintenance includes adequate laboratory control, where appropriate, and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by the Discharger, when necessary to achieve compliance with the conditions of the Waste Discharge Requirements.

7. Waste Discharge Requirement Actions

The Waste Discharge Requirements may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for waste discharge requirement modification, revocation and reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any of the Waste Discharge Requirements conditions.

8. Property Rights

The Waste Discharge Requirements do not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

9. Enforcement

The California Water Code provides for civil liability and criminal penalties for violations or threatened violations of the Waste Discharge Requirements including imposition of civil liability or referral to the Attorney General.

10. Availability

A copy of the Waste Discharge Requirements shall kept and maintained by the Discharger and be available at all times to operating personnel.

11. Severability

Provisions of the Waste Discharge Requirements are severable. If any provision of the requirements is found invalid, the remainder of the requirements shall not be affected.

12. Public Access

General public access shall be effectively excluded from disposal/treatment facilities.

13. Transfers

Providing there is no material change in the operation of the facility, this Order may be transferred to a new owner or operator. The owner/operator must request the transfer in writing and receive written approval from the Regional Board's Executive Officer.

14. Definitions

a. "Surface waters" as used in this Order, include, but are not limited to, live streams, either perennial or ephemeral, which flow in natural or artificial water courses and natural lakes and artificial impoundments of waters. "Surface waters" does not include artificial water courses or impoundments used exclusively for wastewater disposal.

b. "Ground waters" as used in this Order, include, but are not limited to, all subsurface waters being above atmospheric pressure and the capillary fringe of these waters.

15. Storm Protection

a. All facilities used for collection, transport, treatment, storage, or disposal of waste shall be adequately protected against overflow, washout, inundation, structural damage or a significant reduction in efficiency resulting from a storm or flood having a recurrence interval of once in 100 years.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

MONITORING AND REPORTING PROGRAM NO. 95-107
WDID NO. 6B150112001

FOR

ROSAMOND COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT FACILITY

Kern County

MONITORING

A. Flow Monitoring

The Discharger shall monitor the following:

1. The total volume, in million gallons, of wastewater flow to the treatment facility for each day.

2. The average flow rate, in million gallons per day (mgd), of wastewater to the treatment facility calculated for each month.

3. The freeboard (distance from the top of the lowest part of the dike to the wastewater surface in the pond) measured each month in each pond. If a pond does not contain wastewater, indicate that it is empty.

B. Plant Influent Monitoring

Beginning immediately, grab samples of the influent shall be collected and analyzed to determine the magnitude of the following parameters:

Parameter	Units	Frequency
Biochemical Oxygen Demand	mg/l	Semi-annually
Chemical Oxygen Demand	mg/l	Semi-annually
Methylene Blue Active Substances	mg/l	Semi-annually
Kjeldahl Nitrogen	mg/l as N	Semi-annually
Nitrate Nitrogen	mg/l as N	Semi-annually
Ammonia Nitrogen	mg/l as N	Semi-annually
Purgeable Organics*	mg/l	Annually
Base/Neutral Extractable Organics*	mg/l	Annually
Acid Extractable Organics*	mg/l	Annually
Heavy Metals*	mg/l	Annually

* Analysis shall be conducted for those substances included on the EPA list of priority pollutants and all other toxic substances known to be discharged to the Discharger's system.

C. Ground Water Monitoring

1. Grab samples from the entire thickness or the upper 20 feet, whichever is less, of the uppermost ground water bearing zone shall be collected, in accordance with the prescribed frequencies, from the four (4) monitoring wells, as shown on Attachment "B" of the Waste Discharge Requirements (WDRs), and analyzed to determine the magnitude of the following parameters:

Parameter	Units	Frequency
Methylene Blue Active Substances	mg/l	Annually
Chloride	mg/l	Annually
Total Dissolved Solids	mg/l	Annually
Kjeldahl Nitrogen	mg/l	Annually
Ammonia Nitrogen	mg/l as N	Annually
Nitrate Nitrogen	mg/l as N	Annually
Purgeable Organics*	µg/l	Annually
Base/Neutral Extractable Organics*	µg/l	Annually
Acid Extractable Organics*	µg/l	Annually
Heavy Metals*	mg/l	Annually
Total Coliform	MPN/100 ml	Annually

* Analysis shall be conducted for those substances included on the EPA list of priority pollutants and all other toxic substances known to be discharged to the Discharger's system.

a. Each time a monitoring well is sampled, and prior to well purging as specified below, the elevation (mean sea level) and depth (below ground surface) of ground water in each well shall be measured, and reported with the results of ground water analyses.

b. Well Purging

(1) Ground water samples shall be collected only after at least three volumes of water in the well casing have been removed and temperature, electrical conductivity, and pH measurements of the water in the well have stabilized to approximately ±10% for each successive well volume removed.

(2) The measurements of temperature, electrical conductivity and pH during purging shall be reported with the results of ground water analyses. Parameter values shall be reported in the following units:

Parameter	Units
Temperature	°C or °F
Electrical Conductivity	mmhos/cm or dS/m
pH	pH units

(3) The well casing diameter, well depth, and total volume purged prior to sampling shall be reported with the results of ground water analyses.

c. The velocity and direction of ground water flow under the facility site shall be determined at least annually unless it can be shown that no changes have occurred.

D. Sludge Monitoring

1. The Discharger shall submit a Sludge Management Plan Report by January 1, 1996.

2. The Discharger shall provide information on any deviations from the Sludge Management Plan.

3. Total quantity of sludge generated (cleaned from any ponds) during the monitoring period.

4. Date and quantity of any sludge landfilled or moved offsite, recipient (including name and address), location of receiving area, and sludge disposal method (including crops grown, if applicable).

5. Cumulative total quantity of sludge currently stockpiled onsite, including the quantity of sludge added to the stockpile during the monitoring period.

6. For sewage sludge removed from ponds, stockpiled onsite, or discharged offsite during the previous month, a representative composite sample shall be collected and analyzed for the following constituents:

a. total Kjeldahl nitrogen as N

b. ammonia nitrogen as N

c. nitrate nitrogen as N

d. total phosphate as P

e. heavy metals

7. At least 90 days prior to sample collection and analysis, a sludge sampling protocol shall be submitted to the Executive Officer for approval.

I. REPORTING

A. General Provisions

The Discharger shall comply with the "General Provisions for Monitoring and Reporting," dated September 1, 1994, which is attached to and made part of this Monitoring and Reporting Program.

B. Submittal Periods

By not later than the 15th day of the month following the adoption of this Order, the Discharger shall submit a monitoring report including the preceding information to the Regional Board. Subsequent monitoring reports shall be submitted to the Regional Board by the 15th day following each quarter.

C. Annual Report

By January 15 of each year, the Discharger shall submit an annual report to the Regional Board with the following information:

1. The compliance record, and corrective actions taken or planned which may be needed to bring the discharge into full compliance with the WDRs.

2. Graphical and tabular presentation of the monitoring data obtained for the previous year.

Ordered by: Harold J. Singer
HAROLD J. SINGER
EXECUTIVE OFFICER

Dated: September 14, 1995

Attachment: General Provisions for Monitoring and Reporting

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

GENERAL PROVISIONS
FOR MONITORING AND REPORTING

1. SAMPLING AND ANALYSIS

a. All analyses shall be performed in accordance with the current edition(s) of the following documents:

i. Standard Methods for the Examination of Water and Wastewater

ii. Methods for Chemical Analysis of Water and Wastes, EPA

b. All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health Services or a laboratory approved by the Regional Board Executive Officer. Specific methods of analysis must be identified on each laboratory report.

c. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The methods used shall also be reported. If methods other than EPA-approved methods or Standard Methods are used, the exact methodology must be submitted for review and must be approved by the Regional Board Executive Officer prior to use.

d. The discharger shall establish chain-of-custody procedures to insure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage, and analysis shall be conducted in accordance with an approved Sampling and Analysis Plan (SAP). The most recent version of the approved SAP shall be kept at the facility.

e. The discharger shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall insure that both activities will be conducted. The calibration of any wastewater flow measuring device shall be recorded and maintained in the permanent log book described in 2.b, below.

f. A grab sample is defined as an individual sample collected in fewer than 15 minutes.

g. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.

2. OPERATIONAL REQUIREMENTS

a. Sample Results

Pursuant to California Water Code Section 13267(b), the discharger shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

b. Operational Log

Pursuant to California Water Code Section 13267(b), an operation and maintenance log shall be maintained at the facility. All monitoring and reporting data shall be recorded in a permanent log book.

3. REPORTING

a. For every item where the requirements are not met, the discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time, and shall submit a timetable for correction.

b. Pursuant to California Water Code Section 13267(b), all sampling and analytical results shall be made available to the Regional Board upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

c. The discharger shall provide a brief summary of any operational problems and maintenance activities to the Board with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

d. Monitoring reports shall be signed by:

i. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;

ii. In the case of a partnership, by a general partner;

iii. In the case of a sole proprietorship,by the proprietor; or

iii. In the case of a sole proprietorship, by the proprietor;

iv. In the case of a municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

e. Monitoring reports are to include the following:

i. Name and telephone number of individual who can answer questions about the report.

ii. The Monitoring and Reporting Program Number.

iii. WDID Number.

f. Modifications

This Monitoring and Reporting Program may be modified at the discretion of the Regional Board Executive Officer.

4. NONCOMPLIANCE

Under Section 13268 of the Water Code, any person failing or refusing to furnish technical or monitoring reports or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation under Section 13268 of the Water Code.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. 6-95-107A2
WDID NO. 6B150112001

AMENDED WASTE DISCHARGE REQUIREMENTS

FOR

ROSAMOND COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT FACILITY

Kern County

The California Regional Water Quality Control Board, Lahontan Region, (Regional Board) finds:

1. Discharger

The Rosamond Community Services District (CSD) submitted a complete revised Report of Waste Discharge (RWD) for the Rosamond CSD Wastewater Treatment Facility on November 30, 1999. For the purposes of this Regional Board Order (Order), the Rosamond CSD is referred to as the "Discharger."

2. Order History

The Regional Board previously established Waste Discharge Requirements (WDRs) for the Facility under Board Order No. 6-95-107, which was adopted on September 14, 1995. The Regional Board amended WDRs under Board Order No. 6-95-107A1, which was adopted on July 11, 1996. This action amended the WDRs to include an additional oxidation/percolation pond.

3. Reason for Action

The Regional Board is amending WDRs for the facility to include the addition of one more clay lined oxidation pond (Pond No. 17) as an authorized disposal site.

4. Facility Location

The Facility is located in the Community of Rosamond, Kern County within Section 27, T9N, R12W, SBB&M, as shown on Attachments "A" and "B" which are made a part of this Order.

5. Facility Description

The Discharger currently discharges wastewater to sixteen existing clay-lined evaporation/ oxidation ponds. The Discharger constructed one more pond, number seventeen, which is clay-lined and proposes to receive wastewater overflow from pond fifteen. Regional Board staff understands that the Rosamond CSD may propose in the near future to construct a tertiary treatment plant to provide recycled water for landscape irrigation.

6. California Environmental Quality Act Compliance

A Negative Declaration was adopted by the Discharger on December 12, 1998 under the California Environmental Quality Act in accordance with Title 14, Sections 15071 (a) and (c) of the California Code of Regulations for the proposed additional ponds. No negative impacts to water quality are expected to occur as the result of the additional disposal site.

7. Notification of Interested Parties

The Regional Board has notified the Discharger and interested parties of its intent to amend WDRs for the discharge.

8. Consideration of Public Comments

The Regional Board has, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Discharger comply with the following:

1. Finding No. 8 of Board Order No. 6-95-107 shall be amended to read as follows:

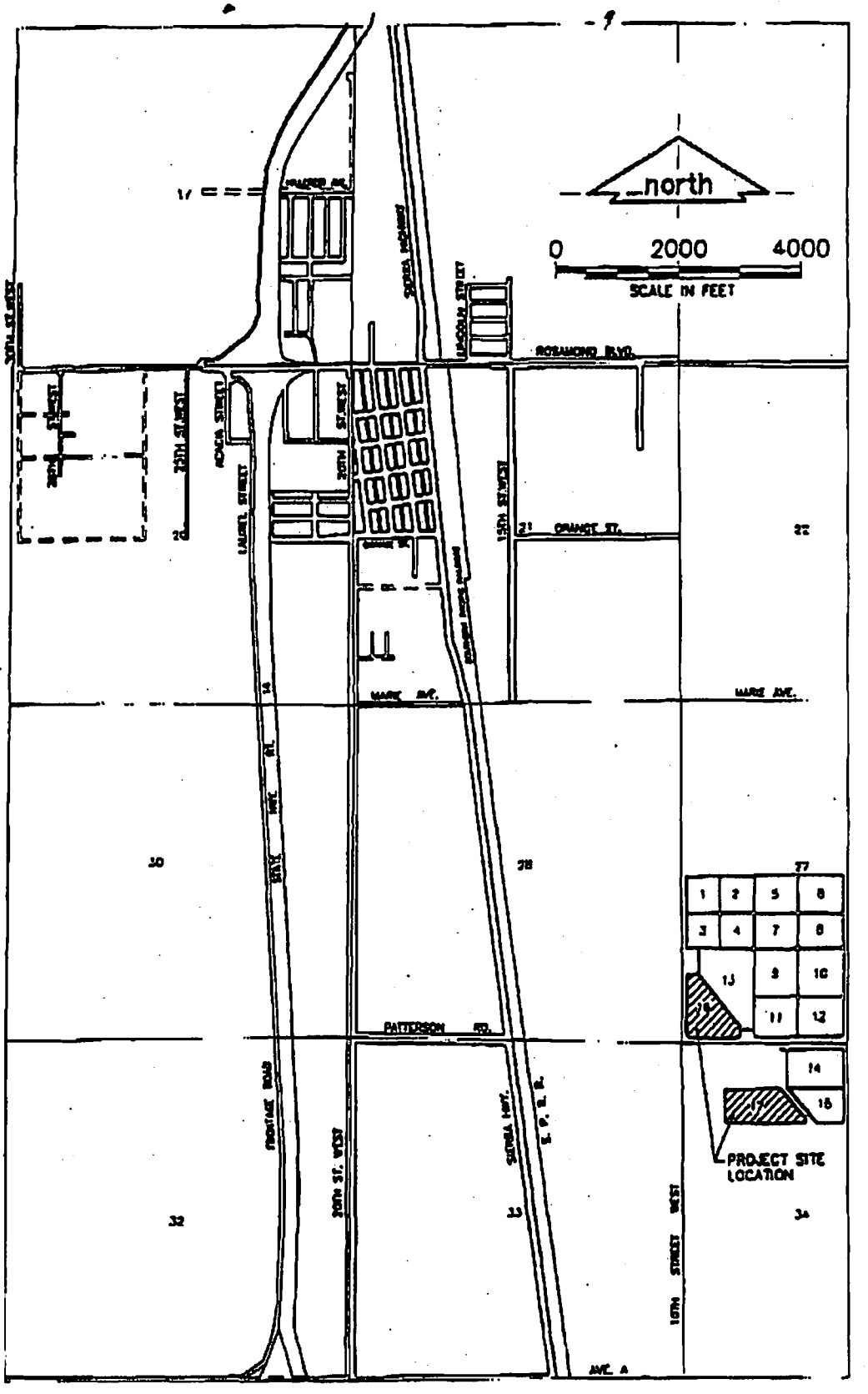
"8. The seventeen oxidation/evaporation ponds at the Facility, are the only authorized disposal sites for wastewater. The land at the Facility is the only authorized disposal site for sludge unless sludge is transported to an authorized offsite location. The authorized disposal sites are located on land owned by the Rosamond CSD."

All Findings, Specifications, and Provisions contained in Board Order Nos. 6-95-107 and 6-95-107A1 not amended by this Order remain in affect.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on May 10, 2000.

for HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A. Location Map
B. WTF Pond Flow Schematic



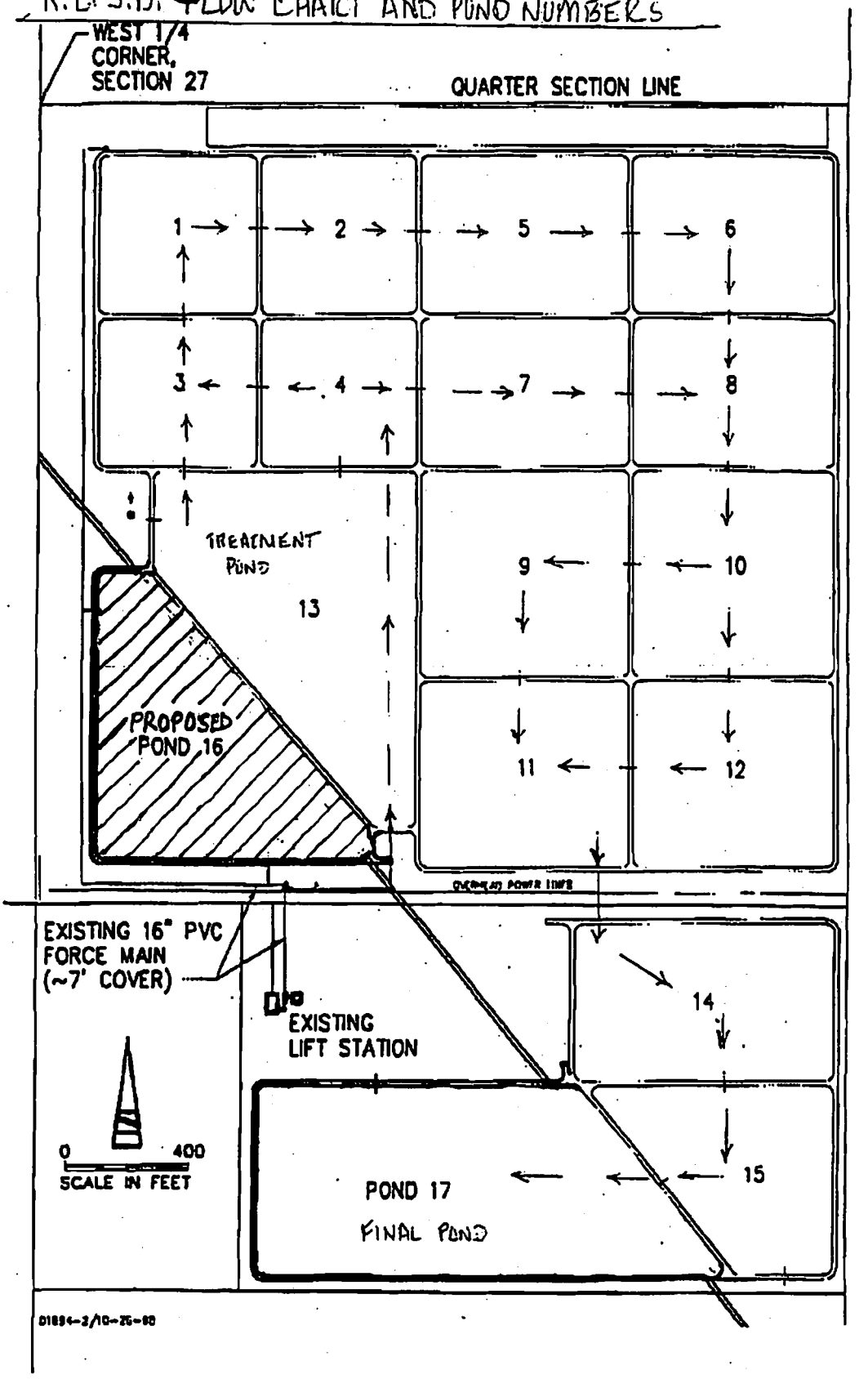
Attachment "A"

LOCATION MAP

R.C.S.D. FLOW CHART AND POND NUMBERS

LEGEND

→ FLOW



DEM
-4-99

Attachment "B"

Ponds 1 Through 15, 17

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. 6-95-107A1
WDID NO. 6B150112001

AMENDMENT TO WASTE DISCHARGE REQUIREMENTS

FOR

ROSAMOND COMMUNITY SERVICES DISTRICT
WASTEWATER TREATMENT FACILITY

Kern County

The California Regional Water Quality Control Board, Lahontan Region (Regional Board) finds:

1. Discharger

The Rosamond Community Services District (CSD) is authorized to discharge domestic wastewater under Board Order No. 6-95-107. For the purposes of this Regional Board Order, The Rosamond CSD is referred to as the "Discharger."

2. Order History

The Regional Board previously adopted revised waste discharge requirements (WDRs) for the discharge under Board Order No. 6-95-107, which was adopted on September 14, 1995.

3. Reason for Action

This Order amends Board Order No. 6-95-107 for the purpose of adding an additional evaporation/oxidation pond and non food-bearing tree areas at the facility as authorized disposal sites. Fourteen ponds are currently in use. A fifteenth evaporation/oxidation pond is being constructed in order to provide additional capacity which is needed due to high wet weather flows and lower than expected evaporation rates.

4. Facility Location

The Facility is located approximately one mile southeast of the Community of Rosamond, Kern County within Section 27, T9N, R12W, SBB&M, as shown on Attachment "A", which is made part of this Order.

5. Facility Description

The Discharger currently discharges wastewater to fourteen existing clay-lined evaporation/oxidation ponds. The Discharger is constructing a fifteenth clay-lined pond which is proposed to receive wastewater overflow from evaporation/oxidation pond No. 14. There are also non food-bearing trees around the northern, southern and eastern boundaries of the facility which the Discharger will be irrigating with treated wastewater.

6. California Environmental Quality Act Compliance

A Negative Declaration was certified by the Rosamond CSD on February 22, 1995 under the California Environmental Quality Act, in accordance with Title 14 of the California Code of Regulations for the additional disposal sites addressed in the amended WDRs. No negative impacts to water quality are expected to occur as the result of the additional disposal sites.

7. Notification of Interested Parties

The Regional Board has notified the Discharger and interested parties of its intent to amend WDRs for the discharge.

8. Consideration of Public Comments

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Discharger shall comply with the following:

1. Finding No. 8 of Board Order 6-95-107 shall be amended to read as follows:

   "8. The fifteen evaporation/oxidation ponds and the non food-bearing tree areas, at the Facility, are the only authorized disposal sites for wastewater. The land at the Facility is the only authorized disposal site for sludge. The authorized disposal sites are located on land owned by the Rosamond CSD."

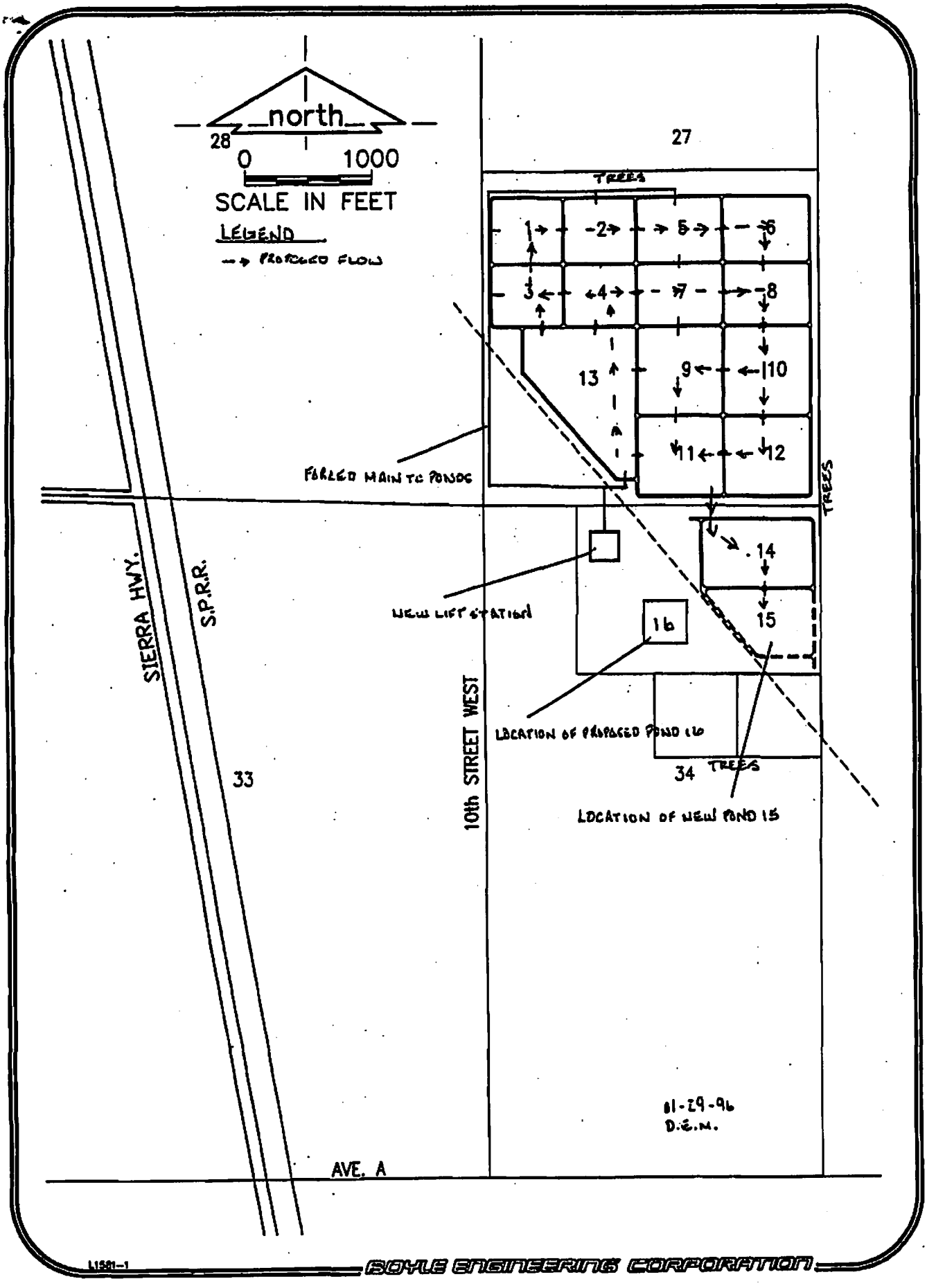
2. All findings, Specifications, and Provisions contained in Board Order No. 6-95-107 not amended by this Order remain in effect.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on July 11, 1996.

Harold J. Singer

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachment: Location Map


north
0
1000
SCALE IN FEET
LEGEND
PROPOSED FLOW
28
27
TREES
1
2
5
6
3
4
7
8
13
9
10
11
12
FORCED MAIN TO PONDS
TREES
14
15
16
NEW LIFT STATION
LOCATION OF PROPOSED POND 16
LOCATION OF NEW POND 15
34
TREES
SIERRA HWY.
S.P.R.R.
33
10th STREET WEST
AVE. A
01-29-96
D.E.M.
L1581-1
BOYLE ENGINEERING CORPORATION

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

BOARD ORDER NO. 6-00-94
WDID NO. 6B150118001

REVISED WASTE DISCHARGE REQUIREMENTS

FOR

THE CITY OF CALIFORNIA CITY
WASTEWATER TREATMENT FACILITY

Kern County

The California Regional Water Quality Control Board, Lahontan Region, (Regional Board) finds:

1. Discharger

The City of California City submitted a complete revised Report of Waste Discharge for an expansion to the California City Wastewater Treatment Facility on July 24, 2000. For the purposes of this Regional Board Order (Order), the City of California City is referred to as the "Discharger."

2. Facility

The California City Wastewater Treatment Facility collects, treats, disposes and recycles domestic wastewater from the Discharger. For the purposes of this Order, the California City Wastewater Treatment Facility is referred to as the "Facility."

3. Order History

The Regional Board previously established Waste Discharge Requirements (WDRs) for the Facility under Board Order No. 6-85-121, which was adopted on October 21, 1985 and Board Order No. 6-93-76, which was adopted on August 12, 1993.

4. Reason for Action

The Regional Board is revising this Order to allow an expansion of the treatment facilities and revise the monitoring program.

5. Facility Location

The Facility is located in Section 18 of T32S, R38E, MDB&M of the USGS California City North Quadrangle. The Facility is located on Nelson Drive approximately two (2.0) miles northeast of the California City Business District, California City, Kern County, as shown on Attachment "A", which is made part of this Order.

6. Description of Facility and Discharge

The existing Facility is designed to treat an average flow of 1.0 million gallons per day (mgd) and a peak flow of 2.0 mgd. Currently, the average influent flow is 0.3 mgd of domestic wastewater. The present treatment processes include an influent pump station, head works consisting of a parshall flume, mechanical bar screen, and communitors, secondary treatment consisting of one extended aeration activated sludge basin, (split into two cells) two clarifiers and a return activated sludge (RAS)/waste activated sludge (WAS) pump station and tertiary treatment facilities consisting of a filter influent pump station, a chemical mixing flocculation tank, upflow sand filtration filters, disinfection in a chlorine contact chamber, a tertiary effluent storage pond and chemical storage facilities for alum, ploymer and chlorine.

7. Disposal and Recycling Area

Secondary treated wastewater, in excess of recycled water use demand, is disposed in seven percolation ponds. Normally, tertiary treated effluent is delivered to the Central Park Lake for storage as a recreational non-contact impoundment and subsequent irrigation of Central Park and the City's Municipal Course (Tierra del Sol). The disposal and recycling sites are shown in Attachment "A", which is made part of this Order. The percolation ponds are also used for disposal when the tertiary facilities are unable to meet recycled water use criteria.

8. Sludge Treatment and Disposal

The WAS is conveyed to 10 lined sand type sludge drying beds for dewatering. The sludge drying beds, with a total area of 15,000 square feet, are located east of the percolation ponds. Dried sludge is removed and disposed at an authorized site, currently a landfill.

9. Expansion

Wastewater from a newly constructed prison will be conveyed to the Facility. In order to accommodate the increased flows from the new prison, the Discharger is implementing a Facility expansion. The expansion involves modifications and improvements of the individual unit processes to achieve a design flow of 1.5 mgd and peak flow of 3.0. mgd.

Based on a recommended capacity evaluation report, the following upgrades are proposed:

a. replace the influent pumps to be capable of pumping the peak 3.0 mgd flow;

b. upgrading the power section of the aeration basin aerators;

c. adding new RAS/WAS pumps;

d. adding nine similar sludge drying beds with an increase of 27,000 square feet to an approximate total of 42,000 square feet drying area;

e. replacing the filter influent pumps;

f. adding two new filter cells for a total operating arrangement of 5+l. Since the existing filters can handle 1.1 mgd and current flow is 0.3 mgd, the new filters will be added when average daily flows are 0.88 mgd (80% capacity); and

g. increase the chlorine contact chamber when average daily flows are 0.88 mgd.

Until items f and g (above) are completed to reach the total 1.5 mgd capacity in the tertiary treatment train, secondary treated flows in excess of 1.1 mgd will be disposed in the percolation ponds. Construction completion is expected to take approximately one year or less.

10. Authorized Disposal Recycling Sites

The percolation ponds are the only authorized disposal sites and Central Park Lake, Central Park, and the Tierra del Sol Golf Course are the only authorized recycling sites for wastewater effluent.

11. Recycling Regulations

The State Department of Health Services has established statewide recycling criteria for the use of recycled water for landscape irrigation as specified in Chapter 3, Division 4, Title 22 of the California Code of Regulations.

In accordance with Section 13523 of the California Water Code, the Regional Board consulted with and received the recommendations of the State Department of Health Services concerning recycling requirements which are incorporated within this Order.

12. Site Geology

The Facility is located in the Fremont Valley in the northwest portion of the Mojave Desert. Fremont Valley is a deep structural depression in the overlap of the east and west strands of the Garlock fault. More than 3,200 feet of unconsolidated and moderately consolidated sediments underlie Fremont Valley with the thickness of unconsolidated sediments changing locally across faults. In general, the upper soils of the Discharger's area consist of a thick alluvial sequence of gravel, sand, silt, and clay, which have eroded from the surrounding hills. The thick alluvial sequence within the site vicinity is underlain by Tertiary volcanic and sedimentary rocks which are underlain by a pretertiary basement complex of granitic rock. The subsurface conditions consist of loose to medium-dense silt and sand with gravel.

13. Site Hydrology

Surface drainage flows to Koehn Dry Lake which is about 10 miles north-northeast of the Facility. The underlying ground water aquifer is generally unconfined, with ground water movement toward the Koehn Dry Lake. The Koehn Hydrologic Area receives subsurface inflow from the Antelope Valley to the south and east. Since there is no known outflow, the ground water basin is considered to be closed. Depth to ground water at the Facility is approximately 200 to 250 feet.

14. Receiving Waters

The receiving waters are the ground waters of the Koehn Hydrologic Area (DWR# 625.40) of the Fremont Hydrologic Unit.

15. South Lahontan Basin Plan

The Regional Board adopted a Water Quality Control Plan for the South Lahontan Region (Basin Plan) which became effective on March 31, 1995. This Order implements the Basin Plan, as amended.

16. Ground Water Beneficial Uses

The beneficial uses of the ground waters of the Koehn Hydrologic Area of the Fremont Hydrologic Unit (also known as the Fremont Valley Ground Water Basin, DWR #6-46) as set forth and defined in the Basin Plan are as follows:

a. Municipal and Domestic supply (MUN);
b. Agricultural Supply (AGR);
c. Industrial Service Supply (IND); and
d. Freshwater Replenishment (FRSH).

17. California Environmental Quality Act (CEQA) Compliance

The Discharger has certified a final Negative Declaration for expansion dated May 16, 2000, in accordance with the CEQA (Public Resources Code Section 21000 et seq.). The project, as approved by the Discharger, will not have a significant effect on water quality.

18. Nondegradation

State Water Resources Control Board Resolution No. 68-16 (Statement of policy with respect to maintaining high quality of waters in California) is called the nondegradation objective in the Basin Plan. This objective requires maintenance of existing high quality in surface waters, ground waters, or wetlands. Whenever the existing quality of water is better than the quality of water established in the basin plan, such existing quality shall be maintained unless appropriate findings are made under Resolution No. 68-16.

Discharges of wastewater, through percolation from the disposal ponds and irrigation of the golf course will result in some degradation of ground water locally over time. This degradation will primarily by an increase in total dissolved solids, nitrate and some other inorganic constituents in areas of percolation. The Regional Board acknowledges that some local degradation will occur to ground water underlying the percolation ponds and irrigation areas. Currently, most of the effluent is used for irrigation and will not result in deep percolation to ground water. This degradation is expected to be minor and no adverse effects on present and future beneficial uses are anticipated.

19. Notification of Interested Parties

The Regional Board has notified the Discharger and interested parties of its intent to revise WDRs for the discharge.

20. Consideration of Comments

The Regional Board, in a public meeting, heard and considered all comments pertaining to the discharge.

IT IS HEREBY ORDERED that the Discharger shall comply with the following:

I. DISCHARGE SPECIFICATIONS

A. Effluent /Discharge Limitations

1. The total average effluent flow of wastewater during a 24-hour period shall not exceed 1.0 million gallons and, following expansion, 1.5 million gallons.

   The current maximum peak instantaneous flow rate of wastewater shall not exceed 2.0 mgd. Following completion of expansion, the maximum peak instantaneous flow rate of wastewater shall not exceed 3.0 mgd.

2. All wastewater discharged to the authorized disposal/recycling sites shall not contain concentrations of parameters in excess of the following limits:

Parameter	Units	Mean[1]	Maximum
BOD[2]	mg/L	30	45
Methylene Blue Active Substances	mg/L	1.0	2.0

3. All wastewater made available to the authorized disposal/recycling sites shall have a pH of not less than 6.0 pH units nor more than 9.0 pH units.

4. All wastewater discharged to the authorized disposal/recycling sites shall have a dissolved oxygen concentration not less than 1.0 mg/l.

B. Receiving Water Limitation

This discharge shall not cause a violation of any applicable water quality standards for receiving water adopted by the Regional Board or the State Water Resources Control Board (SWRCB). The discharge shall not cause the presence of the following substances or conditions in ground or surface waters or wetlands of the Koehn Hydrologic Area of the Fremont Hydrologic Unit.

1. Ground Waters

a. Bacteria - In Ground waters, the median concentration of coliform organisms over any seven-day period shall be less than 1.1/100 milliliter.

b. Chemical Constituents

Ground waters shall not contain concentrations of chemical constituents in excess of the maximum contaminant level (MCL) or secondary maximum contaminant level (SMCL) based upon drinking water standards specified in the following provisions of Title 22 of the California Code of Regulations: Table 64431-A of Section 64431 (Inorganic Chemicals), Table 64431-B of Section 64431 (Fluoride), Table 6444-A of Section 64444 (Organic Chemicals), Table 64449-A of Section 64449 (SMCLs - Consumer Acceptance Limits), and Table 64449-B of Section 64449 (SMCLs - Ranges). This incorporation-by-reference is prospective including future changes to the incorporated provisions as the changes take effect.

Waters designated as AGR shall not contain concentrations of chemical constituents in amounts that adversely affect the water for beneficial uses (i.e., agricultural purposes).

Ground waters shall not contain concentrations of chemical constituents that adversely affect the water for beneficial uses.

c. Radioactivity - Radionuclides shall not be present in concentrations that are deleterious to human, plant, animal, or aquatic life, or that result in the accumulation of radionuclides in the food chain to an extent that it presents a hazard to human, plant, animal, or aquatic life. Waters shall not contain concentrations of radionuclides in excess of limits specified in the California Code of Regulations, Title 22, Chapter 15, Article 5, Section 64443.

d. Taste and Odors - Ground waters shall not contain taste or odor-producing substances in concentrations that cause nuisance or that adversely affect beneficial uses. For ground waters designated as MUNs at a minimum, concentrations shall not exceed adopted SMCLs specified in Table 64449-A of Section 64449 (SMCLs - Ranges), and

Table 64449-B of Section 64449 (SMCLs - Ranges) of Title 22 of the California Code of Regulations, including future changes as the changes take effect.

C. Recycling Requirements

1. All effluent made available for recycling shall comply with the standard Department of Health Services reclamation requirements as specified in §60301 Chapter 3, Division 4, Title 22 of the California Code of Regulations.

2. Recycled water used as a source of supply for Central Park Lake shall be at all times an adequately disinfected, oxidized, clarified, filtered wastewater. The wastewater shall be considered disinfected if at some location in the treatment process the median number of coliform organisms does not exceed 2.2 MPN per 100 milliliters and the number of coliform organisms does not exceed 23 MPN per 100 milliliters in more than one sample within any 30-day period. The median value shall be determined from the bacteriological results of the last seven (7) days for which analyses have been completed.

3. Recycled water shall not exceed an average operating turbidity of two (2) turbidity units and five (5) turbidity units for more than five percent of the time during any 24-hour period.

4. Flows of tertiary treated effluent delivered to the recycling areas shall be limited to 1.1 mgd until certification is provided, signed by a California registered Civil Engineer, that the tertiary plant is capable of handling increased flows.

D. General Requirements and Prohibitions

1. There shall be no discharge, bypass, or diversion of raw or partially treated sewage, sewage sludge, grease, or oils from the collection, transport, treatment, or disposal facilities to adjacent land areas or surface waters.

2. Surface flow or visible discharge of sewage or sewage effluent from the authorized disposal/recycling sites to adjacent land areas or surface waters is prohibited.

3. The freeboard at the lowest point of a pond or lake containing treated effluent shall not be less than two (2.0) feet.

4. The discharge shall not cause a pollution as defined in Section 13050 of the California Water Code, or a threatened pollution.

5. Neither the treatment nor the discharge shall cause a nuisance as defined in Section 13050 of the California Water Code.

6. The discharge of wastewater except to the authorized disposal/recycling sites is prohibited.

7. The discharge of waste, as defined in the California Water Code, which causes violation of any narrative water quality objective contained in the Basin Plan, including the Nondegradration Objective, is prohibited.

8. The discharge of waste which causes violation of any numeric water quality objective contained in the Basin Plan is prohibited.

9. Where any numeric or narrative water quality objective contained in the Basin Plan is already being violated, the discharge of waste which causes further degradation or pollution is prohibited.

10. The Discharger shall comply with all existing federal and state laws and regulations that apply to sewage sludge use and disposal practices.

11. Prior to construction, 80 percent design drawings shall be provided to the Regional Board signed by a California registered Civil Engineer. Within 60 days of completing construction activities that provide for a 1.5 mgd design flow (3.0 mgd peak flow) as-built drawings and certification shall be provided to the Regional Board signed by a California registered Civil Engineer.

12. All sludge drying beds shall be lined to effectively prevent leaching. If synthetic liners are used, the liners shall comply with the flexible membrane liner (FML) standards provided in Title 27, California Code of Regulations for subgrade preparation, thickness, type and construction.

II. PROVISIONS

A. Rescission of Waste Discharge Requirements

Board Order No. 6-93-76 is hereby rescinded.

B. Operator Certificates

The Discharger's wastewater treatment shall be supervised by persons possessing a wastewater treatment plant operator certificate of appropriate grade pursuant to Chapter 3, Subchapter 14, Title 23, California Code of Regulations.

C. Standard Provisions

The Discharger shall comply with the "Standard Provisions for Waste Discharge Requirements", dated September 1, 1994, in Attachment "B", which is made part of this Order.

D. Monitoring and Reporting

1. Pursuant to Section 13267(b), the Discharger shall comply with the Monitoring and Reporting Program No. 00-94 as specified by the Executive Officer.

2. The Discharger shall comply with the "General Provisions for Monitoring and Reporting," dated September 1, 1994, which is attached to and made a part of the Monitoring and Reporting Program.

I, Harold J. Singer, Executive Officer, do hereby certify that the foregoing is a full, true, and correct copy of an Order adopted by the California Regional Water Quality Control Board, Lahontan Region, on November 15, 2000.

HAROLD J. SINGER
EXECUTIVE OFFICER

Attachments: A. Location Map
B. Standard Provisions for Waste Discharge Requirements

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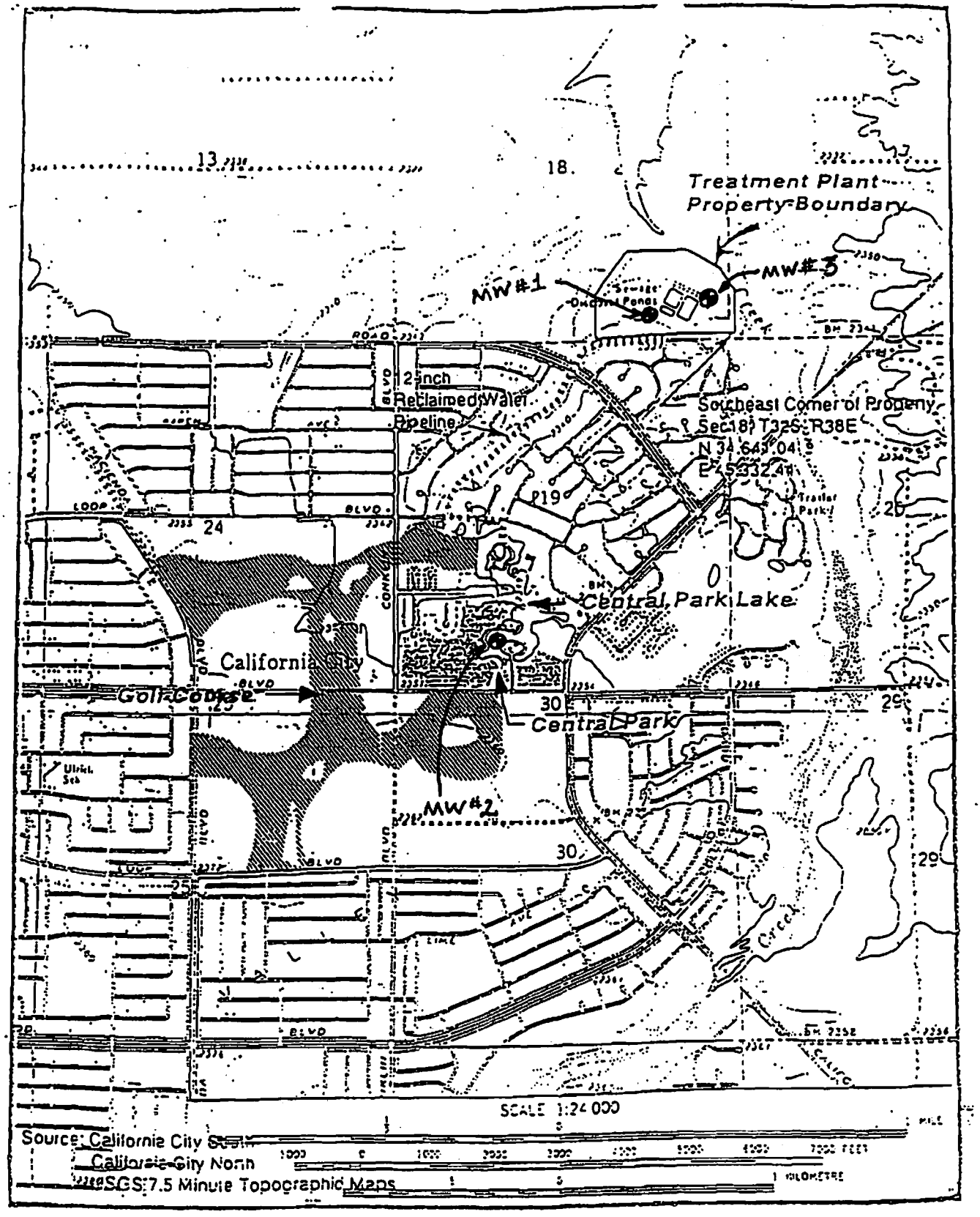
1 The arithmetic mean of lab results for effluent samples collected in a period of 30 consecutive days.
2 Biochemical Oxygen Demand (5 day, 20°C) of a filtered sample using a No.1 Whatman filter or equivalent and reseeded with an unfiltered sample.



ATTACHMENT "A"

LOCATION MAP

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

STANDARD PROVISIONS
FOR WASTE DISCHARGE REQUIREMENTS

ATTACHMENT B

1. Inspection and Entry

The Discharger shall permit Regional Board staff:

a. to enter upon premises in which an effluent source is located or in which any required records are kept;

b. to copy any records relating to the discharge or relating to compliance with the Waste Discharge Requirements;

c. to inspect monitoring equipment or records; and

d. to sample any discharge.

2. Reporting Requirements

a. Pursuant to California Water Code 13267(b), the Discharger shall immediately notify the Regional Board by telephone whenever an adverse condition occurred as a result of this discharge; written confirmation shall follow within two weeks. An adverse condition includes, but is not limited to, spills of petroleum products or toxic chemicals, or damage to control facilities that could affect compliance.

b. Pursuant to California Water Code Section 13260(c), any proposed material change in the character of the waste, manner or method of treatment or disposal, increase of discharge, or location of discharge, shall be reported to the Regional Board at least 120 days in advance of implementation of any such proposal. This shall include, but not limited to, all significant soil disturbances.

c. The Owners/Discharger of property subject to Waste Discharge Requirements shall be considered to have a continuing responsibility for ensuring compliance with applicable Waste Discharge Requirements in the operations or use of the owned property. Pursuant to California Water Code Section 13260(c), any change in the ownership and/or operation of property subject to the Waste Discharge Requirements shall be reported to the Regional Board. Notification of applicable Waste Discharge Requirements shall be furnished in writing to the new owners and/or operators and a copy of such notification shall be sent to the Regional Board.

d. If a Discharger becomes aware that any information submitted to the Regional Board is incorrect, the Discharger shall immediately notify the Regional Board, in writing and correct that information.

e. Reports required by the Waste Discharge Requirements, and other information requested by the Regional Board, must be signed by a duly authorized representative of the Discharger. Under Section 13268 of the California Water Code, any person failing or refusing to furnish technical or monitoring reports, or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation.

f. If the Discharger becomes aware that their Waste Discharge Requirements (or permit) is no longer needed (because the project will not be built or the discharge will cease) the Discharger shall notify the Regional Board in writing and request that their Waste Discharge Requirements (or permit) be rescinded.

3. Right to Revise Waste Discharge Requirements

The Regional Board reserves the privilege of changing all or any portion of the Waste Discharge Requirements upon legal notice to and after opportunity to be heard is given to all concerned parties.

4. Duty to Comply

Failure to comply with the Waste Discharge Requirements may constitute a violation of the California Water Code and is grounds for enforcement action or for permit termination, revocation and reissuance, or modification.

5. Duty to Mitigate

The Discharger shall take all reasonable steps to minimize or prevent any discharge in violation of the Waste Discharge Requirements which has a reasonable likelihood of adversely affecting human health or the environment.

6. Proper Operation and Maintenance

The Discharger shall at all times properly operate and maintain all facilities and systems of treatment and control (and related appurtenances) that are installed or used by the Discharger to achieve compliance with the Waste Discharge Requirements. Proper operation and maintenance includes adequate laboratory control, where appropriate, and appropriate quality assurance procedures. This provision requires the operation of backup or auxiliary facilities or similar systems that are installed by the Discharger, when necessary to achieve compliance with the conditions of the Waste Discharge Requirements.

7. Waste Discharge Requirement Actions

The Waste Discharge Requirements may be modified, revoked and reissued, or terminated for cause. The filing of a request by the Discharger for waste discharge requirement modification, revocation and reissuance, termination, or a notification of planned changes or anticipated noncompliance, does not stay any of the Waste Discharge Requirements conditions.

8. Property Rights

The Waste Discharge Requirements do not convey any property rights of any sort, or any exclusive privileges, nor does it authorize any injury to private property or any invasion of personal rights, nor any infringement of federal, state or local laws or regulations.

9. Enforcement

The California Water Code provides for civil liability and criminal penalties for violations or threatened violations of the Waste Discharge Requirements including imposition of civil liability or referral to the Attorney General.

10. Availability

A copy of the Waste Discharge Requirements shall kept and maintained by the Discharger and be available at all times to operating personnel.

11. Severability

Provisions of the Waste Discharge Requirements are severable. If any provision of the requirements is found invalid, the remainder of the requirements shall not be affected.

12. Public Access

General public access shall be effectively excluded from disposal/treatment facilities.

13. Transfers

Providing there is no material change in the operation of the facility, this Order may be transferred to a new owner or operator. The owner/operator must request the transfer in writing and receive written approval from the Regional Board's Executive Officer.

14. Definitions

a. "Surface waters" as used in this Order, include, but are not limited to, live streams, either perennial or ephemeral, which flow in natural or artificial water courses and natural lakes and artificial impoundments of waters. "Surface waters" does not include artificial water courses or impoundments used exclusively for wastewater disposal.

b. "Ground waters" as used in this Order, include, but are not limited to, all subsurface waters being above atmospheric pressure and the capillary fringe of these waters.

15. Storm Protection

a. All facilities used for collection, transport, treatment, storage, or disposal of waste shall be adequately protected against overflow, washout, inundation, structural damage or a significant reduction in efficiency resulting from a storm or flood having a recurrence interval of once in 100 years.

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

REVISED MONITORING AND REPORTING PROGRAM NO. 00-94
WDID NO. 6B150118001

FOR

THE CITY OF CALIFORNIA CITY
WASTEWATER TREATMENT FACILITY

Kern County

I. MONITORING

The Discharger shall monitor and report the following:

A. Flow Monitoring

1. The total volume, in million gallons, of wastewater flow to the Facility for each day.

2. The total volume, in million gallons, of wastewater flow to the Facility calculated for each month.

3. The maximum instantaneous flow rate, in million gallons per day (mgd), of wastewater to the treatment Facility that occurs each day.

4. The average flow rate, in mgd, of wastewater flow to the Facility to the calculated for each month.

5. The freeboard (distance from the top of the lowest part of the dike to the wastewater surface in a pond or lake) measured each month in each pond or lake when the pond is accessible. If the pond or lake does not contain wastewater, indicate that it is empty. If the ponds or lakes are inaccessible, indicate so and provide an explanation why they are inaccessible.

6. The total flow, in mgd, of tertiary treated effluent delivered to the Central Park Lake for each day.

B. Facility Effluent Monitoring

1. Grab samples of treated effluent discharged into the storage pond shall be collected prior to chlorination and analyzed to determine the magnitude of the following parameters. If treated effluent is discharged into the percolation ponds during the reporting period, a sample shall also be collected from the first pond in which percolation may occur.

Parameter	Units	Frequency
BOD[1]	mg/L	Twice per month
Dissolved Oxygen	mg/L	Twice per month
pH	pH units	Twice per month
Methylene Blue Active Substances	mg/L	Twice per month
Oil & Grease	mg/L	Twice per month
Kjeldahl Nitrogen	mg/L as N	Monthly
Nitrate Nitrogen	mg/L as N	Monthly
Ammonia Nitrogen	mg/L as N	Monthly
Total Dissolved Solids (TDS)	mg/L	Semiannually
Chloride	mg/L	Semiannually
Sodium	mg/L	Semiannually
Sulfate	mg/L	Semiannually
Total Hardness	mg/L as $CaCO_3$	Semiannually
Boron	mg/L	Semiannually
Fluoride	mg/L	Semiannually
Priority Pollutants [2/3]	µg/L	Annually
Methyl Teritiary Butyl Ether	µg/L	Annually

2. Grab samples of chlorinated tertiary effluent discharged to recycling sites shall be collected and analyzed to determine the magnitude of the following parameter:

Parameter	Units	Frequency
Total Coliform	MPN/100ml	Daily
Turbidity	NTU	Daily

C. Ground Water Monitoring

Beginning immediately, grab samples from monitoring wells 1, 2 and 3 shall be collected from the entire thickness or the upper 20 feet, whichever is less, of the uppermost ground water bearing zone and analyzed to determine the magnitude of the following parameters:

Parameter	Units	Frequency
Methylene Blue Active Substances	mg/L	Semiannually
Total Dissolved Solids	mg/L	Semiannually
Kjeldahl Nitrogen	mg/L as N	Semiannually
Nitrate Nitrogen	mg/L as N	Semiannually
Ammonia Nitrogen	mg/L as N	Semiannually
Priority Pollutants [2/3]	µg/L	Annually
Methyl Teritiary Butyl Ether	µg/L	Annually

1. Field Parameters - Each time a ground water monitoring well is sampled, the following field parameters shall be monitored and reported.

Table 1

Parameter	Units
Standing Water Level (SWL)	Feet above msl
Electrical Conductivity (E_c)	µmhos/cm
Turbidity	NTU
pH	0-14
Temperature (T)	F° or C°

2. For each ground water sampling event, submit a map showing well locations and ground water contours. Include elevations from any adjacent wells that are sampled by the California City Wastewater Treatment Facility personnel.

D. Sludge Monitoring

1. Total quantity of sludge generated during the monitoring period.

2. Date and quantity of sludge removed off site, location of use, recipient (including name and address) and sludge disposal method (including crops grown if appropriate) for all sludge removed off site.

3. Cumulative total quantity of sludge currently stockpiled on site including the quantity of sludge added to the stock pile during this monitoring period.

4. For wastewater sludge removed from the drying beds, stockpiled on-site, or discharged off-site during the previous month, a representative sample shall be collected and analyzed for the following constituents:

   a. total kjeldahl nitrogen (as N);

   b. nitrate nitrogen (as N);

c. ammonia nitrogen (as N);

d. total phosphate (as P); and

e. parameters listed in Section 66699 (b) and (c) of Chapter 30, Division 4, Title 22 of the California Code of Regulations.

The Discharger shall make a determination whether the analyses indicate that the sludge shall be considered a hazardous material.

E. Pretreatment

1. A summary of activities undertaken to monitor and regulate industrial wastewater sources shall be prepared and submitted with each annual report.

   a. An inventory of significant industrial users, including names, addresses, categories, industrial pollutants, and volumes. A significant industrial user is either:

      (1) an industrial user discharging more that 25,000 gallons per day to the treatment plant,

      (2) is a categorical industrial user as defined in 40 CFR 400-471, or

      (3) can pass through or cause interference to the wastewater treatment plant.

   b. A discussion of upset, interference, or pass through incidents, if any, at the treatment plant which the Discharger knows or suspects was caused by industrial users.

   c. A discussion of enforcement actions taken or proposed.

2. A summary of the pretreatment functions including, but not limited to:

   a. necessary legal authorities;

   b. pretreatment requirements; and

   c. status of funding and personnel to implement the pretreatment program.

F. Off-site Disposal

The Discharger shall include in each monitoring report the volume and type of all waste hauled off-site for disposal. The person or company doing the hauling and the legal point of disposal shall also be recorded.

G. Operation and Maintenance

A brief summary of any operational problems and maintenance activities shall be submitted to the Regional Board with each monitoring report.

This summary shall discuss:

1. Any modifications or additions to the wastewater conveyance system, treatment facilities, or disposal facilities;

2. Any major maintenance conducted on the wastewater conveyance system, treatment facilities, or disposal facilities;

3. Any major problems occurring in wastewater conveyance system, treatment facilities, or disposal facilities; and

4. The calibration of any wastewater flow measuring devices.

II. REPORTING

A. General Provisions

1. In accordance with General Provisions 3.a., the Discharger shall make a compliance statement in each submitted monitoring report, noting each violation that occurred during the reporting period and actions taken and/or proposed to return into compliance.

2. Pursuant to General Provisions 1.d of the General Provisions for Monitoring and Reporting, the Discharger shall submit by **December 30, 2000**, a Sampling and Analysis Plan (SAP) to the Regional Board for approval. The SAP shall define methods for sample collection, monitoring well purging, preservation and analysis shipment protocol, field procedures, laboratory Quality Assurance/Quality Control and Data Quality for all constituents listed in this Order.

B. Submittal Periods

1. Monthly monitoring reports containing the above required information shall be submitted to the Regional Board beginning on **January 15, 2001**. Subsequent monitoring reports shall be submitted to the Regional Board by the **15th day following the end of each month**.

2. An annual monitoring report shall be submitted along with the quarterly monitoring report to the Regional Board by **January 15th of each year**.

Ordered by: Harold J. Singer
HAROLD J. SINGER
EXECUTIVE OFFICER

Dated: November 15, 2000

Attachments: A. List of Priority Pollutants from Appendix 4, Tables 2a, b, c and d of SWRCB Resolution 2000 – 015 (Policy for Implementation of Toxics Standards for Inland Surface Waters, Enclosed Bay, and Estuaries of California)

B. General Provisions for Monitoring and Reporting Program

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1 Biochemical Oxygen Demand (5 day, 20°C) of a filtered samples using a No. 1 Whatman filter or equivalent and reseeded with an unfiltered sample.

2 Analysis shall be conducted for those substances included on the EPA list of Priority Pollutants (refer to Attachment A) and all other substances known to be discharged to the California City Area sewer system.

3 Purgeable organics analysis shall be conducted in accordance with EPA method 601, 40 CFR part 136, Appendix A.
Base/neutral/acid extractable organics analysis shall be conducted in accordance with EPA method 625, 40 CFR, part 136, Appendix A.
Purgeable Aromatics analysis shall be conducted in accordance with EPA method 602, 40 CFR, part 136, Appendix A.

APPENDIX 4

SWRCB Minimum Levels in ppb (µg/L)

The Minimum Levels (MLs) in this appendix are for use in reporting and compliance determination purposes in accordance with section 2.4 of this Policy. These MLs were derived from data for priority pollutants provided by State certified analytical laboratories in 1997 and 1998. These MLs shall be used until new values are adopted by the SWRCB and become effective. The following tables (Tables 2a - 2d) present MLs for four major chemical groupings: volatile substances, semi-volatile substances, inorganics, and pesticides & PCBs.

Table 2a - VOLATILE SUBSTANCES*	GC	GCMS
1,1 Dichloroethane	0.5	1
1,1 Dichloroethene	0.5	2
1,1,1 Trichloroethane	0.5	2
1,1,2 Trichloroethane	0.5	2
1,1,2,2 Tetrachloroethane	0.5	1
1,2 Dichlorobenzene (volatile)	0.5	2
1,2 Dichloroethane	0.5	2
1,2 Dichloropropane	0.5	1
1,3 Dichlorobenzene (volatile)	0.5	2
1,3 Dichloropropene (volatile)	0.5	2
1,4 Dichlorobenzene (volatile)	0.5	2
Acrolein	2.0	5
Acrylonitrile	2.0	2
Benzene	0.5	2
Bromoform	0.5	2
Bromomethane	1.0	2
Carbon Tetrachloride	0.5	2
Chlorobenzene	0.5	2
Chlorodibromo-methane	0.5	2
Chloroethane	0.5	2
Chloroform	0.5	2
Chloromethane	0.5	2
Dichlorobromo-methane	0.5	2
Dichloromethane	0.5	2
Ethylbenzene	0.5	2
Tetrachloroethene	0.5	2
Toluene	0.5	2
trans-1,2 Dichloroethylene	0.5	1
Trichloroethene	0.5	2
Vinyl Chloride	0.5	2

*The normal method-specific factor for these substances is 1, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance.

Table 2b - SEMI-VOLATILE SUBSTANCES*	GC	GCMS	LC	COLOR
1,2 Benzanthracene	10	5		
1,2 Dichlorobenzene (semivolatile)	2	2		
1,2 Diphenylhydrazine		1		
1,2,4 Trichlorobenzene	1	5		
1,3 Dichlorobenzene (semivolatile)	2	1		
1,4 Dichlorobenzene (semivolatile)	2	1		
2 Chlorophenol	2	5		
2,4 Dichlorophenol	1	5		
2,4 Dimethylphenol	1	2		
2,4 Dinitrophenol	5	5		
2,4 Dinitrotoluene	10	5		
2,4,6 Trichlorophenol	10	10		
2,6 Dinitrotoluene		5		
2- Nitrophenol		10		
2-Chloroethyl vinyl ether	1	1		
2-Chloronaphthalene		10		
3,3' Dichlorobenzidine		5		
3,4 Benzofluoranthene		10	10	
4 Chloro-3-methylphenol	5	1		
4,6 Dinitro-2-methylphenol	10	5		
4- Nitrophenol	5	10		
4-Bromophenyl phenyl ether	10	5		
4-Chlorophenyl phenyl ether		5		
Acenaphthene	1	1	0.5	
Acenaphthylene		10	0.2	
Anthracene		10	2	
Benzidine		5		
Benzo(a) pyrene(3,4 Benzopyrene)		10	2	
Benzo(g,h,i)perylene		5	0.1	
Benzo(k)fluoranthene		10	2	
bis 2-(1-Chloroethoxyl) methane		5		
bis(2-chloroethyl) ether	10	1		
bis(2-Chloroisopropyl) ether	10	2		
bis(2-Ethylhexyl) phthalate	10	5		
Butyl benzyl phthalate	10	10		
Chrysene		10	5	
di-n-Butyl phthalate		10		
di-n-Octyl phthalate		10		
Dibenzo(a,h)-anthracene		10	0.1	
Diethyl phthalate	10	2		
Dimethyl phthalate	10	2		
Fluoranthene	10	1	0.05	
Fluorene		10	0.1	
Hexachloro-cyclopentadiene	5	5		

Table 2b - SEMI-VOLATILE SUBSTANCES*	GC	GCMS	LC	COLOR
Hexachlorobenzene	5	1		
Hexachlorobutadiene	5	1		
Hexachloroethane	5	1		
Indeno(1,2,3,cd)-pyrene		10	0.05	
Isophorone	10	1		
N-Nitroso diphenyl amine	10	1		
N-Nitroso-dimethyl amine	10	5		
N-Nitroso -di n-propyl amine	10	5		
Naphthalene	10	1	0.2	
Nitrobenzene	10	1		
Pentachlorophenol	1	5		
Phenanthrene		5	0.05	
Phenol **	1	1		50
Pyrene		10	0.05	

* With the exception of phenol by colorimetric technique, the normal method-specific factor for these substances is 1000, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance multiplied by 1000.

** Phenol by colorimetric technique has a factor of 1.

Table 2c – INORGANICS*	FAA	GFAA	ICP	ICPMS	SPGFAA	HYDRIDE	CVAA	COLOR	DCP
Antimony	10	5	50	0.5	5	0.5			1000
Arsenic		2	10	2	2	1		20	1000
Beryllium	20	0.5	2	0.5	1				1000
Cadmium	10	0.5	10	0.25	0.5				1000
Chromium (total)	50	2	10	0.5	1				1000
Chromium VI	5							10	
Copper	25	5	10	0.5	2				1000
Cyanide								5	
Lead	20	5	5	0.5	2				10,000
Mercury				0.5			0.2		
Nickel	50	5	20	1	5				1000
Selenium		5	10	2	5	1			1000
Silver	10	1	10	0.25	2				1000
Thallium	10	2	10	1	5				1000
Zinc	20		20	1	10				1000

* The normal method-specific factor for these substances is 1, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance.

Table 2d - PESTICIDES – PCBs*	GC
4,4'-DDD	0.05
4,4'-DDE	0.05
4,4'-DDT	0.01
a-Endosulfan	0.02
a-Hexachloro-cyclohexane	0.01
Aldrin	0.005
b-Endosulfan	0.01
b-Hexachloro-cyclohexane	0.005
Chlordane	0.1
d-Hexachloro-cyclohexane	0.005
Dieldrin	0.01
Endosulfan Sulfate	0.05
Endrin	0.01
Endrin Aldehyde	0.01
Heptachlor	0.01
Heptachlor Epoxide	0.01
Lindane(g-Hexachloro-cyclohexane)	0.02
PCB 1016	0.5
PCB 1221	0.5
PCB 1232	0.5
PCB 1242	0.5
PCB 1248	0.5
PCB 1254	0.5
PCB 1260	0.5
Toxaphene	0.5

* The normal method-specific factor for these substances is 100, therefore, the lowest standard concentration in the calibration curve is equal to the above ML value for each substance multiplied by 100.

Techniques:

GC - Gas Chromatography
GCMS - Gas Chromatography/Mass Spectrometry
HRGCMS - High Resolution Gas Chromatography/Mass Spectrometry (i.e., EPA 1613, 1624, or 1625)
LC - High Pressure Liquid Chromatography
FAA - Flame Atomic Absorption
GFAA - Graphite Furnace Atomic Absorption
HYDRIDE - Gaseous Hydride Atomic Absorption
CVAA - Cold Vapor Atomic Absorption
ICP - Inductively Coupled Plasma
ICPMS - Inductively Coupled Plasma/Mass Spectrometry
SPGFAA - Stabilized Platform Graphite Furnace Atomic Absorption (i.e., EPA 200.9)
DCP - Direct Current Plasma
COLOR - Colorimetric

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD
LAHONTAN REGION

GENERAL PROVISIONS
FOR MONITORING AND REPORTING

ATTACHMENT B

1. SAMPLING AND ANALYSIS

a. All analyses shall be performed in accordance with the current edition(s) of the following documents:

i. Standard Methods for the Examination of Water and Wastewater
ii. Methods for Chemical Analysis of Water and Wastes, EPA

b. All analyses shall be performed in a laboratory certified to perform such analyses by the California State Department of Health Services or a laboratory approved by the Regional Board. Specific methods of analysis must be identified on each laboratory report.

c. Any modifications to the above methods to eliminate known interferences shall be reported with the sample results. The method used shall also be reported. If methods other than USEPA approved methods or Standard Methods are used, the exact methodology must be submitted for review and must be approved by the Regional Board prior to use.

d. The Discharger shall establish chain-of-custody procedures to ensure that specific individuals are responsible for sample integrity from commencement of sample collection through delivery to an approved laboratory. Sample collection, storage and analysis shall be conducted in accordance with an approved Sampling and Analysis Plan (SAP). The most recent version of the approved SAP shall be kept at the facility.

e. The Discharger shall calibrate and perform maintenance procedures on all monitoring instruments and equipment to ensure accuracy of measurements, or shall ensure that both activities will be conducted. The calibration of any wastewater flow measuring device shall be recorded and maintained in the permanent log book described in 2.b, below.

f. A grab sample is defined as an individual sample collected in fewer than 15 minutes.

g. A composite sample is defined as a combination of no fewer than eight individual samples obtained over the specified sampling period at equal intervals. The volume of each individual sample shall be proportional to the discharge flow rate at the time of sampling. The sampling period shall equal the discharge period, or 24 hours, whichever period is shorter.

2. OPERATIONAL REQUIREMENTS

a. Sample Results

Pursuant to California Water Code Section 13267(b), the Discharger shall maintain all sampling and analytical results including: strip charts; date, exact place, and time of sampling; date analyses were performed; sample collector's name; analyst's name; analytical techniques used; and results of all analyses. Such records shall be obtained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

b. Operational Log

Pursuant to California Water Code Section 13267(b), an operation and maintenance log shall be maintained at the facility. All monitoring and reporting data shall be recorded in a permanent log book.

3. REPORTING

a. For every item where the requirements are not met, the Discharger shall submit a statement of the actions undertaken or proposed which will bring the discharge into full compliance with requirements at the earliest time and submit a timetable for correction.

b. Pursuant to California Water Code Section 13267(b), all sampling shall be made available to the Regional Board upon request. Results shall be retained for a minimum of three years. This period of retention shall be extended during the course of any unresolved litigation regarding this discharge, or when requested by the Regional Board.

c. The Discharger shall provide a brief summary of any operational problems and maintenance activities to the Regional Board with each monitoring report. Any modifications or additions to, or any major maintenance conducted on, or any major problems occurring to the wastewater conveyance system, treatment facilities, or disposal facilities shall be included in this summary.

d. Monitoring reports shall be signed by:

i. In the case of a corporation, by a principal executive officer at least of the level of vice-president or his duly authorized representative, if such representative is responsible for the overall operation of the facility from which the discharge originates;

ii. In the case of a partnership, by a general partner;

iii. In the case of a sole proprietorship, by the proprietor;

iv. In the case of a municipal, state or other public facility, by either a principal executive officer, ranking elected official, or other duly authorized employee.

e. Monitoring reports are to include the following:

i. Name and telephone number of individual who can answer questions about the report.

ii. The Monitoring and Reporting Program Number.

iii. WDID Number.

f. Modifications

This Monitoring and Reporting Program may be modified at the discretion of the Regional Board Executive Officer.

4. NONCOMPLIANCE

Under Section 13268 of the Water Code, any person failing or refusing to furnish technical or monitoring reports or falsifying any information provided therein, is guilty of a misdemeanor and may be liable civilly in an amount of up to one thousand dollars ($1,000) for each day of violation under Section 13268 of the Water Code.

PLANNING DEPARTMENT

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RESOURCE MANAGEMENT AGENCY

Ted James, Interim RMA DIRECTOR
Community & Economic Development Department
Engineering & Survey Services Department
Environmental Health Services Department
Planning Department
Roads Department

January 15, 2010

File: Beacon Solar Energy
FPL

California Energy Commission
Attn: Eric Solorio
1516 Ninth Street MS-15
Sacramento, California 95814

RE: Additional Kern County Planning Department Comments
Final Staff Assessment for the Proposed Beacon Solar Energy Project (08-AFC-2)
Impacts on Public Services

Dear Mr. Solorio,

The Kern County Planning Department appreciates the opportunity to participate in the permitting process and to provide comments and request changes to the recommended conditions of certification on the application for certification by Beacon Solar, LLC for a proposed 250 MW solar electric generating facility in unincorporated eastern Kern County. The following are additional staff comments and requests for changes based on our consultation with the County Administrative Office for impacts on public services.

The analysis appears to be deficient in the discussion of the significant impacts on County public services from the introduction of this industrial power plant on vacant land. Kern County is very experienced with heavy industry, power plants and internal fire protection control measures. While important, they are not sufficient to protect the employees, traveling public and surrounding potential for wildfire and potential injuries without backup from Kern County Fire Department and other emergency service providers.

The Kern County Board of Supervisors authorized the development of a Capital Improvement Plan (CIP) that would provide information that represents the best current understanding of the new public facilities that will be needed to serve the county's projected development through 2030. The scope of services includes parks, libraries, sheriff (public protection and investigation), fire, animal control, public health, landfill/transfer stations, and general government. Roads and sewer costs and impacts are not part of this program. A CIP was approved by the Board in 2008 and in March 2009, a Public Facilities Impact Fee Study was reviewed by the Board of Supervisors and finalized May 2009. A copy of this report has been provided to the CEC Staff. This report includes the fees necessary for residential, commercial and industrial projects, broken down into Mountain, Desert and Valley areas, to ensure that new development pays the capital costs associated with growth. The baseline for the study used the

anticipated property taxes and growth in facilities required for that growth. The study concluded that the property taxes would not meet the needs for expanded facilities when new development occurred. .

This project as a solar thermal project will have impacts from the categories of countywide public protection, sheriff patrol and investigation and fire protection. The estimated fee based on the 1226 acres of coverage ($576.88 per 1000 square feet) would be $ 31,813,178.

Staff is requesting a condition of approval that requires this amount be allocated over 30 years, as a per year estimated fee of $1,590,658.90 payable to the Kern County Auditor –Controller by April 30 of each calendar year. The rate amount of $576.88 is to be adjusted annually for inflation using the US. Cities Average-All Urban Consumers (CPI-U) Price Index provided by the US Bureau of Labor Statistics. As the fee was calculated to close the gap from assessment of industrial property taxes in the study that were calculated based on a fully assessed industrial project and not the reduced valuation of this solar thermal project it can be concluded that the proposed fee is actually does not fully mitigate the impacts. However, to support renewable energy the CAO has indicated that this amount will be sufficient for the County to consider the impacts mitigated

Kern County supports all forms of renewable energy if appropriately sited with mitigation that provides protection for existing property owners and Kern County interests. Thank you for your partnership on this opportunity for Kern County to contribute to energy solutions through commercial solar development in California.

Sincerely,

Lorelei H. Oviatt, AICP
Special Projects Division Chief

cc: Ted James, RMA Director (Interim), Planning Director
Supervisor McQuiston
Supervisor Maben
CAO – Adel Klein
Applicant – Beacon Solar

KERN COUNTY

PUBLIC FACILITIES IMPACT FEE STUDY

DRAFT

MAY 18, 2009

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Executive Summary

This report summarizes an analysis of the need for public facilities and capital improvements to support future development within Kern County through 2030. It is the County's intent that the costs representing future development's share of these facilities and improvements be imposed on that development in the form of a development impact fee, also known as a public facilities fee.

Background and Study Objectives

The primary policy objective of a public facilities fee program is to ensure that new development pays the capital costs associated with growth. The primary purpose of this report is to calculate and present fees that will enable the County to expand its inventory of public facilities – and therefore maintain its facilities standards – as new development leads to service population increases.

In 2008, the County adopted a Capital Improvement Plan (CIP) that documented the best current understanding of the public facilities that will be needed to accommodate new development anticipated through 2030. The CIP identified appropriate facility demand standards to be used as a basis for estimating future facility needs. The impact fees documented in this study are based on the facility needs identified in the CIP. Since adopting the CIP, the County has identified some additional facilities that will be needed to accommodate new development. Those facilities are also included in the impact fee program.

The County can impose public facilities fees in unincorporated areas under authority granted by the *Mitigation Fee Act* (the *Act*), contained in *California Government Code Sections 66000 et seq*. For County services that also serve development in incorporated cities in Kern County, this report also presents the appropriate fees for development in incorporated areas. To recover the fair-share costs allocated to incorporated development, the County will need the cities to adopt those fees on its behalf. This report provides the necessary findings required by the *Act* for adoption of the fees presented in the fee schedules contained herein.

Fee Categories

The public facilities and improvements included in this analysis of the County's public facilities fee program are divided into the fee categories listed below:

- Countywide Public Protection Facilities;
- Sheriff Patrol and Investigation Facilities;
- Library Facilities;
- Animal Control Facilities;
- Park Facilities;
- Fire Facilities;
- Waste Management Facilities;

- Public Health Facilities; and
- General Government Facilities.

Fee Zones

Varying levels of facility investment are needed in different zones of the County. For sheriff patrol and investigation, library, and fire facilities, the County is divided into three impact fee zones. By dividing the County into zones, the impact fees for each development project will be based on the standards at which facilities are needed in the area of the County where the project is located.

The fee zones used in this study are the Desert Zone, Mountain Zone, and Valley Zone, as defined in the Kern County General Plan. A zone-based fee approach is not appropriate for the other facility categories because levels of service do not vary based on geography. Facilities in these categories are part of a unified system of facilities serving the entire County, so the fees are not calculated at separate levels for each zone.

Use of Fee Revenues

Impact fee revenue must be spent on new facilities or expansion of current facilities to serve new development. Facilities can be generally defined as capital acquisition items with a useful life greater than five years. Impact fee revenue can be spent on the following capital facilities to serve new development: land acquisition, construction of buildings, vehicles, equipment, information technology, library collections, waste management facilities, software licenses and equipment.

The County recently adopted a Capital Improvement Plan (CIP) that identifies the capital facilities that will be needed to accommodate development anticipated through 2030. The County will use impact fee revenue to fund the facilities identified in the CIP, as well as some additional facilities identified after the CIP was adopted. The additional facilities will be added to the CIP in future updates of the document.

Facility Standards and Costs of Growth

This report uses facility cost standards to determine the approximate cost of facilities required to accommodate growth per unit of new development. A cost standard for each fee category considered in this study is derived from an examination of the existing inventory of facilities and planned facilities identified in the CIP. To support the findings required by the *Act*, this study ensures that there is a reasonable relationship between new development, the amount of the fee, and facilities funded by the fee.

Depending on the facility category, there currently may or may not be sufficient facilities to serve existing development. If the existing facilities are below the facility cost standard used as the basis for the impact fee, a deficiency exists. In this case, the County must allocate the cost of planned facilities between new and existing development. Public facilities fees may be use to fund facilities needed to serve new development or new development's fair share of facilities needed to achieve a level of service that is consistent with the General Plan.

Fee Schedules

Not all development projects will be subject to all of the impact fees contained in this report. The applicability of the fees is based on the services provided by the County to a given area of the County. **Table E.1** summarizes the applicability of each of the proposed impact fees.

Table E.1: Impact Fee Applicability

Fee Category	Geographic Applicability	Service Population	
		Residential	Non-Residential
Public Protection	Countywide	✓	✓
Sheriff Patrol & Investigation	Unincorporated	✓	✓
Library	Countywide	✓	
Animal Control	Unincorporated areas, Maricopa, McFarland, Tehachapi, Arvin, Bakersfield	✓	
Community Parks	Unincorporated areas outside of independent parks districts	✓	
Regional Parks	Countywide	✓	
Fire	Kern County Fire Dept. service area	✓	✓
Waste Management	Countywide	✓	✓
Public Health	Countywide	✓	✓
General Government	Countywide, different rates for cities and unincorporated	✓	✓

Tables E.2, E.3, and E.4 summarize the maximum justified public facilities fees based on the analysis contained in this report for each of the three fee zones. Certain fees have different rates in the unincorporated areas than in incorporated cities, as reflected in the tables.

As reflected in the tables, the animal control fee would apply in the unincorporated area and the cities of Arvin, Bakersfield, Maricopa, McFarland, and Tehachapi. Other cities in the County do not use County animal control facilities. A lower animal control fee would apply

in Arvin and Bakersfield than in other cities and unincorporated areas because Arvin and Bakersfield use County animal control shelter services but provide their own field services.

The areas where the fire protection and community parks fees would be charged do not entirely correspond with the City boundaries. Accordingly, the fee totals shown in Tables E.2, E.3, and E.4 are higher than that actual fee total that would apply to some developments.

The fire protection fee would be charged in areas in the Kern County Fire Department (KCFD) primary service area. The KCFD primary service area covers the entire County, with the exception of military bases and areas where fire protection is provided by the Bakersfield Fire Department or the California City Fire Department.

The community parks fee would only be charged in areas where the Kern County Parks Department will provide community parks to accommodate new development. The Parks Department will provide community parks in unincorporated areas that are not served by independent park districts.

Table E.2: Kern County Development Impact Fees - Desert Zone

	Countywide Public Protection	Sheriff Patrol and Inves-tigation	Library	Animal Control[1]	Community Parks[2]	Regional Parks[3]	Fire[4]	Waste Management	Public Health	General Government	Total
Unincorporated County											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	$ 432.15	$ 34.17	$ 57.29	$ 3,088.37	$ 1,283.39	$ 972.84	$ 260.30	$ 132.66	$ 84.42	**$ 7,658.12**
Multi-family Unit	869.33	286.43	22.11	37.19	2,046.19	850.23	644.21	172.86	87.44	55.28	**5,071.27**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	$ 82.41	N/A	N/A	N/A	N/A	$ 534.66	$ 50.25	$ 25.13	$ 18.09	**$ 961.79**
Office	334.67	109.55	N/A	N/A	N/A	N/A	712.55	66.33	33.17	23.12	**1,279.39**
Industrial	167.84	55.28	N/A	N/A	N/A	N/A	356.78	33.17	17.09	12.06	**642.22**
Incorporated Cities											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	N/A	$ 34.17	N/A	N/A	$ 1,283.39	$ 972.84	$ 260.30	$ 132.66	$ 60.30	**$ 4,056.19**
Multi-family Unit	869.33	N/A	22.11	N/A	N/A	850.23	644.21	172.86	87.44	40.20	**2,686.38**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	N/A	N/A	N/A	N/A	N/A	$ 534.66	$ 50.25	$ 25.13	$ 13.07	**$ 874.36**
Office	334.67	N/A	N/A	N/A	N/A	N/A	712.55	66.33	33.17	17.09	**1,163.81**
Industrial	167.84	N/A	N/A	N/A	N/A	N/A	356.78	33.17	17.09	8.04	**582.92**

[1] Fee charged in jurisdictions where County provides animal control services. In Desert Zone, fee applies in unincorporated areas only.

[2] Fee amounts represent the combined total for park land and park improvements. Fee charged to unincorporated areas that are not part of any independent park district.

[3] Fee amounts represent the combined total for park land and park improvements.

[4] Fee charged only in areas where Kern County Fire Department is the primary service provider. Includes some incorporated and some unincorporated areas.

Sources: Tables 3.7, 4.7, 5.11, 6.6, 7.7, 8.9, 9.5, 10.5 and 11.6.

Table E.3: Kern County Development Impact Fees - Mountain Zone

	Countywide Public Protection	Sheriff Patrol and Inves-tigation	Library	Animal Control[1]	Community Parks[2]	Regional Parks[3]	Fire[4]	Waste Management	Public Health	General Government	Total
Unincorporated County											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	$ 1,154.75	$ 1,076.36	$ 57.29	$ 3,088.37	$ 1,283.39	$ 2,025.08	$ 260.30	$ 132.66	$ 84.42	**$ 10,475.15**
Multi-family Unit	869.33	764.81	712.55	37.19	2,046.19	850.23	1,341.68	172.86	87.44	55.28	**6,937.56**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	$ 221.10	N/A	N/A	N/A	N/A	$ 1,112.54	$ 50.25	$ 25.13	$ 18.09	**$ 1,678.36**
Office	334.67	294.47	N/A	N/A	N/A	N/A	1,481.37	66.33	33.17	23.12	**2,233.13**
Industrial	167.84	147.74	N/A	N/A	N/A	N/A	742.70	33.17	17.09	12.06	**1,120.60**
Incorporated Cities											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	N/A	$ 1,076.36	$ 57.29	N/A	$ 1,283.39	$ 2,025.08	$ 260.30	$ 132.66	$ 60.30	**$ 6,207.91**
Multi-family Unit	869.33	N/A	712.55	37.19	N/A	850.23	1,341.68	172.86	87.44	40.20	**4,111.48**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	N/A	N/A	N/A	N/A	N/A	$ 1,112.54	$ 50.25	$ 25.13	$ 13.07	**$ 1,452.24**
Office	334.67	N/A	N/A	N/A	N/A	N/A	1,481.37	66.33	33.17	17.09	**1,932.63**
Industrial	167.84	N/A	N/A	N/A	N/A	N/A	742.70	33.17	17.09	8.04	**968.84**

[1] Fee charged in jurisdictions where County provides animal control services. In Mountain Zone, fee applies in unincorporated areas and the City of Tehachapi (entire Mountain Zone).

[2] Fee amounts represent the combined total for park land and park improvements. Fee charged to unincorporated areas that are not part of any independent park district.

[3] Fee amounts represent the combined total for park land and park improvements.

[4] Fee charged only in areas where Kern County Fire Department is the primary service provider. KCFD is primary service provider throughout the Desert Zone.

Sources: Tables 3.7, 4.7, 5.11, 6.6, 7.7, 8.9, 9.5, 10.5 and 11.6.

Table E.4: Kern County Development Impact Fees - Valley Zone

	Countywide Public Protection	Sheriff Patrol and Inves-tigation	Library	Animal Control[1]	Community Parks[2]	Regional Parks[3]	Fire[4]	Waste Management	Public Health	General Government	Total
Unincorporated County											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	$ 927.62	$ 1,026.11	$ 57.29	$ 3,088.37	$ 1,283.39	$ 841.19	$ 260.30	$ 132.66	$ 84.42	**$ 9,013.88**
Multi-family Unit	869.33	615.06	679.38	37.19	2,046.19	850.23	557.78	172.86	87.44	55.28	**5,970.74**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	$ 176.88	N/A	N/A	N/A	N/A	$ 462.30	$ 50.25	$ 25.13	$ 18.09	**$ 983.90**
Office	334.67	236.18	N/A	N/A	N/A	N/A	616.07	66.33	33.17	23.12	**1,309.54**
Industrial	167.84	118.59	N/A	N/A	N/A	N/A	308.54	33.17	17.09	12.06	**657.29**
Arvin											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	N/A	$ 1,026.11	$ 50.25	N/A	$ 1,283.39	$ 841.19	$ 260.30	$ 132.66	$ 60.30	**$ 4,966.73**
Multi-family Unit	869.33	N/A	679.38	33.17	N/A	850.23	557.78	172.86	87.44	40.20	**3,290.39**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	N/A	N/A	N/A	N/A	N/A	$ 462.30	$ 50.25	$ 25.13	$ 13.07	**$ 802.00**
Office	334.67	N/A	N/A	N/A	N/A	N/A	616.07	66.33	33.17	17.09	**1,067.33**
Industrial	167.84	N/A	N/A	N/A	N/A	N/A	308.54	33.17	17.09	8.04	**534.68**
Bakersfield											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	N/A	$ 1,026.11	$ 50.25	N/A	$ 1,283.39	N/A	$ 260.30	$ 132.66	$ 84.42	**$ 4,149.66**
Multi-family Unit	869.33	N/A	679.38	33.17	N/A	850.23	N/A	172.86	87.44	55.28	**2,747.69**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	N/A	N/A	N/A	N/A	N/A	N/A	$ 50.25	$ 25.13	$ 18.09	**$ 344.72**
Office	334.67	N/A	N/A	N/A	N/A	N/A	N/A	66.33	33.17	23.12	**457.29**
Industrial	167.84	N/A	N/A	N/A	N/A	N/A	N/A	33.17	17.09	12.06	**230.16**

[1] Fee charged in jurisdictions where County provides animal control services. In Valley Zone, fee applies in Arvin, Bakersfield, Maricopa, and McFarland. Reduced fee in Arvin and Bakersfield because County provides shelter services only.

[2] Fee amounts represent the combined total for park land and park improvements. Fee charged to unincorporated areas that are not part of any independent park district.

[3] Fee amounts represent the combined total for park land and park improvements.

[4] Fee charged only to areas where Kern County Fire Department is the primary service provider. Includes some incorporated and some unincorporated areas. Bakersfield Fire Department is primary service provider in most areas within Bakersfield City Limits and in some unincorporated areas near Bakersfield.

Sources: Tables 3.7, 4.7, 5.11, 6.6, 7.7, 8.9, 9.5, 10.5 and 11.6.

Table E.4: Kern County Development Impact Fees - Valley Zone *(continued)*

	Countywide Public Protection	Sheriff Patrol and Inves-tigation	Library	Animal Control[1]	Community Parks[2]	Regional Parks[3]	Fire[4]	Waste Management	Public Health	General Government	Total
Maricopa, McFarland											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	N/A	$ 1,026.11	$ 57.29	N/A	$ 1,283.39	$ 841.19	$ 260.30	$ 132.66	$ 60.30	**$ 4,973.77**
Multi-family Unit	869.33	N/A	679.38	37.19	N/A	850.23	557.78	172.86	87.44	40.20	**3,294.41**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	N/A	N/A	N/A	N/A	N/A	$ 462.30	$ 50.25	$ 25.13	$ 13.07	**$ 802.00**
Office	334.67	N/A	N/A	N/A	N/A	N/A	616.07	66.33	33.17	17.09	**1,067.33**
Industrial	167.84	N/A	N/A	N/A	N/A	N/A	308.54	33.17	17.09	8.04	**534.68**
Delano, Shafter, Taft, Wasco											
Residential					*(Fee per Dwelling Unit)*						
Single Family Unit	$ 1,312.53	N/A	$ 1,026.11	N/A	N/A	$ 1,283.39	$ 841.19	$ 260.30	$ 132.66	$ 60.30	**$ 4,916.48**
Multi-family Unit	869.33	N/A	679.38	N/A	N/A	850.23	557.78	172.86	87.44	40.20	**3,257.22**
Nonresidential					*(Fee per 1,000 Square Feet)*						
Commercial	$ 251.25	N/A	N/A	N/A	N/A	N/A	$ 462.30	$ 50.25	$ 25.13	$ 13.07	**$ 802.00**
Office	334.67	N/A	N/A	N/A	N/A	N/A	616.07	66.33	33.17	17.09	**1,067.33**
Industrial	167.84	N/A	N/A	N/A	N/A	N/A	308.54	33.17	17.09	8.04	**534.68**

[1] Fee charged in jurisdictions where County provides animal control services. In Valley Zone, fee applies in Arvin, Bakersfield, Maricopa, and McFarland. Reduced fee in Arvin and Bakersfield because County provides shelter services only.

[2] Fee amounts represent the combined total for park land and park improvements. Fee charged to unincorporated areas that are not part of any independent park district.

[3] Fee amounts represent the combined total for park land and park improvements.

[4] Fee charged only to areas where Kern County Fire Department is the primary service provider. KCFD is primary service provider in these cities.

Sources: Tables 3.7, 4.7, 5.11, 6.6, 7.7, 8.9, 9.5, 10.5 and 11.6.

1. Introduction

This report presents an analysis of the need for public facilities to accommodate new development in Kern County. This chapter provides background for the study and explains the study approach under the following sections:

- Public Facilities Financing in California;
- Study Objectives;
- Study Methodology; and
- Organization of the Report.

Public Facilities Financing In California

The changing fiscal landscape in California during the past 30 years has steadily undercut the financial capacity of local governments to fund infrastructure. Three dominant trends stand out:

- The passage of a string of tax limitation measures, starting with Proposition 13 in 1978 and continuing through the passage of Proposition 218 in 1996;
- Declining popular support for bond measures to finance infrastructure for the next generation of residents and businesses; and
- Steep reductions in federal and state assistance.

Faced with these trends, many cities and counties have had to adopt a policy of "growth pays its own way." This policy shifts the burden of funding infrastructure expansion from existing rate and taxpayers onto new development. This funding shift has been accomplished primarily through the imposition of assessments, special taxes, and development impact fees also known as public facilities fees. Assessments and special taxes require approval of property owners and are appropriate when the funded facilities are directly related to the developing property. Development fees, on the other hand, are an appropriate funding source for facilities that benefit all development jurisdiction-wide. Development fees need a majority vote of the legislative body for adoption.

Study Objectives

The primary policy objective of a public facilities fee program is to ensure that new development pays the capital costs associated with growth. The primary purpose of this report is to calculate and present fees that will enable the County to expand its inventory of public facilities and maintain its facilities standards as new development leads to increases in service demands.

The County Board of Supervisors may impose public facilities fees in unincorporated areas under authority granted by the *Mitigation Fee Act (*the *Act)*, contained in *California Government Code* Sections 66000 *et seq*. This report provides the necessary findings required by the *Act* for adoption of the fees presented in the fee schedules contained herein. The Board of

Supervisors does not have authority to impose impact fees in incroporated cities. In incorporated cities, the city council would have to impose impact fees for County facilities on behalf of the County.

Kern County is expected to experience substantial growth in both incorporated cities and unincorporated areas through this study's planning horizon of 2030. This growth will create an increase in demand for public services and the County facilities required to deliver them. The County recently adopted a Capital Improvement Plan (CIP) that identifies the public facilities that will be needed to accommodate growth projected through 2030. This impact fee program is based on the facility standards and facility plans identified in the CIP.[1]

Given the revenue challenges described above that are common to most cities and counties in California, the County has decided to consider using a development impact fee program to ensure that new development funds the share of facility costs associated with growth. The CIP and this report make use of the most current available growth forecasts, facility plans, and engineering studies to ensure that the County's fee program is representative of the facility needs resulting from new development.

Fee-funded capital projects are programmed through the County's CIP. Use of a CIP helps the County identify and direct its fee revenue to public facilities projects that will accommodate future growth. By programming fee revenues to specific capital projects, the County ensures a reasonable relationship between new development and the use of fee revenues as required by the *Mitigation Fee Act*.

Study Methodology

Public facilities fees are calculated to fund the cost of facilities required to accommodate growth. The four steps followed in a public facilities fee study include:

1. **Estimate existing development and future growth:** Identify a base year for existing development and a growth forecast that reflects increased demand for public facilities;
2. **Identify facility standards:** Determine the facility standards used to plan for new and expanded facilities;
3. **Determine facilities required to serve new development and their costs:** Estimate the total amount and cost of planned facilities, and identify the share required to accommodate new development; and
4. **Calculate fee schedule:** Allocate facilities costs per unit of new development to calculate the public facilities fee schedule.

[1] The CIP was adopted in May 2008, and the estimates of current residents and workers shown in the CIP were developed in 2007. For this report, estimates of existing development were updated to 2008 figures; therefore, the current development estimates do not exactly match between the two documents.

The key public policy issue in development impact fee studies is the identification of facility standards (step 2, above). Facility standards document a reasonable relationship between new development and the need for new facilities. Standards ensure that new development does not fund deficiencies associated with existing development.

Types of Facility Standards

There are three separate components of facility standards:

- *Demand standards* determine the amount of facilities required to accommodate growth, for example, park acres per thousand residents, square feet of library space per capita, or gallons of water per day. The facility standards established in the Kern County CIP are typically demand standards.
- *Design standards* determine how a facility should be designed to meet expected demand; for example, park improvement requirements and technology infrastructure for city office space. Design standards are typically not explicitly evaluated as part of an impact fee analysis but can have a significant impact on the cost of facilities. Our approach incorporates current facility design standards into the fee program to reflect the current construction cost of public facilities.
- *Cost standards* are an alternate method for determining the amount of facilities required to accommodate growth based on facility costs per unit of demand. *Cost standards* are useful when demand standards were not explicitly developed for the facility planning process. *Cost standards* also enable different types of facilities to be analyzed based on a single measure (cost or value), useful when disparate facilities are funded by a single fee program. Examples include facility costs per capita, per vehicle trip, or cost per gallon of water per day. The cost standards used in this study for each facility category are derived from one of the cost allocation methods described below.

New Development Facility Needs and Costs

A number of approaches are used to identify facility needs and costs to serve new development. Often there is a two step process: (1) identify total facility needs, and (2) allocate to new development its fair share of those needs.

There are three common methods for determining new development's fair share of planned facilities costs: the **existing inventory method**, the **system plan method**, and the **planned facilities method**. The method selected often depends on the degree to which the community has engaged in comprehensive facility master planning to identify facility needs.

The formula used by each approach and the advantages and disadvantages of each method are summarized below:

Existing Inventory Method

The existing inventory method allocates costs based on the ratio of existing facilities to demand from existing development as follows:

$$\frac{\text{Current Value of Existing Facilities}}{\text{Existing Development Demand}} = \$/\text{unit of demand}$$

Under this method new development funds the expansion of facilities at the same standard currently serving existing development. By definition the existing inventory method results in no facility deficiencies attributable to existing development. This method is often used when a long-range plan for new facilities is not available. Only the initial facilities to be funded with fees are identified in the fee study. Future facilities to serve growth are identified through an annual capital improvement plan and budget process, possibly after completion of a new facility master plan. In this report, the existing inventory cost allocation method is only used for the regional parks impact fee.

Planned Facilities Method

The planned facilities method allocates costs based on the ratio of planned facility costs to demand from new development as follows:

$$\frac{\text{Cost of Planned Facilities}}{\text{New Development Demand}} = \$/\text{unit of demand}$$

This method is appropriate when specific planned facilities can be identified that only benefit new development. Examples include street improvements to avoid deficient levels of service or a sewer trunk line extension to a previously undeveloped area. This method is appropriate when planned facilities would not serve existing development or when new development can be accommodated with a lower level of facilities per capita than is currently provided. Under this method new development funds the expansion of facilities at the standards used for the master facility plan and fee amounts are constrained such that fee revenue will not exceed the cost of planned facilities.

In this report, the planned facilities cost allocation method is used for the following facilities categories:

- Sheriff Patrol and Investigation (Desert Zone),
- Library (Desert Zone),
- Community Parks,
- Waste Management, and
- General Government.

System Plan Method

This method calculates the fee based on the value of existing facilities plus the cost of planned facilities, divided by demand from existing and new development:

$$\frac{\text{Value of Existing Facilities} + \text{Cost of Planned Facilities}}{\text{Existing} + \text{New Development Demand}} = \$/\text{unit of demand}$$

This method is useful when planned facilities need to be analyzed as part of a system that benefits both existing and new development. It is difficult, for example, to allocate a new fire station solely to new development when that station will operate as part of an integrated system of fire stations that together achieve the desired level of service. Police substations, civic centers, and regional parks provide examples of similar facilities.

The system plan method ensures that new development does not pay for existing deficiencies. Facility standards based on policies such as those found in General Plans are often higher than existing facility standards. This method enables the calculation of the existing deficiency required to bring existing development up to the policy-based standard. The local agency must secure non-fee funding for that portion of planned facilities required to correct the deficiency to ensure that new development receives the level of service funded by the impact fee.

In this report, the system plan cost allocation method is used for the following facilities categories:

- Public Protection,
- Sheriff Patrol and Investigation (Mountain and Valley Zones),
- Library (Mountain and Valley Zones),
- Animal Control,
- Fire Protection, and
- Public Health.

Administrative Charge

The impact fees calculated in this report are based on the facility standards described above. In addition to the facility costs, an administrative charge of 0.5 percent is added to each impact fee. This charge is used to fund the costs of developing, updating, and administering the fee program. The administrative charge is used to fund costs that may include:

- Overhead charges applied to County programs for legal, accounting, and other departmental and countywide administrative support costs;
- Capital planning and programming associated with the share of projects funded by the impact fee; and
- Impact fee program administrative costs including revenue collection, revenue and cost accounting, mandated public reporting, and fee justification analyses. The administrative charge can be used for costs related to the preparation and management of capital improvement project documents whose tasks clearly tie to facilities required to accommodate growth, including master facility planning documents.

The administrative charge of 0.5 percent is based on estimated costs of program administration and future updates of the CIP and impact fee study.

Organization of the Report

This report is organized as follows:

- Chapter 1 -- Introduction (this chapter): summarizes facilities financing in California and the general approach used to calculate appropriate impact fees in this study;

- Chapter 2 -- Growth Forecasts and Unit Cost Estimates: describes the growth forecasts used to estimate future demand and the unit costs used to estimate total facility costs;
- Chapter 3 -- Public Protection: Charged countywide. Fee revenue will fund expansion of the Lerdo Detention Facility.
- Chapter 4 -- Sheriff Patrol and Investigation: Only charged in unincorporated areas. Fee revenue will fund new Sheriff substations.
- Chapter 5 -- Libraries: Charged countywide, may be adopted at different rates in sub-county zones. Fee revenue will be used for new bookmobiles and new and expanded library branches, and associated library volumes, furnishings, and equipment.
- Chapter 6 -- Animal Control: Charged in unincorporated areas and the cities of Maricopa, McFarland, Tehachapi, Arvin and Bakersfield. Fee revenue will fund a new or expanded animal care facility.
- Chapter 7 -- Parks and Recreation: Regional parks fee charged countywide. Community parks fee charged in unincorporated areas outside of independent parks districts. Fee revenue will fund new regional and community parks.
- Chapter 8 -- Fire Protection: Charged in the Kern County Fire Department primary service area. Fee revenue will fund new and expanded fire stations, training facilities, and administrative space.
- Chapter 9 -- Waste Management: Charged countywide. Fee revenue will fund landfill and transfer station expansion and improvements.
- Chapter 10 -- Public Health: Charged countywide. Fee revenue will fund new health department offices, storage space, and parking facility.
- Chapter 11 -- General Government: Charged countywide, with different rates for cities and unincorporated areas. Fee will fund new County government buildings in several areas expected to have significant growth.
- Chapter 12 -- Implementation: Provides guidelines for the implementation and ongoing maintenance of the public facilities fee program.
- Chapter 13 -- *Mitigation Fee Act* Findings: summarizes the five statutory findings required for adoption of the proposed public facilities fees in accordance with the *Mitigation Fee Act* (codified in *California Government Code* Sections 66000 through 66025).

2. Growth Forecasts and Unit Cost Estimates

Growth forecasts assist in estimating facility needs based on additional service demand. New development is estimated using a base year of 2008 and a planning horizon of 2030. The growth forecast is used throughout this study.

This chapter also presents the unit cost assumptions used throughout the study to estimate the total cost of planned facilities.

Service Population

Different land use types use public facilities at different rates in relation to each other, depending on the services provided. In each chapter, a specific service population is identified for each facility category to reflect total demand.

Some County facilities provide services only to residents, while others provide services to both residents and businesses. A service population is a measure of all residents and workers that rely on a given set of services. The service population weights residential land use types against non-residential land uses based on the relative demand for services between residents and workers.

Use of Growth Forecasts for Impact Fees

Estimates of the existing service population and forecasts of growth are critical assumptions used throughout this report. These estimates are used as follows:

- Estimates of existing development in 2008 are used to determine the existing facility standards in the County.
- Estimates of total development at the 2030 planning horizon are used:
  - To determine the total amount of public facilities required to accommodate growth based on the facility standards used for each facility category (see Chapter 1), and
  - To estimate total fee revenues.

Growth Forecasts for Kern County

The base year for this study is the year 2008. Base year population estimates are from California Department of Finance (DOF) data. Base year employment estimates are based on data from the California Employment Development Department. With the exception of Bakersfield, future 2030 population and employment estimates are based on growth rates projected by the Kern Council of Governments (KernCOG). The 2030 population of Bakersfield was estimated based on the annual population growth forecast by the 2004 Kern County General Plan Environmental Impact Report. Bakersfield's estimated employment

growth rate is based on a combination of the City's projected population growth rate estimated from the General Plan EIR and the City's employment growth rate projected by KernCOG.

Government employment is excluded from all current and future employment estimates presented here because local government facilities are typically added to serve new development. Whereas non-government development creates an increased demand for public facilities, development of government facilities occurs to meet that demand. The residents and workers that comprise the service populations outlined in this report constitute only those individuals that create demand for public facilities.

Table 2.1 presents the current and future demographic estimates used in this study in terms of population and employment for residential and nonresidential development.

Table 2.1: Population and Employment Estimates and Projections

	2008	2030	Net Growth 2009-2030	%	Annual Growth Rate
Population[1]					
Arvin	16,400	29,800	13,400	82%	2.8%
Bakersfield[2]	324,900	580,100	255,200	79%	2.7%
California City	11,800	17,400	5,600	47%	1.8%
Delano	42,500	58,400	15,900	37%	1.5%
Maricopa	1,100	1,400	300	27%	1.1%
McFarland	12,000	16,300	4,300	36%	1.4%
Ridgecrest	27,800	31,800	4,000	14%	0.6%
Shafter	15,000	30,500	15,500	103%	3.3%
Taft	6,200	7,800	1,600	26%	1.0%
Tehachapi	8,300	13,500	5,200	63%	2.2%
Wasco	18,700	30,500	11,800	63%	2.2%
Unincorporated	294,400	383,900	89,500	30%	1.2%
Total	779,100	1,201,400	422,300	54%	1.8%
Employment[3,4]					
Arvin	2,100	3,000	900	43%	1.7%
Bakersfield[5]	101,300	161,200	59,900	59%	2.1%
California City	1,300	2,400	1,100	85%	2.9%
Delano	18,000	25,500	7,500	42%	1.6%
Maricopa	50	70	20	40%	1.8%
McFarland	6,200	9,000	2,800	45%	1.7%
Ridgecrest	5,800	8,400	2,600	45%	1.7%
Shafter	3,700	8,100	4,400	119%	3.6%
Taft	2,300	3,400	1,100	48%	1.8%
Tehachapi	1,500	2,800	1,300	87%	2.9%
Wasco	2,800	4,200	1,400	50%	1.9%
Unincorporated	107,000	133,200	26,200	24%	1.0%
Total	252,050	361,270	109,220	43%	1.6%
Unincorporated					
Population	294,400	383,900	89,500	30%	1.2%
Employment[3,4]	107,000	133,200	26,200	24%	1.0%

[1] Population and employment growth from 2009 through 2030 for all cities except Bakersfield is estimated by applying KernCOG's projected rate of growth for a given Regional Statistical Area (RSA) to the City located within that RSA.

[2] Bakersfield population in 2030 is estimated by extrapolating the projected City population growth from 2000 (308,000) through 2020 (540,000) which equates to an annual increase of 11,600 residents.

[3] Excludes local government employment and agricultural employment.

[4] Represents jobs located within the City/County (not employed residents).

[5] Bakersfield employment in 2030 estimated by taking the midpoint between the projected Bakersfield population percentage growth shown above and the KernCOG projected employment growth (39.7%) for the Bakersfield Metro area.

Sources: California Department of Finance (DOF); California Economic Development Department (EDD) Quarterly Census of Employment and Wages, Annual Data for 2007; Kern County Council of Governments (KernCOG); County of Kern 2004 General Plan EIR, p. 3-12; Willdan Financial Services.

Impact Fee Zones

For some of the facility categories, impact fees are calculated fees at different levels for different zones of the County. By dividing the County into zones, the impact fees for each development project will be based on the standards at which facilities are needed in the area of the County where the project is located. Fees are calculated for sub-county zones for Sheriff patrol and investigation, fire protection, and library facilities. A zone-based fee approach is not appropriate for the other facility categories because levels of service are unlikely to vary based on geography. Facilities in these categories are part of a unified system of facilities serving the entire County, so the fees are not calculated at separate levels for each zone.

The following criteria are often considered when determining impact fee zone boundaries:

- Seek to make boundaries contiguous;
- Avoid boundary effects that would cause adjacent and presumably similar developments to pay fees at vastly different rates;
- When reasonable, conform to existing local planning area boundaries to simplify fee analysis and implementation; and
- Create zones with similar development patterns and service levels (e.g. urban vs. rural).

The proposed impact fee zones for Kern County are the Valley Region, Mountain Region, and Desert Region, as defined in the Kern County General Plan. **Figure 1** is a map of the three impact fee zones. The zones are defined as follows:

- Valley Region: The southern San Joaquin Valley below an elevation of 1,000 feet mean sea level (MSL).
- Mountain Region: The westernmost and central portion of the County above the 1,000 foot MSL contour in the valley and western region of the County and west of the primary alignment of the Los Angeles Aqueduct in the eastern County, including the southernmost portion of the County.
- Desert Region: The eastern section of the County east of the primary alignment of the Los Angeles Aqueduct.

These zones meet the criteria listed above. The zones are established County planning areas with boundaries that are easy to identify, facilitating fee collection. The development patterns and types of development are similar within each of the zones. The Valley Region includes the County's agricultural areas and the most intensively urbanized areas. The Mountain Region is sparsely populated, with recreational uses, as well as the California Correctional Institution and other development in the Tehachapi area. The Desert Region has relatively sparse development, with areas used for military facilities and mineral extraction.

The geography and type of development found in each region influences the public facilities that are needed in each. For example, in the Mountain Zone, sparse development and the slow speed at which fire equipment can travel leads to a greater per capita need for fire stations and equipment to maintain adequate response times.

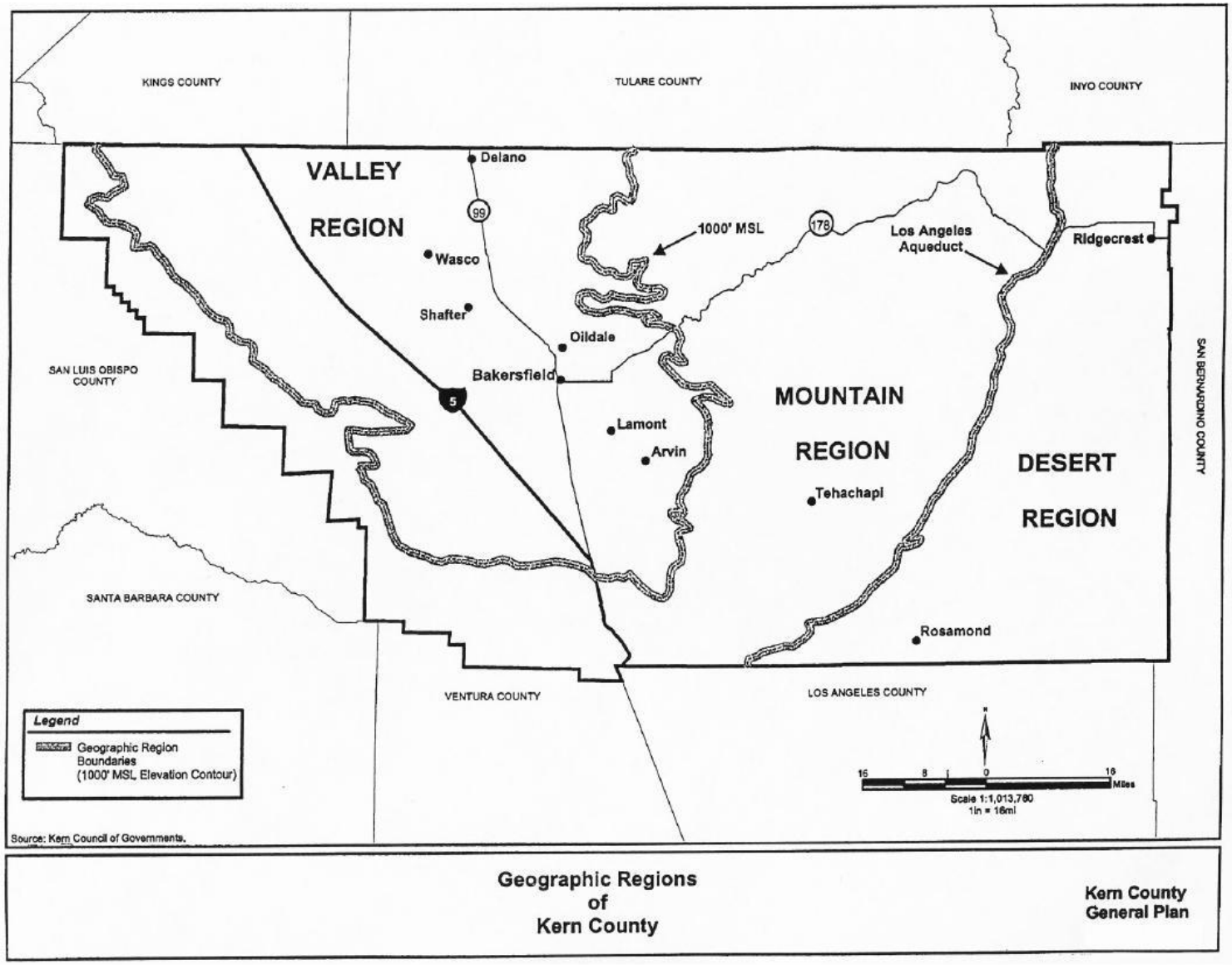
Table 2.2 shows the estimated population and employment in each of the fee zones for 2008, as well as a projection for 2030. Population and employment in the unincorporated area of each of the fee zones was estimated based on data for traffic analysis zones used in the KernCOG traffic model.

Table 2.2: Population and Employment by Zone

	Population			Employment		
	2008	2030	Net Growth 2009-2030	2008	2030	Net Growth 2009-2030
Desert Zone						
California City	11,800	17,400	5,600	1,300	2,400	1,100
Ridgecrest	27,800	31,800	4,000	5,800	8,400	2,600
Unincorporated	40,500	67,700	27,200	28,400	36,300	7,900
Desert Zone Total	80,100	116,900	36,800	35,500	47,100	11,600
Mountain Zone						
Tehachapi	8,300	13,500	5,200	1,500	2,800	1,300
Unincorporated	61,300	89,100	27,800	12,500	18,800	6,300
Mountain Zone Total	69,600	102,600	33,000	14,000	21,600	7,600
Valley Zone						
Arvin	16,400	29,800	13,400	2,100	3,000	900
Bakersfield	324,900	580,100	255,200	101,300	161,200	59,900
Delano	42,500	58,400	15,900	18,000	25,500	7,500
Maricopa	1,100	1,400	300	50	70	20
McFarland	12,000	16,300	4,300	6,200	9,000	2,800
Shafter	15,000	30,500	15,500	3,700	8,100	4,400
Taft	6,200	7,800	1,600	2,300	3,400	1,100
Wasco	18,700	30,500	11,800	2,800	4,200	1,400
Unincorporated	192,700	227,000	34,300	66,100	78,200	12,100
Valley Zone Total	629,500	981,800	352,300	202,550	292,670	90,120
County Total	779,200	1,201,300	422,100	252,050	361,370	109,320

Sources: Table 2.1; KernCOG Traffic Model; Willdan Financial Services.

Figure 1: Impact Fee Zone Map



Geographic Regions of Kern County

Kern County General Plan

Land Use Types

To ensure a reasonable relationship between each fee and the type of development paying the fee, growth forecasts distinguish between different land use types. The land use types used in this analysis are defined below.

- **Single family:** Attached and detached one-family dwelling units, including townhomes;
- **Multi-family:** All attached multi-family dwellings such as duplexes and condominiums, plus mobile homes, apartments, and dormitories;
- **Commercial:** All commercial, retail, educational, and hotel/motel development;
- **Office:** All general, professional, and medical office development;
- **Industrial:** All industrial development, including manufacturing, mixed use/distribution, and warehouses.

Some developments may include more than one land use type, such as an industrial warehouse with living quarters (a live-work designation) or a planned unit development with both single and multi-family uses. In these cases the public facilities fee would be calculated separately for each land use type.

The County should have the discretion to impose the public facilities fee based on the specific aspects of a proposed development regardless of zoning. The guideline to use is the probable occupant density of the development, either residents per dwelling unit or workers per building square foot. The fee imposed should be based on the land use type that most closely represents the probable occupant density of the development.

Occupant Densities

Facility demand is estimated based on service population increases. Developers pay the public facilities fee based on the number of additional housing units or building square feet of nonresidential development, so the fee schedule must convert service population estimates to these measures of project size. This conversion is done with average occupant density factors by land use type, shown in **Table 2.3**.

Table 2.3: Occupancy Density Assumptions

Residential		
Single Family Unit	3.14	Persons per dwelling unit
Multi-family Unit	2.08	Persons per dwelling unit
Nonresidential		
Commercial	2.50	Employees per 1,000 sq. ft.
Office	3.33	Employees per 1,000 sq. ft.
Industrial	1.67	Employees per 1,000 sq. ft.

Sources: United States 2000 Census (Tables H-31, H-32, H-33) for Kern County; The Natelson Company, Inc., Employment Density Study Summary Report, prepared for the Southern California Association of Governments, October 31, 2001; Department of Finance E-5 report for Kern County Jan. 1, 2005; Willdan Financial Services.

The residential occupant density factors are derived from the 2000 U.S. Census Bureau's Tables H-31 through H-33. Table H-31 provides vacant housing units data, while Table H-32 provides information relating to occupied housing. Table H-33 documents the total 2000 population residing in occupied housing. The U.S. Census numbers are adjusted by using the California Department of Finance (DOF) estimates for January 1, 2008,[2] the most recent State of California data available. The non-residential density factors are based on a study of employment density in Southern California performed by the Natelson Company.

Unit Costs

This study makes use of unit costs for land values and building construction. These costs are used to estimate the replacement value of existing facilities, as well as the construction or acquisition costs for planned facilities. Building costs are typically expressed in terms of cost per square foot while land costs are expressed in terms of cost per acre.

Table 2.4 lists the estimated facility values used in this study and in the County's Capital Improvement Plan. Building values were informed by recent appraisals and projects in the County, and by County staff. Costs for some individual projects in subsequent chapters may vary from the unit costs shown here based on specific department estimates.

[2] State of California, Department of Finance, *E-5 Population and Housing Estimates for Cities, Counties and the State, 2001-2008, with 2000 Benchmark*. Sacramento, California, May 2008.

Table 2.4: Estimated Building Unit Costs

Item	Unit	Construction Unit Costs	Total Unit Costs[1]
General/Community Building Space	square foot	$ 293	$ 351
Public Health Facilities	square foot	311	373
Animal Control Facility	square foot	350	420
Jail Space	bed	116,900	146,100
Warehouse/Industrial	square foot	150	180
Sheriff Substation	square foot	351	421
Libraries	square foot	449	539
Fire Station Space	square foot	353	424
Community Park Improvements	acre	200,000	240,000
Regional Park Improvements	acre	50,000	60,000
Park Restrooms	building	500,000	600,000
Parking Deck Construction	parking space	17,000	20,400

[1] Total unit costs include 20 percent of construction costs for architecture and engineering, contract administration, inspection, project management, and other costs associated with the development of new public facilities.

Source: Kern County Capital Improvement Plan.

Table 2.5 shows the estimated land values used in this study. Land values were estimated by Kern County property management staff based on recent sales. Due to the recent decline in real estate values in Kern County, the values used in this study are lower than the values that were used in the CIP. The land costs shown below were used to estimate land acquisition costs for planned facilities for which a precise location has not yet been identified. Land value estimates for existing parcels were also provided by County property management staff, and may vary from the estimates shown here.

Table 2.5: Estimated Land Costs

Area	Cost per Acre	Cost per Square Foot
Arvin	$ 86,400	$ 1.98
Bakersfield	350,000	8.03
California City	121,800	2.80
Delano	226,500	5.20
Maricopa	31,400	0.72
McFarland	52,200	1.20
Ridgecrest	190,480	4.37
Shafter	104,800	2.41
Taft	223,200	5.12
Tehachapi	139,200	3.20
Wasco	170,200	3.91
Buttonwillow	87,200	2.00
Frazier Park	116,800	2.68
Kernville	121,600	2.79
Lake Isabella	90,400	2.08
Lebec	69,600	1.60
Lost Hills	52,000	1.19
Rosamond	81,600	1.87
Unincorporated	31,400	0.72
Bulk Land - East Kern Desert	3,000	0.07
Bulk Land - Other	10,000	0.23

Source: Kern County Capital Improvement Plan.

3. Public Protection Facilities

The purpose of this fee is to ensure that new development funds its fair share of public protection facilities. Public protection facilities include criminal detention facilities, courthouse, coroner, 911 communications, and Sheriff's Department administrative buildings. In contrast with Sheriff patrol and investigation facilities, which are used primarily to provide services in unincorporated areas of the County, public protection facilities serve residential and nonresidential development countywide.

Service Population

Public protection facilities serve both residents and businesses and provide services equally to both incorporated and unincorporated portions of the County. **Table 3.1** shows the estimated service population in 2008 and 2030. The demand for countywide public protection facilities is primarily related to the demands that residents and businesses place on those facilities. It is reasonable to assume that demand for these services is less for one employee compared to one resident, because nonresidential buildings are typically occupied less intensively than dwelling units. The 0.24-weighting factor for workers is based on a 40-hour workweek divided by the total number of hours in a week (168) and reflects the degree to which nonresidential development yields a lesser demand for public protection facilities.

Table 3.1: Countywide Public Protection Service Population

	Residents	Workers	Service Population
Existing - Countywide (2008)	779,100	252,050	839,600
New Development - Countywide (2009-2030)	422,300	109,220	448,500
Total - Countywide (2030)	1,201,400	361,270	1,288,100
Weighting Factor	1.00	0.24	

Sources: Table 2.1; Willdan Financial Services.

Existing and Planned Facilities

The proposed public protection impact fees are based on the County's inventory of existing and planned public protection facilities using the system plan approach (see *Introduction* for further information). **Table 3.2** presents the inventory of existing public protection facilities in Kern County. The land value for existing facilities is based on estimates provided by Kern County property management staff. The replacement value of public protection buildings is based on unit cost estimates shown in Table 2.4.

Table 3.2: Countywide Public Protection Existing Facilities

Facility (Location)	Inventory		Unit Cost[1]	Total Value
Land				
1501 "L" Street Facility	1.76	acres	$ 350,000	$ 617,300
Arvin/Lamont Admin/Courts (12014 Main St)	4.20	acres	33,500	140,700
Bakersfield Justice Bldg (1215 Truxton Ave)	8.56	acres	350,000	2,996,000
Buttonwillow County Building (181 E. 1st St.)	1.07	acres	138,700	148,400
Communications Facility (2601 Panorama Dr.)	16.95	acres	43,600	739,000
Coroner Facility (1832 Flower St)	37.26	acres	350,000	13,041,000
Delano/McFarland Courts Bldg (1121 Jefferson)	0.02	acres	226,500	4,500
Kern River Valley Complex	-	acres	-	-
Kern River Valley Courts	4.15	acres	29,300	121,600
Lerdo Facility (Lerdo Hwy and Hwy 65)	391.60	acres	7,700	3,015,300
Mojave Justice Building (1771, 1773 Highway 58)	4.72	acres	42,500	200,600
Ridge Road Warehouse, Coroner (1831 Ridge Rd)	1.00	acres	148,800	148,800
Ridgecrest Justice Facility (132 E. Coso)	20.97	acres	32,400	679,400
Sheriff-Central Receiving (1415 Truxton Ave)	3.59	acres	350,000	1,256,800
Taft Administration Building (315 Lincoln St)	3.71	acres	4,900	18,200
Willard L. Weddell Bldg. (1315 Truxtun Ave)[2]	-	acres	-	-
Sheriff's Pistol Range (Hart Park)	2.20	acres	24,400	53,700
Subtotal - Land	501.76	acres		$ 23,181,300
Buildings				
1501 "L" Street Facility	14,848	sq. ft.	$ 351	$ 5,211,600
Arvin/Lamont Admin	490	sq. ft.	351	172,000
Arvin/Lamont Courts	6,863	sq. ft.	351	2,408,900
Bakersfield Justice Bldg	2,520	sq. ft.	351	884,500
Buttonwillow County Building	1,495	sq. ft.	351	524,700
Communications Facility	6,470	sq. ft.	351	2,271,000
Coroner Facility	12,224	sq. ft.	351	4,290,600
Delano/McFarland Courts Bldg	1,173	sq. ft.	351	411,700
Kern River Valley Complex	6,747	sq. ft.	351	2,368,200
Kern River Valley Courts	6,706	sq. ft.	351	2,353,800
Mojave Justice Building	5,559	sq. ft.	351	1,951,200
Ridge Road Warehouse	25,000	sq. ft.	180	4,500,000
Ridgecrest Justice Facility	8,344	sq. ft.	351	2,928,700
Sheriff-Central Receiving	81,435	sq. ft.	180	14,658,300
Taft Administration Building	2,564	sq. ft.	351	900,000
Willard L. Weddell Bldg.	478	sq. ft.	351	167,800
Sheriff's Pistol Range	1,488	sq. ft.	180	267,800
Subtotal - Buildings	184,404	sq. ft.		$ 46,270,800
Detention Beds				
Lerdo Facility	2,302	beds	$ 146,100	$ 336,322,200
Total Existing Facilities				$ 405,774,300

[1] Based on estimated replacement cost.

[2] Building on same parcel as Sheriff-Central Receiving facility.

Sources: Kern County; Willdan Financial Services.

Table 3.3 shows the inventory of existing public protection equipment. This equipment includes furnishings, communications equipment, correctional facility equipment, and coroner equipment.

Table 3.3: Existing Countywide Public Protection Equipment

Equipment by Location		
Arvin/Lamont Court Facility	$	200,000
Buttonwillow County Building		250,000
Coroner Equipment		1,000,000
CRF		500,000
Delano/McFarland Courts		10,000
GST (Probation Building)		5,000
Lake Isabella/Kernville Courts		250,000
Maximum Security Facility		500,000
Minimum Security Facility		250,000
Mojave Justice Building		250,000
Sheriff's Pistol Range		500,000
Pretrial		1,000,000
Radio Communications Equipment[1]		2,061,900
Ridgecrest Justice Facility		250,000
Wasco County Building		300,000
Total Value, Existing Equipment	$	7,326,900

[1] All County radio communications equipment controlled by General Services. Radio inventory assigned to Sheriff's Department is assumed to be split 50/50 between countywide public protection and patrol and investigation.

Source: Kern County Sheriff's Department; Kern County General Services.

Table 3.4 shows the current total of beds in the County's criminal detention facilities.

Table 3.4: Existing Countywide Public Protection Beds

Location	Beds
Central Receiving	
Subtotal - Central Receiving	292
Lerdo	
Maximum/Medium	374
Minimum[1]	704
Pretrial	1,232
Female Minimum	96
Subtotal - Lerdo	2,406
Total Beds	2,698

[1] This facility will be replaced by the planned Lerdo Maximum Facility.

Source: Kern County Sheriff's Department; Kern County General Services.

The County can use public protection facilities fee revenues for the construction or purchase of new buildings, land, equipment, and other facilities that expand the capacity of the public protection system to accommodate new development. At this time, the only planned public protection facility identified in the Kern County CIP is the replacement of the Lerdo Minimum Security Facility. **Table 3.5** shows the planned public protection facility, as identified in the CIP. The County plans to replace the 704 bed Lerdo Minimum Security Facility with a new 1,536 bed facility, a net increase of 832 beds. The facility value is based on an estimated cost of $146,100 per bed, along with $1 million in new equipment.

Table 3.5: Public Protection Planned Facilities

	Inventory		Unit Cost	Total Value
Land[1]				
Lerdo Facility Replacement	-	acres	$ -	$ -
Buildings[2]				
Lerdo Facility Replacement	1,536	beds	146,100	224,409,600
Equipment				
Lerdo Facility Replacement				1,000,000
Total Value Planned Facilities				$ 225,409,600

[1] Located at existing Lerdo Facility.

[2] Building costs include architecture and engineering.

Source: Kern County Sheriff's Department; Kern County Capital Improvement Plan; Willdan Financial Services.

Facility Standards and Cost Allocation

Facility Standard

The County's standard for public protection facilities is 4.43 jail beds per 1,000 service population, as adopted in the Kern County CIP. This standard is based on the current need for jail beds estimated in a 2007 study for Kern County by Justice Concepts, Inc. and the National Center for State Courts.[3] Instead of the adopted standard, the proposed Public Protection Impact Fee is based on the system plan cost standard, which is new development's fair share of the cost of existing and currently planned public protection facilities. The planned Lerdo facility replacement project will increase the County's supply of jail beds, but will not be sufficient to meet the adopted standard.

The adopted standard is not used in determining the public protection impact fee for several reasons. First, without substantial outside funding the County is not likely to be able to afford the additional facilities that would be needed to meet the adopted standard. The planned facilities used as a basis for the CIP represent a more reasonably attainable increase in facilities based on the County's fiscal constraints. The County may receive additional funding for jail facilities through state bond programs, but no funding has been secured at this time. Second, the per capita need for jail space and the cost per bed may decrease in the future based on recent trends in incarceration practices, such as doubling the number of bunk beds per jail cell. This approach results in lower fees that fund only facility plans that have been identified to date.

[3] See Kern County CIP, Table 1.1.

Cost Allocation

Table 3.6 shows the facility cost standard for of public protection facilities at the 2030 planning horizon, based on the system plan cost allocation approach. The facility standard is based on the total value of facilities that will be in place at the 2030 planning horizon and the anticipated 2030 service population. The system plan approach is used to develop the facility standard for public protection facilities because it is not practical to differentiate between public protection facilities serving new development and facilities serving existing development. Additionally, using the system plan approach allows the County to charge new development an impact fee based on the future value of facilities per capita, which is higher than the current public protection cost standard.

Table 3.6: Public Protection Facilities Cost Per Capita

Existing Land and Buildings	$ 405,774,300
Existing Equipment	7,326,900
Total Value Existing Facilities	$ 413,101,200
Less: Lerdo Minimum Facility (to be replaced)[1]	(102,854,400)
Total Value Planned Facilities	225,409,600
Total Value Countywide Public Protection Facilities (2030)	$ 535,656,400
2030 Service Population	1,288,100
Cost Per Capita	$ 416
Cost Per Resident	$ 416
Cost Per Worker[2]	100

[1] Based on replacement of 704 beds in Lerdo Minimum Facility and cost per bed of $146,100.

[2] Workers weighted at 0.24 of residents.

Sources: Tables 3.2, 3,3, 3.4 and 3.6; Willdan Financial Services.

Fee Schedule

Table 3.7 shows the public protection facilities fee schedule. The cost per capita is converted to a fee per unit of new development based on dwelling unit and employment densities (persons per dwelling unit or employees per 1,000 square feet of nonresidential building space) shown in Table 2.3.

Table 3.7: Countywide Public Protection Facility Impact Fees

	A Cost per Capita	B Density[1]	C=AxB Base Fee[2]	D=0.5%xC Admin. Charge	E=C+D Fee[2]
Residential					
Single Family Unit	$ 416	3.14	$ 1,306	$ 6.53	$ 1,312.53
Multi-family Unit	416	2.08	865	4.33	869.33
Nonresidential					
Commercial	$ 100	2.50	$ 250	$ 1.25	$ 251.25
Office	100	3.33	333	1.67	334.67
Industrial	100	1.67	167	0.84	167.84

[1] Persons per dwelling unit or workers per 1,000 square feet.
[2] Fee per dwelling unit (residential) or per 1,000 square feet (nonresidential).
[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 3.6; Willdan Financial Services.

Additional Funding

The only planned public protection facility at this time is the replacement of the Lerdo Minimum Security Facility, estimated to cost $225.4 million. Non-fee funding will be needed to partially fund the planned facility because the planned future value of facilities per capita in Kern County is higher than the current value per capita. Impact fee revenue may not be used for the share of facility costs resulting from increasing the level of facilities per capita for existing development. The $38.8 million in non-fee revenue needed to complete the planned facility represents the share of costs related to increasing the facility standard for existing development. **Table 3.8** displays projected fee revenue and non-fee funding required through 2030.

Table 3.8: Allocation of Countywide Public Protection Facility Costs to New Development

Facility System Cost Per Capita	$ 416
New Development Service Population (2009-2030)	448,500
New Development Contribution to Planned Facilities	$ 186,576,000
Total Cost of Planned Facilities	$ 225,409,600
Non-Fee Revenue to be Identified	$ 38,833,600

Sources: Tables 3.1, 3.5 and 3.6; Willdan Financial Services.

The County will need to develop alternative funding sources to fund existing development's share of the facility. Potential sources of revenue include state bond fund programs, existing or new general fund revenues, new special or general taxes, special assessments, or grants.

4. Sheriff Patrol and Investigation

The purpose of this fee is to ensure that new development funds its fair share of Sheriff patrol and investigation facilities. The fee will be charged to residential and nonresidential development in unincorporated areas of the County. The Sheriff's Department provides basic law enforcement services in the unincorporated area. The County will use fee revenues to expand Sheriff patrol and investigation facilities, including new Sheriff substations and equipment, to serve new development.

This chapter presents potential Sheriff patrol and investigation impact fees for three separate fee zones. The fee zone boundaries are described in Chapter 2. By dividing the County into zones, the impact fees for each development project will be based on the standards at which Sheriff patrol and investigation facilities are needed in the area of the County where the project is located.

Service Population

The Kern County Sheriff's Department provides basic law enforcement services in the unincorporated area, while City police departments provide law enforcement in incorporated cities. Therefore, the impact fee for Sheriff patrol and investigation facilities will be charged only in unincorporated areas of the County.

Both residents and workers in unincorporated portions of Kern County benefit from patrol and investigation services provided by the Sheriff's Department. Therefore, demand for Sheriff patrol and investigation facilities is based on the County's combined unincorporated residential and worker populations.

It is reasonable to assume that demand for these services is less for one employee compared to one resident, because nonresidential buildings are typically occupied less intensively than dwelling units. The 0.24-weighting factor for workers is based on a 40-hour workweek divided by the total number of hours in a week (168) and reflects the degree to which nonresidential development yields a lesser demand for Sheriff patrol and investigation facilities. **Table 4.1** shows the estimated service population in 2008 and 2030, both for the entire unincorporated area and for each of the three fee zones.

Table 4.1: Sheriff Patrol & Investigation Service Population

	Residents	Workers	Service Population	Percent of Total
Desert Zone Unincorporated				
Existing - Unincorporated (2008)	40,500	28,400	47,300	
New Development - Unincorporated (2009-2030)	27,200	7,900	29,100	
Total - Unincorporated (2030)	67,700	36,300	76,400	18%
Mountain Zone Unincorporated				
Existing - Unincorporated (2008)	61,300	12,500	64,300	
New Development - Unincorporated (2009-2030)	27,800	6,300	29,300	
Total - Unincorporated (2030)	89,100	18,800	93,600	23%
Valley Zone Unincorporated				
Existing - Unincorporated (2008)	192,700	66,100	208,600	
New Development - Unincorporated (2009-2030)	34,300	12,100	37,200	
Total - Unincorporated (2030)	227,000	78,200	245,800	59%
Total Unincorporated Area				
Existing - Unincorporated (2008)	294,400	107,000	320,100	
New Development - Unincorporated (2009-2030)	89,500	26,200	95,800	
Total - Unincorporated (2030)	383,900	133,200	415,900	100%
Weighting Factor	1.00	0.24		

Note: Totals may not sum exactly due to rounding.

Sources: Table 2.2; Willdan Financial Services.

Facility Standards

The Kern County CIP identifies a Countywide facility standard of 0.39 square feet of building space per capita for Sheriff patrol and investigation facilities, which was the existing standard at the time the CIP was prepared. The CIP identifies needs for new Sheriff substations to accommodate anticipated growth through 2030. The substation needs were based on an analysis by County staff of the anticipated geographic distribution of new development. As a result of varying development patterns in each of the three fee zones, the facility standard will vary between the three fee zones. **Table 4.2** shows the anticipated facility standard in each fee zone in 2030.

Table 4.2: Sheriff Patrol and Investigation Facility Standard

	Desert Zone	Mountain Zone	Valley Zone
Existing Building Square Feet (2008)	21,002	23,794	70,871
Planned Additional Building Square Feet (2009-2030)	6,000	24,000	18,000
Total Planned Building Square Feet (2030)	27,002	47,794	88,871
Future Service Population (2030)	76,400	93,600	245,800
Facility Standard (sq. ft. per capita)	0.35	0.51	0.36

Sources: Tables 4.1, 4.3, and 4.5.

Existing and Planned Facilities

The proposed Sheriff patrol and investigation impact fees are based on the Sheriff's Office's inventory of existing and planned public protection facilities, as identified in the Kern County CIP. **Table 4.3** presents the inventory of existing Sheriff patrol and investigation facilities in Kern County along with each facility's current value based on the unit costs shown in Tables 2.4 and 2.5.

The inventory of square footage and facility costs in each of the three fee zones is included in Table 4.3. The facilities at the main Norris Road Sheriff's office, the pistol range, and the aircraft hangar are used to provide services Countywide, rather than in one particular zone. The cost of these facilities is allocated to fee zones based on the share of future service population in each zone.[4]

[4] The future service population is used as the basis for allocating these facilities rather than the existing service population because the impact fees are based on the future inventory of facilities and service population in each zone.

Table 4.3: Existing Sheriff Patrol and Investigation Facilities

Facility (Location)		Inventory		Unit Cost[1]	Total Value	Zone[3]
Land						
Boron Sheriff (26949 Cote St)		0.50	acres	$ 53,680	$ 26,800	Desert
Inyokern Substation (6612 Orchard St)		1.00	acres	20,560	20,600	Desert
Main Facility (1350 Norris Road)		8.13	acres	50,880	413,700	General
East Bakersfield Substation		5.27	acres	350,000	1,844,500	Valley
Sheriff - Walker Basin (14700 Caliente Cr)		0.92	acres	31,400	28,800	Mountain
Subtotal - Land		15.82	acres		$ 2,334,400	
Buildings						
Frazier Park Substation[2]		-	sq. ft.	$ 421	$ -	Mountain
Inyokern Sheriff's Substation		1,890	sq. ft.	421	795,700	Desert
Rosamond Sheriff's Substation[2]		-	sq. ft.	-	-	Desert
Sheriff - Boron		1,220	sq. ft.	421	513,600	Desert
Sheriff - Building A		13,000	sq. ft.	421	5,473,000	General
Sheriff - Building B		21,000	sq. ft.	421	8,841,000	General
Sheriff - Building C		3,100	sq. ft.	421	1,305,100	General
Sheriff - Building D		3,100	sq. ft.	421	1,305,100	General
Sheriff - Building E		11,500	sq. ft.	421	4,841,500	General
Sheriff - Building F		20,000	sq. ft.	421	8,420,000	General
Sheriff - Building G		2,900	sq. ft.	421	1,220,900	General
Sheriff - Building H		4,833	sq. ft.	421	2,034,700	General
Sheriff - Building J		3,500	sq. ft.	421	1,473,500	General
Sheriff - Building K-1		1,700	sq. ft.	421	715,700	General
Sheriff - Building K-2		815	sq. ft.	421	343,100	General
Sheriff - Building K-3		900	sq. ft.	421	378,900	General
Sheriff - Building K-4		950	sq. ft.	421	400,000	General
Sheriff - Building L		616	sq. ft.	421	259,300	General
Sheriff - East Bakersfield		12,224	sq. ft.	421	5,146,300	Valley
Sheriff - Hangar (Bld. I)		10,000	sq. ft.	180	1,800,000	General
Sheriff - New Horizon Blvd.[2]		-	sq. ft.	421	-	Valley
Sheriff - Unicorn Field Office[2]		-	sq. ft.	421	-	N/A (Leased)
Sheriff - Walker Basin		932	sq. ft.	421	392,400	Mountain
Tehachapi Substation[2]		-	sq. ft.	421	-	Mountain
Subtotal - Buildings		114,180	sq. ft.		$ 45,659,800	
Countywide Existing Facilities					$ 47,994,200	
Desert Zone Existing Facilities	18%	21,002	sq. ft.		$ 8,475,160	
Mountain Zone Existing Facilities	21%	23,794	sq. ft.		9,517,010	
Valley Zone Existing Facilities	61%	70,871	sq. ft.		30,323,530	
Total	100%	115,668	sq. ft.		$ 48,315,700	

[1] Based on estimated replacement cost.
[2] Facility leased, not owned, by the County.
[3] Facilities categorized as "General" are used for administrative or other Countywide functions. These facilities are allocated to the fee zones based on service population.

Sources: Kern County; Willdan Financial Services.

Table 4.4 shows the inventory of existing Sheriff patrol and investigation equipment for each of the three potential fee zones. The majority of this equipment is general equipment, not associated with a particular fee zone. This equipment value is allocated to fee zones based on the share of the total future service population in each zone.

Table 4.4: Existing Sheriff Patrol & Investigation Equipment and Vehicles

Location/Description		Value	Zone[3]
Equipment			
Air Support	$	11,500,000	General
Boron Sheriff		15,000	Desert
Calmmet		212,390	General
Civil/Arr Records/Prop RM Equiment		500,000	General
Comm. Center		1,000,000	General
East Bakersfield Substation		250,000	Valley
Frazier Park Substation		200,000	Mountain
HIDTA		400,134	General
Identix Equipment		720,000	General
Inyokern Substation		100,000	Desert
Livescans and Ancillary Equipment		2,050,000	General
Maricopa		100,000	Valley
McFarland Substation		200,000	Valley
Network Equipment		412,000	General
Norris Road Equipment		2,000,000	General
PC's, Printers, Laptops		1,550,000	General
Radio Communications Equipment[1]		2,061,900	General
Ran Board Equipment		350,000	General
Rosamond Substation		240,800	Desert
Rosedale Substation		46,500	Valley
Servers, SANS, Tape Backups		225,000	General
Tehachapi Substation		244,000	Mountain
Walker Basin		1,850	Mountain
Subtotal, Equipment	$	24,379,574	
Existing Sheriff Vehicles[2]		25,000,000	General
Countywide Existing Equipment and Vehicles	$	49,379,574	
Desert Zone Existing Equipment and Vehicles	$	8,992,456	18%
Mountain Zone Existing Equipment and Vehicles		11,481,578	23%
Valley Zone Existing Equipment and Vehicles		28,905,540	59%
Total	$	49,379,574	100%

[1] All County radio communications equipment controlled by General Services. Radio inventory assigned to Sheriff's Department is assumed to be split 50/50 between countywide public protection and sheriff patrol and investigation.

[2] Vehicle value is an estimated replacement value for the entire fleet of patrol and investigation vehicles provided by the Kern County Sheriff's Department. Fleet includes patrol cars, slick tops, administration vehicles, buses, vans, and

[3] Facilities categorized as "General" are used for administrative or other Countywide functions. These facilities are allocated to the fee zones based on service population.

Source: Kern County Sheriff's Department; Willdan Financial Services.

The County can use Sheriff patrol and investigation facilities fee revenues for the construction or purchase of new buildings, land, land improvements, vehicles, and

equipment that expands the capacity of the existing system to serve new development. According to the Kern County CIP, the County will need to construct eight Sheriff substations around the County to accommodate growth anticipated through the 2030 planning horizon. Of the eight planned substations, four will be located in the Mountain Zone, three will be in the Valley Zone, and one will be in the Desert Zone. **Table 4.5** shows the planned Sheriff patrol and investigation facilities.

Table 4.5: Planned Sheriff Patrol and Investigation Facilities

	Inventory		Unit Cost	Total Value	Zone
Land					
Buttonwillow	0.46	acres	$ 87,200	$ 40,000	Valley
Frazier Park	0.46	acres	116,800	53,600	Mountain
Rosedale West	0.46	acres	350,000	160,700	Valley
Rosamond	0.46	acres	81,600	37,500	Desert
Metro South	0.46	acres	350,000	160,700	Valley
Tehachapi	0.46	acres	139,200	63,900	Mountain
Tejon Ranch	0.46	acres	116,800	53,600	Mountain
Kernville	0.46	acres	121,600	55,800	Mountain
Subtotal	3.67	acres		$ 625,800	
Buildings [1]					
Buttonwillow	6,000	sq. ft.	$ 421	$ 2,526,000	Valley
Frazier Park	6,000	sq. ft.	421	2,526,000	Mountain
Rosedale West	6,000	sq. ft.	421	2,526,000	Valley
Rosamond	6,000	sq. ft.	421	2,526,000	Desert
Metro South	6,000	sq. ft.	421	2,526,000	Valley
Tehachapi	6,000	sq. ft.	421	2,526,000	Mountain
Tejon Ranch	6,000	sq. ft.	421	2,526,000	Mountain
Kernville	6,000	sq. ft.	421	2,526,000	Mountain
Subtotal	48,000	sq. ft.		$ 20,208,000	
Equipment					
Buttonwillow	6,000	sq. ft.	$ 108	$ 648,000	Valley
Frazier Park	6,000	sq. ft.	108	648,000	Mountain
Rosedale West	6,000	sq. ft.	108	648,000	Valley
Rosamond	6,000	sq. ft.	108	648,000	Desert
Metro South	6,000	sq. ft.	108	648,000	Valley
Tehachapi	6,000	sq. ft.	108	648,000	Mountain
Tejon Ranch	6,000	sq. ft.	108	648,000	Valley
Kernville	6,000	sq. ft.	108	648,000	Mountain
Subtotal				$ 5,184,000	
Vehicles [2]					
Patrol Cars	58	cars	$ 52,000	$ 3,016,000	General
Detective Cars	28	cars	45,000	1,260,000	General
Subtotal				$ 4,276,000	
Total Value Planned Facilities				$ 30,293,800	
Desert Zone Planned Facilities	6,000	sq. ft.		$ 3,981,180	
Mountain Zone Planned Facilities	24,000	sq. ft.		13,258,380	
Valley Zone Planned Facilities	18,000	sq. ft.		13,054,240	
Total	48,000	sq. ft.		30,293,800	

[1] Building costs include architecture and engineering and other associated costs.

[2] Vehicle cost is allocated to the fee zones based on service population.

Sources: Kern County Sheriff's Department; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 4.6 shows the Sheriff patrol and investigation cost per capita for each of the three geographic fee zones. The cost per capita is shown in three ways for each zone to allow the appropriate cost per capita to be used as a basis for the impact fee to be identified for each zone. The existing inventory cost per capita is based on the estimated value of existing facilities and the current service population. The system plan cost per capita is based on the combined value of existing and planned facilities and the projected service population at the 2030 planning horizon. The planned facilities cost per capita is based on the planned new facilities and the estimated increase in service population through 2030. (See page 3 for more information on the alternative cost allocation methods.)

For the Mountain Zone and the Valley Zone, the system plan standard is slightly higher than the existing standard. This means that the County plans to provide a slightly higher value of facilities per capita in the future than is currently provided in these zones. The system plan cost per capita will be used as a basis for the proposed impact fees for these zones so that new development contributes to facilities based on the planned future standard of facilities per capita. The portion of new facility costs related to increasing the facility standard provided to existing development will need to be funded by non-impact fee sources.

For the Desert Zone, the system plan standard is lower than the existing standard. In these areas, the County anticipates that the marginal cost of accommodating growth will be less than the current average cost to serve the existing service population. The lower cost of growth is due to economies of scale and other efficiencies in serving these areas, and not an anticipated decline in the level of service. In this zone, the proposed impact fee is based on the planned facilities cost per capita; otherwise, new development would be projected to provide more funding than is needed to complete the planned facilities in these zones.

Table 4.6: Sheriff Patrol and Investigation Facilities Cost Per Capita

	Desert Zone	Mountain Zone	Valley Zone
Existing Inventory			
Total Value Existing Facilities (2008)	$ 17,467,616	$ 20,998,588	$ 59,229,070
2008 Service Population	47,300	64,300	208,600
Cost Per Capita	$ 369	$ 327	$ 284
Cost Per Resident	$ 369	$ 327	$ 284
Cost Per Worker[1]	89	78	68
System Plan			
Total Value Existing Facilities (2008)	$ 17,467,616	$ 20,998,588	$ 59,229,070
Total Value Planned Facilities (2009-2030)	3,981,180	13,258,380	13,054,240
Total Value Public Protection Facilities (2030)	$ 21,448,796	$ 34,256,968	$ 72,283,310
2030 Service Population	76,400	93,600	245,800
Cost Per Capita	$ 281	$ 366	$ 294
Cost Per Resident	$ 281	$ 366	$ 294
Cost Per Worker[1]	67	88	71
Planned Facilities			
Total Value Planned Facilities (2009-2030)	$ 3,981,180	$ 13,258,380	$ 13,054,240
2008-2030 Service Population Growth	29,100	29,300	37,200
Cost Per Capita	$ 137	$ 453	$ 351
Cost Per Resident	$ 137	$ 453	$ 351
Cost Per Worker[1]	33	109	84

Note: Service population totals may not sum exactly due to rounding.

[1] Based on 0.24 worker weighting factor.

Sources: Tables 4.1 and 4.2-4.5; Willdan Financial Services.

Fee Schedule

Table 4.7 displays the Sheriff patrol and investigation facilities fee schedule. The cost per capita is converted to a fee per unit of new development based on the dwelling unit and employment densities (persons per dwelling unit or employees per 1,000 square feet of nonresidential building space) shown in Table 2.3.

Table 4.7: Countywide Sheriff Patrol and Investigation Facility Impact Fees

	A Cost per Capita[1]	*B* Density[2]	*C=AxB* Base Fee[3]	*D=0.5%xC* Admin. Charge[4]	*E=C+D* Fee
Desert Zone					
Residential					
Single Family Unit	$ 137	3.14	$ 430	$ 2.15	$ 432.15
Multi-family Unit	137	2.08	285	1.43	286.43
Nonresidential					
Commercial	$ 33	2.50	$ 82	$ 0.41	$ 82.41
Office	33	3.33	109	0.55	109.55
Industrial	33	1.67	55	0.28	55.28
Mountain Zone					
Residential					
Single Family Unit	$ 366	3.14	$ 1,149	$ 5.75	$ 1,154.75
Multi-family Unit	366	2.08	761	3.81	764.81
Nonresidential					
Commercial	$ 88	2.50	$ 220	$ 1.10	$ 221.10
Office	88	3.33	293	1.47	294.47
Industrial	88	1.67	147	0.74	147.74
Valley Zone					
Residential					
Single Family Unit	$ 294	3.14	$ 923	$ 4.62	$ 927.62
Multi-family Unit	294	2.08	612	3.06	615.06
Nonresidential					
Commercial	$ 71	2.50	$ 176	$ 0.88	$ 176.88
Office	71	3.33	235	1.18	236.18
Industrial	71	1.67	118	0.59	118.59

[1] Desert Zone fees based on planned facilities cost per capita. Mountain Zone and Valley Zone fees based on system plan cost per capita.

[2] Persons per dwelling unit or workers per 1,000 square feet.

[3] Fee per dwelling unit (residential) or per 1,000 square feet (nonresidential).

[4] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 4.6; Willdan Financial Services.

Additional Funding

Table 4.8 shows the projected impact fee revenue based on the proposed impact fee cost per capita for each zone, as well as for the unincorporated area as a whole. Table 4.6 also shows the non-fee revenue that would be needed to complete the planned facilities in the Mountain Zone and Valley Zone, if the County adopts different Sheriff patrol and investigation impact fees for each geographic zone. In these two zones, the County plans to increase the value of facilities provided per capita. The non-fee revenue needed reflects the cost of increasing the value of facilities per capita for existing development. Impact fee revenue may not be used for this purpose.

Table 4.8: Allocation of Sheriff Patrol and Investigation Facility Costs to New Development

	Desert Zone	Mountain Zone	Valley Zone
Impact Fee Cost per Capita[1]	$ 137	$ 366	$ 294
New Development Service Population (2009-2030)	29,100	29,300	37,200
New Development Contribution to Planned Facilities	$ 3,981,180	$ 10,723,800	$ 10,936,800
Total Cost of Planned Facilities	3,981,180	13,258,380	13,054,240
Non-Fee Revenue to Be Identified	$ -	$ 2,534,580	$ 2,117,440

[1] Desert Zone fees based on planned facilities cost per capita. Mountain Zone and Valley Zone fees based on system plan cost per capita.

Sources: Tables 4.1 and 4.6; Willdan Financial Services.

The County will need to develop alternative funding sources to fund existing development's share of the planned facilities. Potential sources of revenue include existing or new general fund revenues, new special or general taxes, special assessments, or grants.

5. Library

The purpose of this fee is to ensure that new development funds its fair share of library facilities. The Kern County Library provides library services in the entire County; therefore, the fee will be charged to all residential development countywide. The County will use fee revenue to provide the library facilities needed to accommodate new development, including new or expanded branch libraries, volumes, and technology.

This chapter presents potential library impact fees for three separate fee zones. The fee zone boundaries are described in Chapter 2. By dividing the County into zones, the impact fees for each development project will be based on the standards at which library facilities are needed in the part of the County where the project is located.

Service Population

Residents, rather than businesses, are the primary users of the Kern County Library system. The Kern County Library provides services in both cities and unincorporated areas. Therefore, demand for library facilities is based on the countywide residential population. **Table 5.1** shows the estimated service population in 2008 and 2030, both for the entire County and for each of the three fee zones.

Table 5.1: Library Service Population

	Residents	Percent of Total
Desert Zone		
Existing (2008)	80,100	
New Development (2009-2030)	36,800	
Total (2030)	116,900	10%
Mountain Zone		
Existing (2008)	69,600	
New Development (2009-2030)	33,000	
Total (2030)	102,600	9%
Valley Zone		
Existing (2008)	629,500	
New Development (2009-2030)	352,300	
Total (2030)	981,800	82%
Countywide		
Existing (2008)	779,100	
New Development (2009-2030)	422,300	
Total (2030)	1,201,400	100%

Note: Totals may not sum exactly due to rounding.

Source: Table 2.2.

Facility Standards

In the Kern County CIP, the County adopted library facility demand standards of 0.78 building square feet per capita and 2.50 volumes per capita. These are the system-wide targets identified in the Kern County Library Facilities Master Plan, which was adopted in 2002.

Based on these standards and anticipated development, the Library Facilities Master Plan identified facility needs, which are included in the CIP. The facility needs identified in the Master Plan were based on a 2020 planning horizon. Because the CIP and this impact study have a planning horizon of 2030 with a higher service population than the 2020 Master Plan, the County is projected to fall short of the facility targets by 2030. Additional facilities may be added in future versions of the CIP. If this occurs, the County should consider revising the library impact fee.

Existing and Planned Facilities

Existing Facilities

The proposed library impact fees are based on the Kern County Library's inventory of existing and planned facilities. **Table 5.2** presents the inventory of existing Kern County Library land and buildings, along with each facility's current value based on the unit costs shown in Tables 2.4 and 2.5 and, in some cases, specific estimates for each facility provided by County staff. The building value has been reduced for several facilities with structural or age-related deficiencies.

The Kern County CIP calls for replacing some existing library facilities with new facilities. Where new facilities are planned to replace existing facilities, no value is shown for the existing facilities so that only the value of facilities that are expected to be in use at this study's 2030 planning horizon are included in the facility inventory. Also, some of the existing libraries are in leased facilities. The value of these facilities is not included in the facility inventory because these facilities do not represent capital investment by the County.

Table 5.2: Existing Library Land and Buildings

	Inventory		Unit Cost[1]	Total Value	Zone
Land					
Arvin Library (201 Campus Dr)	1.15	acres	$ 51,175	$ 58,851	Valley
Baker Library (1400 Baker St)	0.47	acres	79,105	37,200	Valley
Beale Memorial Library & Hq (701 Truxtun Ave)	3.45	acres	350,000	1,207,500	Valley
Buttonwillow Library (116 S. Buttonwillow Ave)[2]	0.14	acres	-	-	Valley
Calif. City Library (9507 Calif. City Blvd)	1.00	acres	34,500	34,500	Desert
Delano Library (925 10th St)[2]	0.26	acres	-	-	Valley
Frazier Park Library	1.08	acres	116,800	126,100	Mountain
Holloway-Gonzales Library (506 E. Brundage Ln)	1.08	acres	350,000	378,000	Valley
Kern River Valley Library (7054 Lake Isabella Blvd)	3.00	acres	29,272	87,800	Mountain
Lamont Library (8304 Segrue Rd)	0.25	acres	35,545	8,900	Valley
McFarland Library (500 Kern Ave)	0.75	acres	37,287	28,000	Valley
Rathbun Library (200 W. China Grade Loop)	1.00	acres	6,621	6,600	Valley
Ridgecrest Library (131 E. Las Flores)	1.00	acres	32,409	32,400	Desert
Shafter Library (236 James St)[2]	0.52	acres	141,831	73,800	Valley
Southwest Branch Library	1.96	acres	350,000	686,000	Valley
Taft Library (27 Emmons Park Dr)	0.67	acres	63,075	42,300	Valley
Wanda Kirk Lib. - Rosamond (3611 Rosamond Blvd)	2.78	acres	90,072	250,400	Desert
Wasco Library (1102 Seventh St)	0.35	acres	126,498	44,300	Valley
Wilson Library (1901 Wilson Rd)[2]	1.02	acres	88,165	89,900	Valley
Subtotal	21.93	acres		$ 3,192,551	
Buildings					
Arvin Library	8,182	sq. ft.	$ 400	$ 3,272,800	Valley
Baker Library	4,242	sq. ft.	300	1,272,600	Valley
Beale Memorial Library & Hq	128,165	sq. ft.	325	41,653,600	Valley
Boron Library[4]	3,000	sq. ft.	-	-	Desert
Buttonwillow Library[2]	1,368	sq. ft.	-	-	Valley
California City Library	6,000	sq. ft.	150	900,000	Desert
Delano Library[2]	6,000	sq. ft.	-	-	Valley
Frazier Park Library[3]	10,000	sq. ft.	545	5,449,200	Mountain
Holloway-Gonzales Library	7,463	sq. ft.	200	1,492,600	Valley
Kern River Valley Library	5,968	sq. ft.	250	1,492,000	Mountain
Kernville Library[4]	564	sq. ft.	-	-	Mountain
Lamont Library	11,425	sq. ft.	400	4,570,000	Valley
McFarland Library	6,207	sq. ft.	350	2,172,500	Valley
Mojave Library[4]	1,794	sq. ft.	-	-	Desert
Northeast Branch Library[4]	10,000	sq. ft.	-	-	Valley
Rathbun Library	7,463	sq. ft.	200	1,492,600	Valley
Ridgecrest Library	7,463	sq. ft.	150	1,119,500	Desert
Shafter Library[2]	4,155	sq. ft.	-	-	Valley
Southwest Branch Library	18,336	sq. ft.	150	2,750,400	Valley
Taft Library	4,726	sq. ft.	100	472,600	Valley
Tehachapi Library[4]	6,000	sq. ft.	-	-	Mountain
Wanda Kirk Lib. - Rosamond	16,290	sq. ft.	350	5,701,500	Desert
Wasco Library	4,400	sq. ft.	150	660,000	Valley
Wilson Library[2]	6,321	sq. ft.	-	-	Valley
Wofford Heights Library[4]	2,025	sq. ft.	-	-	Mountain
Subtotal	287,557	sq. ft.		$ 74,471,900	
Total Value Existing Land and Buildings				$ 77,664,451	
Desert Zone Existing Land and Buildings	34,547	sq. ft.		$ 8,038,300	
Mountain Zone Existing Land and Buildings	24,557	sq. ft.		7,155,100	
Valley Zone Existing Land and Buildings	228,453	sq. ft.		62,471,051	

[1] Land values provided by Kern County. Building values are estimated replacement costs based on age and condition. Frazier Park is a new facility and the replacement cost is based on actual construction costs. Project costs are estimed construction costs only; not total project costs.

[2] Zero facility value shown because CIP calls for replacing existing library with a new facility.

[3] Frazier Park library is in design development. Cost based on actual capital construction project detail.

[4] Facility is leased, not owned, by the County.

Sources: Kern County Library; Willdan Financial Services.

Table 5.3 shows the inventory of existing library volumes, both as a countywide total and for each of the three potential fee zones.

Table 5.3: Existing Library Volumes

	Inventory		Unit Cost[1]	Total Value	Zone
Volumes[1]					
Arvin Library	22,838	volumes	$ 47	$ 1,073,400	Valley
Baker Library	17,857	volumes	47	839,300	Valley
Beale Memorial Library & HQ	307,206	volumes	47	14,438,700	Valley
Boron Library	17,017	volumes	47	799,800	Desert
Buttonwillow Library	10,956	volumes	47	514,900	Valley
California City Library	23,029	volumes	47	1,082,400	Desert
Delano Library	38,672	volumes	47	1,817,600	Valley
Frazier Park Library	13,195	volumes	47	620,200	Mountain
Holloway-Gonzales Library	32,827	volumes	47	1,542,900	Valley
Kern River Valley Library	38,948	volumes	47	1,830,600	Mountain
Kernville Library	7,219	volumes	47	339,300	Mountain
Lamont Library	28,856	volumes	47	1,356,200	Valley
McFarland Library	15,705	volumes	47	738,100	Valley
Mojave Library	14,573	volumes	47	684,900	Desert
Northeast Branch Library	41,047	volumes	47	1,929,200	Valley
Rathbun Library	46,346	volumes	47	2,178,300	Valley
Ridgecrest Library	52,669	volumes	47	2,475,400	Desert
Shafter Library	30,063	volumes	47	1,413,000	Valley
Southwest Branch Library	74,023	volumes	47	3,479,100	Valley
Taft Library	37,619	volumes	47	1,768,100	Valley
Tehachapi Library	39,422	volumes	47	1,852,800	Mountain
Wanda Kirk Lib. - Rosamond	48,646	volumes	47	2,286,400	Desert
Wasco Library	29,482	volumes	47	1,385,700	Valley
Wilson Library	40,895	volumes	47	1,922,100	Valley
Wofford Heights Library	11,681	volumes	47	549,000	Mountain
Total Existing Volumes	1,040,791	volumes		$ 48,917,400	
Desert Zone Existing Volumes	155,934	volumes		$ 7,328,900	
Mountain Zone Existing Volumes	110,465	volumes		5,191,900	
Valley Zone Existing Volumes	774,392	volumes		36,396,600	

[1] Unit costs are from the Kern County Library and include books and media items including selection, acquisition, cataloging, processing, and delivery costs.

Sources: Kern County Library; Willdan Financial Services.

Table 5.4 shows the estimated value of existing library technology, art, and furnishings. The value of technology and furnishings for branches with planned replacements in the CIP is not included in Table 5.4 because it is assumed that these facilities will be replaced when these branches move into their new buildings. (Technology and furnishing costs for the planned replacement facilities are included in Table 5.8, below.) It is assumed that the existing art in the Wilson Library will be moved to the replacement facility.

Table 5.4: Library Existing Technology, Art, and Furnishings

	Technology	Art	Furnishings[1]	Total	Zone
Arvin Library	$ 10,691	$ 55,000	$ 5,710	$ 71,401	Valley
Baker Library	24,103	-	25,285	49,388	Valley
Beale Memorial Library & HQ	9,923	-	6,241	16,164	Valley
Boron Library	31,227	-	31,505	62,732	Desert
Buttonwillow Library[3]	-	-	-	-	Valley
California City Library	28,130	5,000	53,530	86,660	Desert
Delano Library[3]	-	-	-	-	Valley
Fire Department[2]	8,710	-	-	8,710	Valley
Frazier Park Library	29,835	-	45,775	75,610	Mountain
Holloway-Gonzales Library	15,899	-	7,312	23,211	Valley
Kern River Valley Library	34,205	-	37,118	71,323	Mountain
Kernville Library[3]	-	-	-	-	Mountain
Lamont Library	29,950	25,000	88,702	143,652	Valley
McFarland Library	16,913	-	20,698	37,611	Valley
Mojave Library	11,460	-	5,064	16,524	Desert
Northeast Branch Library	16,049	-	7,226	23,275	Valley
Rathbun Library	22,040	-	14,153	36,193	Valley
Ridgecrest Library	12,750	-	11,718	24,468	Desert
Shafter Library[3]	-	-	-	-	Valley
Southwest Branch Library	27,790	-	18,056	45,846	Valley
Taft Library	260,545	-	976,519	1,237,064	Valley
Tehachapi Library[3]	-	-	-	-	Mountain
Wanda Kirk Lib. - Rosamond	5,344	-	6,343	11,687	Desert
Wasco Library	18,618	8,200	153,654	180,472	Valley
Wilson Library[3]	-	37,000	-	37,000	Valley
Wofford Heights Library	28,926	6,221	208,767	243,914	Mountain
Total	$ 643,100	$ 136,400	$ 1,723,400	$ 2,502,900	
Desert Zone				$ 202,071	
Mountain Zone				390,847	
Valley Zone				1,909,987	

Note: Totals may not sum exactly due to rounding.

[1] Value includes shelving for Arvin, Beale, and McFarland libraries. Shelving value unavailable for the others.

[2] Small library facility at Fire Department contains computers owned by the Kern County Library.

[3] Zero value shown because CIP calls for replacing existing library with a new facility. Assumes that art at Wilson Library will be moved to new facility.

Sources: Kern County Library; Willdan Financial Services.

Table 5.5 shows the current inventory of vehicles owned by the Kern County Library. These vehicles may be used countywide and are not assigned to particular fee zones. Instead, the value of library vehicles is allocated based on the future population of each zone.

Table 5.5: Existing Library Vehicles

	Units	Value	Total	Zone
Bookmobile 32'	1	$ 450,000	$ 450,000	General
Bookmobile Van 18'	1	160,000	160,000	General
Delivery Van 14'	3	80,000	240,000	General
Passenger Van	2	60,000	120,000	General
Sport Utility Vehicle	1	35,000	35,000	General
Total Value, Existing Vehicles			$ 1,005,000	
Desert Zone			$ 97,790	
Mountain Zone			85,827	
Valley Zone			821,299	

Note: Totals may not sum exactly due to rounding.

Sources: Kern County Library; Willdan Financial Services.

Table 5.6 shows the total value of existing library facilities in each of the three potential fee zones, as well as countywide.

Table 5.6: Total Existing Facilities Value

	Desert Zone	Mountain Zone	Valley Zone
Land and Buildings	$ 8,038,300	$ 7,155,100	$ 62,471,051
Volumes	7,328,900	5,191,900	36,396,600
Computers, Art, and Furnishings	202,071	390,847	1,909,987
Vehicles	97,790	85,827	821,299
Total Existing Facilities Value	$ 15,667,061	$ 12,823,674	$ 101,598,938

Note: Totals may not sum exactly due to rounding.

Sources: Tables 5.2-5.5.

Planned Facilities

The County can use library facilities fee revenues for the construction or purchase of new buildings, land, technology and other equipment, art, and library volumes that expand the capacity of the existing system to serve new development. The County plans to use the impact fee revenue to fund the cost of the land, buildings, equipment, and library volumes needed for the twelve new or expanded branch libraries identified in the Kern County CIP. The County also plans to fund the purchase of three bookmobiles to serve new and existing development. **Table 5.7** shows the planned new library land, building, and vehicles identified in the CIP.

Table 5.7: Planned Library Land, Buildings, and Vehicles

	Inventory		Unit Cost	Total Value	Zone
Land					
Tehachapi	3.23	acres	$ 139,200	$ 449,100	Mountain
Lost Hills	0.69	acres	52,000	35,800	Valley
Kernville	0.28	acres	121,600	34,500	Mountain
Buttonwillow	0.51	acres	87,200	44,500	Valley
SW - Gosford/Panama	6.68	acres	350,000	2,339,100	Valley
Rosedale West	4.45	acres	350,000	1,558,900	Valley
Niles/Fairfax	3.81	acres	350,000	1,332,300	Valley
South Bakersfield	3.59	acres	350,000	1,257,200	Valley
Rio Bravo	2.44	acres	350,000	855,100	Valley
Delano	4.62	acres	226,500	1,045,800	Valley
Shafter	2.35	acres	104,800	246,500	Valley
Wilson	4.58	acres	350,000	1,602,500	Valley
Subtotal	37.24	acres		$ 10,801,300	
Buildings					
Tehachapi	29,572	sq. ft.	$ 539	$ 15,934,000	Mountain
Lost Hills	6,319	sq. ft.	539	3,405,000	Valley
Kernville	2,600	sq. ft.	539	1,401,000	Mountain
Buttonwillow	4,676	sq. ft.	539	2,520,000	Valley
SW - Gosford/Panama	61,262	sq. ft.	539	33,008,000	Valley
Rosedale West	40,828	sq. ft.	539	21,999,000	Valley
Niles/Fairfax	34,892	sq. ft.	539	18,800,000	Valley
South Bakersfield	32,926	sq. ft.	539	17,741,000	Valley
Rio Bravo	22,394	sq. ft.	539	12,066,000	Valley
Delano	42,323	sq. ft.	539	22,804,000	Valley
Shafter	21,563	sq. ft.	539	11,619,000	Valley
Wilson	41,970	sq. ft.	539	22,614,000	Valley
Subtotal	341,325	sq. ft.		$ 183,911,000	
Relocation and Temporary Facilities					
Tehachapi				$ -	Mountain
Lost Hills				-	Valley
Kernville				-	Mountain
Buttonwillow				3,500	Valley
SW - Gosford/Panama				-	Valley
Rosedale West				-	Valley
Niles/Fairfax				-	Valley
South Bakersfield				-	Valley
Rio Bravo				-	Valley
Delano				13,800	Valley
Shafter				10,700	Valley
Wilson				14,600	Valley
Subtotal				$ 42,600	
Vehicles					
Bookmobile 32' (New Growth Areas)[1]	3	vehicles	$ 1,350,000	$ 4,050,000	General
Subtotal	3	vehicles		$ 4,050,000	
Total Value, Planned Facilities				$ 198,804,900	
Desert Zone Planned Facilities	-	sq. ft.		$ 394,000	
Mountain Zone Planned Facilities	32,172	sq. ft.		18,164,000	
Valley Zone Planned Facilities	309,153	sq. ft.		180,246,000	

Note: Totals may not sum exactly due to rounding.

[1] Value of planned bookmobiles is allocated to the fee zones based on service population.

Sources: Kern County Library; Willdan Financial Services.

Table 5.8 shows the volumes, furnishings, technology, and art needed for the planned new library branches.

Table 5.8: Planned Library Volumes and Furnishings

	Inventory		Unit Cost	Total Value	Zone
Volumes[1]					
Tehachapi	18,149	volumes	$ 47	$ 853,000	Mountain
Lost Hills	7,596	volumes	47	357,000	Valley
Kernville	2,681	volumes	47	126,000	Mountain
Buttonwillow	2,681	volumes	47	126,000	Valley
SW - Gosford/Panama	65,468	volumes	47	3,077,000	Valley
Rosedale West	58,809	volumes	47	2,764,000	Valley
Niles/Fairfax	59,319	volumes	47	2,788,000	Valley
South Bakersfield	47,553	volumes	47	2,235,000	Valley
Rio Bravo	17,596	volumes	47	827,000	Valley
Delano	46,511	volumes	47	2,186,000	Valley
Shafter	6,830	volumes	47	321,000	Valley
Wilson	70,894	volumes	47	3,332,000	Valley
Subtotal	404,085	volumes		$ 18,992,000	
Furnishings/Technology/Art					
Tehachapi				$ 1,830,000	Mountain
Lost Hills				380,000	Valley
Kernville				1,160,000	Mountain
Buttonwillow				290,000	Valley
SW - Gosford/Panama				3,800,000	Valley
Rosedale West				2,530,000	Valley
Niles/Fairfax				2,160,000	Valley
South Bakersfield				2,040,000	Valley
Rio Bravo				1,390,000	Valley
Delano				2,623,000	Valley
Shafter				1,336,000	Valley
Wilson				2,601,000	Valley
Subtotal				$ 22,140,000	
Total Value, Planned Volumes and Furnishings				$ 41,132,000	
Desert Zone Planned Volumes and Furnishings	-	volumes		$ -	
Mountain Zone Planned Volumes and Furnishings	20,830	volumes		3,969,000	
Valley Zone Planned Volumes and Furnishings	383,255	volumes		37,163,000	

[1] Planned volume acquisition is an estimate based on the volume acquisition cost from the library Master Plan and the current per volume replacement cost of $47. Actual number of volumes per library may vary slightly.

Sources: Kern County Library; Willdan Financial Services.

Table 5.9 shows the total value of planned new facilities in each of the three potential fee zones.

Table 5.9: Total Planned Facilities Value

	Desert Zone	Mountain Zone	Valley Zone
Land, Buildings and Vehicles	$ 394,000	$ 18,164,000	$ 180,246,000
Volumes and Furnishings	-	3,969,000	37,163,000
Total Existing Facilities Value	$ 394,000	$ 22,133,000	$ 217,409,000

Note: Totals may not sum exactly due to rounding.

Sources: Tables 5.7 and 5.8.

Cost Allocation and Fee Schedule

Costs per Capita

Table 5.10 shows the library facilities cost per capita for each of the three geographic fee zones. The cost per capita is shown in three ways for each zone to allow the appropriate cost per capita to be used as a basis for the impact fee to be identified for each zone. The existing standard cost per capita is based on the estimated value of existing facilities and the current service population. The system plan standard is based on the combined value of existing and planned facilities and the projected service population at the 2030 planning horizon. The planned facilities cost per capita is based on the planned new facilities and the estimated increase in service population through 2030. (See page 3 for more information on the alternative cost allocation methods.)

For the Mountain Zone and the Valley Zone the system plan standard is considerably higher than the existing standard. This means that the County plans to provide a higher value of facilities per capita in the future than is currently provided in these zones. The system plan cost per capita will be used as a basis for the proposed impact fees for these zones so that new development contributes to facilities based on the planned future standard of facilities per capita. The portion of new facility costs related to increasing the facility standard provided to existing development will need to be funded by non-impact fee sources.

For the Desert Zone, the system plan cost per capita is lower than the existing inventory cost per capita because there currently is a very small amount of new facilities planned for the Desert Zone. There are no planned new or replacement branches in the Desert Zone identified in the Library Master Plan and the CIP. The Desert Zone is currently served by libraries in Boron, California City, Mojave, Ridgecrest, and Rosamond. The Wanda Kirk Library in Rosamond is one of the newest libraries in the County.

The only planned facility allocated to the Desert Zone is a portion of the cost of the planned bookmobiles. Using the system plan cost per capita would result in more impact fee revenue than is needed to fund the Desert Zone's share of planned facilities. The Desert Zone impact fee is based on the planned facilities cost per capita, which will generate only the amount of revenue needed to fund the Desert Zone's share of the planned bookmobiles.

Table 5.10: Library Facilities Cost Per Capita

	Desert Zone	Mountain Zone	Valley Zone
Existing Inventory			
Total Value of Existing Facilities (2008)	$ 15,667,061	$ 12,823,674	$ 101,598,938
Existing Service Population	80,100	69,600	629,500
Cost Per Capita	$ 196	$ 184	$ 161
System Plan			
Total Value of Existing Facilities (2008)	$ 15,667,061	$ 12,823,674	$ 101,598,938
Total Cost of Planned Facilities (2009-2030)	394,000	22,133,000	217,409,000
Value of 2030 Library Facilities	$ 16,061,061	$ 34,956,674	$ 319,007,938
2030 Service Population	116,900	102,600	981,800
Cost Per Capita	$ 137	$ 341	$ 325
Planned Facilities			
Total Cost of Planned Facilities (2009-2030)	$ 394,000	$ 22,133,000	$ 217,409,000
2009-2030 Service Population Growth	36,800	33,000	352,300
Cost Per Capita	$ 11	$ 671	$ 617

Sources: Tables 5.1, 5.6, and 5.9; Willdan Financial Services.

Fee Schedule

Table 5.11 displays the library facilities fee schedule. The cost per capita is converted to a fee per unit of new development based on the dwelling unit densities (persons per dwelling unit) for Kern County shown in Table 2.3.

Table 5.11: Library Facilities Impact Fee

	A Cost per Capita[1]	B Density[2]	C=AxB Base Fee[3]	D=0.5%xC Admin. Charge[4]	E=C+D Fee
Desert Zone					
Single Family Unit	$ 11	3.14	$ 35	$ 0.18	$ 35.18
Multi-family Unit	11	2.08	23	0.12	23.12
Mountain Zone					
Single Family Unit	$ 341	3.14	$ 1,071	$ 5.36	$ 1,076.36
Multi-family Unit	341	2.08	709	3.55	712.55
Valley Zone					
Single Family Unit	$ 325	3.14	$ 1,021	$ 5.11	$ 1,026.11
Multi-family Unit	325	2.08	676	3.38	679.38

[1] Desert Zone fees based on planned facilities cost per capita. Mountain Zone and Valley Zone fees based on system plan cost per capita.
[2] Persons per dwelling unit.
[3] Fee per dwelling unit.
[4] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 5.10; Willdan Financial Services.

Additional Funding

Table 5.12 shows the projected impact fee revenue based on the proposed impact fee cost per capita for each zone. Table 5.11 also shows the non-fee revenue that would be needed to complete the planned facilities in the Mountain Zone and Valley Zone, if the County adopts different library impact fees for each geographic zone. In these two zones, the County plans to increase the value of library facilities per capita. The non-fee revenue needed reflects the cost of increasing the value of facilities per capita for existing development. Impact fee revenue may not be used for this purpose. In the Desert Zone, the proposed impact fee is estimated to generate revenue equal to the cost of facilities allocated to the Desert Zone.

Table 5.12: Allocation of Library Facility Costs to New Development

	Desert Zone	Mountain Zone	Valley Zone
Impact Fee per Capita[1]	$ 11	$ 341	$ 325
New Development Service Population (2009-2030)	36,800	33,000	352,300
New Development Contribution to Planned Facilities	$ 394,000	$ 11,253,000	$ 114,498,000
Total Cost of Planned Facilities	394,000	22,133,000	217,409,000
Non-Fee Revenue to Be Identified	$ -	$ 10,880,000	$ 102,911,000

[1] Desert Zone fees based on planned facilities cost per capita. Mountain Zone and Valley Zone fees based on system plan cost per capita.

Sources: Tables 5.1, 5.9 and 5.10; Willdan Financial Services.

The County will need to develop alternative funding sources to fund existing development's share of the planned facilities. Potential sources of revenue include existing or new general fund revenues, new special or general taxes, special assessments, grants, or state bond funds.

6. Animal Control

The purpose of this fee is to ensure that new development funds its fair share of animal control facilities. The Animal Control Department provides services in unincorporated Kern County and in several incorporated cities. The proposed animal control impact fee would be charged only in areas where the County Animal Control Department provides services.

Service Population

The animal control facilities service population is based on the residential population of the areas where the Kern County Animal Control Department provides services. Residents, and not workers, are included in the service population because residents are the primary owners of pets that generate demand for animal control services and facilities.

Table 6.1 shows the animal control facilities service population. The Kern County Animal Control Department provides field and shelter services in unincorporated Kern County and in the cities of Maricopa, McFarland, and Tehachapi. The Department provides only shelter services in Arvin and Bakersfield. The residents of these cities are assigned a weighting factor of 0.87 to reflect their lower demand for animal control facilities. The 0.87 weighting factor is based on share, by value, of total facilities that are used to provide shelter services.

Table 6.1: Animal Control Service Population

	Weighting Factor[1]	2008	2030	Growth
Unincorporated	1.00	294,400	383,900	89,500
Maricopa	1.00	1,100	1,400	300
McFarland	1.00	12,000	16,300	4,300
Tehachapi	1.00	8,300	13,500	5,200
Arvin	0.87	14,300	26,000	11,700
Bakersfield	0.87	283,200	505,700	222,500
Total		613,300	946,800	333,500

[1] Because the Animal Control Department provides only shelter services to the Cities of Arvin and Bakersfield, this portion of the service population has been weighted at a lower level. This factor represents the share of the value of animal control facilities that are devoted to providing shelter services, rather than field services.

Sources: Table 2.1; Kern County; Willdan Financial Services.

Facility Standards

The Kern County CIP identifies an adopted demand standard of 0.04 animal control building square feet per capita, which is based on the existing facility standard at the time the CIP was adopted. The CIP includes a planned 13,000 square foot new animal control complex or addition to an existing complex. With this planned facility, the County will

approximately meet the adopted demand standard with anticipated development through 2030.

Existing and Planned Facilities

Existing Facilities

The proposed animal control impact fees are based on the Animal Control Department's inventory of existing and planned animal control facilities using the system plan approach (see *Introduction* for further information). **Table 6.2** presents the inventory of existing animal control land and building facilities in Kern County along with each facility's current value based on the unit costs shown in Tables 2.4 and 2.5. Land value estimates for the existing animal control facilities were provided by County staff.

Table 6.2: Animal Control Existing Land and Buildings

	Inventory		Unit Cost[1]	Total Value
Land[2]				
Bakersfield Animal Shelter (201 S. Mt. Vernon)[3]	-	acres	$ -	$ -
Kern River Valley Animal Shelter (8620 Jetta Ave.)	5.07	acres	87,200	442,104
Mojave Animal Shelter (923 Poole St)[3]	-	acres	-	-
Taft Administration Building (315 Lincoln St)	0.03	acres	4,879	158
Kern River Valley Admin (7050 Lake Isabella Blvd)	0.03	acres	29,272	1,019
Ridgecrest County Building (400 N. China Lake Blvd.)	2.27	acres	32,409	73,574
Subtotal, Land	7.41	acres		$ 516,854
Buildings				
Bakersfield Animal Shelter[3]	12,927	sq. ft.	420	$ 5,429,300
Kern River Valley Animal Shelter	2,592	sq. ft.	420	1,088,600
Bakersfield Administration Facility[3]	1,440	sq. ft.	420	604,800
Mojave Animal Shelter[3]	4,844	sq. ft.	420	2,034,500
Taft Administration Building	96	sq. ft.	351	33,700
Kern River Valley Admin	85	sq. ft.	351	29,800
Ridgecrest County Building	582	sq. ft.	351	204,300
Subtotal, Buildings	22,566	sq. ft.		$ 9,425,000
Total, Existing Land and Buildings				$ 9,941,854

[1] Based on estimated replacement cost. Construction cost includes architecture and engineering and other costs.

[2] For shared facilities, the share of total parcel land acreage assigned to animal control is equal to the share of building square footage devoted to animal control facilities.

[3] Facilities are County-owned, but located on land leased by the County.

Sources: Tables 2.4 and 2.5; Kern County; Willdan Financial Services.

Table 6.3 shows the existing inventory of animal control vehicles and equipment.

Table 6.3: Existing Animal Control Vehicles and Equipment

Description	Number	Unit Cost	Total
Field Vehicles			
Chevrolet Lumina	1	$ 13,500	$ 13,500
Dodge 3/4 Ton	14	19,500	273,000
Ford 3/4 Ton	6	19,500	117,000
Ford 1.5 Ton	1	23,000	23,000
Featherlite Trailer	1	13,200	13,200
Hale Horse Trailer	1	3,000	3,000
Subtotal, Vehicles			$ 442,700
Mobile Spay/Neuter Van			$ 192,000
Guns			
Tranquilizer Guns	12	$ 400	$ 4,800
12 Gage	7	400	2,800
3006 Rifle	1	600	600
22 Caliber Rifle	3	400	1,200
Subtotal, Guns			$ 9,400
Office Equipment			
Shelter Computers	15	$ 1,600	$ 24,000
Field Computers	8	1,600	12,800
Admin Computers	5	1,600	8,000
Shelter Copy Machines	3	400	1,200
Field/Admin Copy Machine	1	3,000	3,000
Subtotal, Office Equipment			$ 49,000
Cages			
Stainless Steel	6	$ 1,400	$ 8,400
Fiberglass	23	800	18,400
Subtotal, Cages			$ 26,800
Radio Equipment[1]			$ 33,700
Total, Existing Vehicles and Equipment			$ 753,600

[1] Radio equipment in the County is controlled by General Services. Amount shown represents only the equipment value allocated to the Animal Control Department.

Sources: Kern County; Willdan Financial Services.

Planned Facilities

The County can use animal control facilities fee revenues for the construction or purchase of new buildings, land, equipment, and other facilities that expand the capacity of the system of animal control facilities to accommodate new development. The Kern County CIP identifies the need for either an additional animal care complex or an expansion to the current facilities to accommodate the animal control demand associated with a growing population. It is expected that this facility will be located in or near Bakersfield. **Table 6.4** shows the planned animal care facilities identified in the CIP.

Table 6.4: Planned Animal Control Facilities

	Inventory		Unit Cost	Total Value
Buildings				
Animal Care Complex	13,000	sq. ft.	$ 420	$ 5,460,000
Subtotal, Buildings	13,000	sq. ft.		$ 5,460,000
Land				
Animal Care Complex	1.19	acres	$ 350,000	$ 416,500
Subtotal, Land	1.19	acres		$ 416,500
Equipment				
Animal Care Complex				$ 250,000
Subtotal, Equipment				$ 250,000
Total Planned Facilities				$ 6,126,500

Sources: Kern County Capital Improvement Plan; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 6.5 shows the facility cost standard for animal control facilities at the 2030 planning horizon based on the system plan cost allocation approach. This cost standard includes the value of both existing and planned facilities and is based on the projected service population at the 2030 planning horizon. This cost standard is used as the basis for the proposed animal control facilities impact fee. The future cost standard is slightly higher than the current value of animal control facilities per capita.

The reduced cost per capita for Arvin and Bakersfield reflects the fact that these cities receive only shelter services from the County, as described above.

Table 6.5: Animal Control Facilities Cost Per Capita

Total Value Existing Buildings and Land	$	9,941,854
Total Value Existing Vehicles		753,600
Total Value Existing Facilities	$	10,695,454
Total Value Planned Facilities		6,126,500
Value of 2030 Animal Control Facilities	$	16,821,954
2030 Service Population		946,800
Cost Per Capita	$	18
Cost Per Resident	$	18
Adjusted Cost Per Resident for Arvin and Bakersfield	$	16

Sources: Tables 6.1-6.4; Willdan Financial Services.

Fee Schedule

Table 6.6 shows the animal control facilities fee schedule. The cost standard is converted to a fee per unit of new development based on the dwelling unit densities (persons per dwelling unit) for Kern County shown in Table 2.3.

Table 6.6: Animal Control Impact Fee

	A	*B*	*C=AxB*	*D=0.5%xC*	*E=C+D*
	Cost per Capita[1]	**Density**	**Base Fee[2]**	**Admin. Charge[3]**	**Fee**
Primary Service Areas					
Single Family	$ 18	3.14	$ 57	$ 0.29	$ 57.29
Multi-family	18	2.08	37	0.19	37.19
Arvin and Bakersfield					
Single Family	$ 16	3.14	$ 50	$ 0.25	$ 50.25
Multi-family	16	2.08	33	0.17	33.17

[1] Persons per dwelling unit or workers per 1,000 square feet.

[2] Fee per dwelling unit.

[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 6.5; Willdan Financial Services.

Additional Funding

As identified in the Kern County CIP, the County currently plans to use impact fee revenue to fund the development of a 13,000 square foot animal care complex, either as an expansion of an existing facility or as a new stand-alone facility. Fee revenue will be used for buildings at the animal care complex, as well as land and equipment.

Table 6.7 displays projected fee revenue and non-fee funding required through 2030. Because the future value of facilities per capita is slightly higher than the current value, a small amount of non-fee revenue will be needed to fund the planned facilities. This non-fee revenue corresponds to the cost of raising the value per capita of animal control facilities provided to existing development.

Table 6.7: Allocation of Animal Control Facility Costs to New Development

Facility System Cost Per Capita	$	18
New Development Service Population (2009-2030)		333,500
New Development Contribution to Planned Facilities	$	6,003,000
Total Cost of Planned Facilities	$	6,126,500
Non-Fee Revenue to be Identified	$	123,500

Sources: Tables 6.1, 6.4 and 6.5; Willdan Financial Services.

The County will need to develop alternative funding sources to fund existing development's share of the planned facilities. Potential sources of revenue include existing or new general fund revenues, new special or general taxes, special assessments, or grants.

7. Parks and Recreation

The purpose of this fee is to ensure that new development funds its fair share of park and recreation facilities in areas where these new facilities will be provided by the Kern County Parks Department. Separate fees are presented for community and regional parks.

Service Population

The park and recreation facilities service population is based on the residential population of the areas where the Kern County Parks Department will provide facilities to accommodate new development. Residents, and not workers, are included in the service population because the demand for park facilities is primarily related to the number of residents using park facilities during their non-working hours.

Although the County currently owns some community park facilities in incorporated cities and independent park districts, in the future the Parks Department will be responsible for providing new community park facilities only outside of cities and independent park districts. Thus, the service population for community park facilities includes only residents of unincorporated areas outside of independent parks districts.

The Parks Department also provides large regional park facilities that are used by residents of both cities and unincorporated areas. The service population for regional park facilities includes all residents countywide. **Table 7.1** shows the current and projected future service population for community parks and for regional parks.

Table 7.1: County Parks and Recreation Service Population

	Residents
Community Parks Service Population [1]	
Existing (2008)	87,600
New Development (2009-2030)	42,900
Total (2030)	130,500
Regional Parks Service Population	
Existing - Countywide (2008)	779,100
New Development - Countywide (2009-2030)	422,300
Total - Countywide (2030)	1,201,400

[1] Consists of residents that reside in unincorporated County areas that are not part of an independent parks district. Estimates generated by Willdan Financial Services using growth projections by traffic analysis zones provided by KernCOG.

Sources: Table 2.1; KernCOG Traffic Model; Willdan Financial Services.

Facility Standards

The County's demand standard for community parks is 2.50 acres per 1,000 residents, as adopted in the Kern County CIP. The County does not have an adopted standard for regional parks. The proposed regional parks impact fee is base on maintaining the existing standard of 5.72 acres per 1,000 residents (see Table 7.3).

Existing and Planned Facilities

Existing Facilities

Table 7.2 presents the inventory of existing community and regional parks. This inventory will be used to calculate the existing standard of community and regional park facilities per capita. The County intends to charge impact fees and provide community parks only outside of incorporated cities and independent park districts. Correspondingly, only community parks outside of cities and park districts are included in Table 7.2 and in the existing standard that will be calculated for the fee area. Land value estimates for the existing park facilities are based on the figures shown in Table 2.5 and on specific land value estimates for some facilities provided by Kern County staff.

Table 7.2: County Parks Existing Inventory

Park Category	Inventory		Unit Cost	Total Value
Community Parks [1]				
A.W. Noon	12.00	acres	$ 31,360	$ 376,320
Belle Terrace	19.30	acres	350,000	6,755,000
Boron	10.00	acres	27,530	275,300
Buttonwillow	36.00	acres	138,695	4,993,000
Casa Loma	9.00	acres	350,000	3,150,000
Frazier Mountain	27.00	acres	116,800	3,153,600
Greenfield	5.00	acres	350,000	1,750,000
Health Center Park	3.00	acres	87,200	261,600
Heritage	18.00	acres	197,588	3,556,600
Inyokern	3.00	acres	20,560	61,700
Kernville Circle	1.00	acres	87,200	87,200
Lake Isabella	40.00	acres	87,200	3,488,000
Lost Hills	7.00	acres	29,272	204,900
Mojave East	8.00	acres	42,515	340,100
Mojave West	10.00	acres	42,515	425,100
Mountain Mesa	5.20	acres	87,200	453,400
North Edwards	5.00	acres	87,200	436,000
Pioneer	14.00	acres	350,000	4,900,000
Potomac	5.00	acres	350,000	1,750,000
Randsburg	0.20	acres	10,106	2,000
Rexland Acres	4.00	acres	350,000	1,400,000
Riverside	5.00	acres	87,200	436,000
Rosamond	10.00	acres	12,894	128,900
Scodie	4.00	acres	87,200	348,800
Virginia Avenue	9.50	acres	350,000	3,325,000
Wilkins	2.60	acres	350,000	910,000
Wofford Heights[2]	7.00	acres	87,200	610,400
Total - Community Parks	279.80	acres		$ 43,578,920
Regional Parks				
Camp Condor	160.00	acres	$ 7,000	$ 1,120,000
Kernville Fish Hatchery[2]	14.00	acres	87,200	1,220,800
Buena Vista Aquatic Rec. Area	1,585.00	acres	10,000	15,850,000
Greenhorn Mt.[2]	110.00	acres	7,000	770,000
LeRoy Jackson	100.00	acres	7,000	700,000
Kern River County Park Total	1,445.00	acres	10,000	14,450,000
Lake Woollomes	445.00	acres	10,000	4,450,000
Metro Rec. Center	107.00	acres	55,408	5,928,700
Tehachapi Mt.	490.00	acres	10,000	4,900,000
Lake Isabella Rec Area[3]	-	acres	-	-
Total - Regional Parks	4,456.00	acres		$ 49,389,500

[1] Community parks witin the jurisdiction of cities or special districts are not included in calculating the existing community park standard. (See Table 6.2)

[2] The Wofford Heights park is presently leased from the Department of Forestry, the Parks Department is in the process of acquiring this park (as well as the Kernville Fish Hatchery) through a land exchange agreement. The Parks Department will give up 50 acres of Greenhorn Mountain Regional Park through this agreement. This size of Greenhorn Mountain Regional Park has been reduced accordingly in this inventory.

[3] The Parks Department provides services to the Lake Isabella Recreation Area, but does not own the land.

Sources: County of Kern Parks and Recreation Department; Willdan Financial Services.

Table 7.2: County Parks Existing Inventory

Park Category	Inventory		Unit Cost	Total Value
Community Parks [1]				
A.W. Noon	12.00	acres	$ 31,360	$ 376,320
Belle Terrace	19.30	acres	350,000	6,755,000
Boron	10.00	acres	27,530	275,300
Buttonwillow	36.00	acres	138,695	4,993,000
Casa Loma	9.00	acres	350,000	3,150,000
Frazier Mountain	27.00	acres	116,800	3,153,600
Greenfield	5.00	acres	350,000	1,750,000
Health Center Park	3.00	acres	87,200	261,600
Heritage	18.00	acres	197,588	3,556,600
Inyokern	3.00	acres	20,560	61,700
Kernville Circle	1.00	acres	87,200	87,200
Lake Isabella	40.00	acres	87,200	3,488,000
Lost Hills	7.00	acres	29,272	204,900
Mojave East	8.00	acres	42,515	340,100
Mojave West	10.00	acres	42,515	425,100
Mountain Mesa	5.20	acres	87,200	453,400
North Edwards	5.00	acres	87,200	436,000
Pioneer	14.00	acres	350,000	4,900,000
Potomac	5.00	acres	350,000	1,750,000
Randsburg	0.20	acres	10,106	2,000
Rexland Acres	4.00	acres	350,000	1,400,000
Riverside	5.00	acres	87,200	436,000
Rosamond	10.00	acres	12,894	128,900
Scodie	4.00	acres	87,200	348,800
Virginia Avenue	9.50	acres	350,000	3,325,000
Wilkins	2.60	acres	350,000	910,000
Wofford Heights[2]	7.00	acres	87,200	610,400
Total - Community Parks	279.80	acres		$ 43,578,920
Regional Parks				
Camp Condor	160.00	acres	$ 7,000	$ 1,120,000
Kernville Fish Hatchery[2]	14.00	acres	87,200	1,220,800
Buena Vista Aquatic Rec. Area	1,585.00	acres	10,000	15,850,000
Greenhorn Mt.[2]	110.00	acres	7,000	770,000
LeRoy Jackson	100.00	acres	7,000	700,000
Kern River County Park Total	1,445.00	acres	10,000	14,450,000
Lake Woollomes	445.00	acres	10,000	4,450,000
Metro Rec. Center	107.00	acres	55,408	5,928,700
Tehachapi Mt.	490.00	acres	10,000	4,900,000
Lake Isabella Rec Area[3]	-	acres	-	-
Total - Regional Parks	4,456.00	acres		$ 49,389,500

[1] Community parks witin the jurisdiction of cities or special districts are not included in calculating the existing community park standard. (See Table 6.2)

[2] The Wofford Heights park is presently leased from the Department of Forestry, the Parks Department is in the process of acquiring this park (as well as the Kernville Fish Hatchery) through a land exchange agreement. The Parks Department will give up 50 acres of Greenhorn Mountain Regional Park through this agreement. This size of Greenhorn Mountain Regional Park has been reduced accordingly in this inventory.

[3] The Parks Department provides services to the Lake Isabella Recreation Area, but does not own the land.

Sources: County of Kern Parks and Recreation Department; Willdan Financial Services.

Table 7.3 shows the existing standard of park acreage per thousand residents for community and regional parks. The existing standard of 5.72 acres of regional parks per thousand residents will be used as the basis for the proposed regional parks impact fee.

The community parks impact fee will be based on a standard of 2.50 acres of parks per thousand residents. As shown in Table 7.3, the standard of 2.50 acres of community parks per thousand residents is lower than the existing standard.

Table 7.3: Existing Park Facility Standards

	Community Parks (acres)	Regional Parks (acres)
Existing (2008) Facility Inventory[1]	279.80	4,456.00
Existing Service Population[2]	87,600	779,100
Existing Facility Standard (per thousand residents)	3.19	5.72

[1] The amount of existing park acres for the Community Parks category exclude park acres within cities and independent park districts because these parks serve a smaller service population. The Kern County Parks Department does not expect to build Community Parks within cities or independent districts in the future.

[2] The existing service population for Community Parks only includes residents within cities and independent park districts.

Sources: Tables 7.1 and 7.2; Willdan Financial Services.

Planned Facilities

The Kern County CIP identifies five specific community park projects. These projects total 41.4 acres of community parks. The Parks Department will need to develop approximately 65.9 acres of additional community parks to meet the policy standard of 2.50 acres of community parks for new development, based on anticipated development through the 2030 planning horizon. **Table 7.4** shows the planned community park and recreation facilities identified in the CIP.

Table 7.4: Planned Parks and Recreation Facilities

Facility (Location/Name)	Inventory		Unit Cost	Total Value
Community Parks				
Metro Bakersfield	12.00	acres	$ 350,000	$ 4,200,000
Rosamond	12.00	acres	81,600	979,200
Lebec	12.00	acres	69,600	835,200
Kernville	0.44	acres	121,600	53,200
Glennville	5.00	acres	40,772	203,900
Subtotal	41.44	acres		$ 6,271,500
Land Improvements				
Metro Bakersfield	12.00	acres	$ 240,000	$ 2,880,000
Rosamond	12.00	acres	240,000	2,880,000
Lebec	12.00	acres	240,000	2,880,000
Kernville[1]	0.44	acres		-
Glennville	5.00	acres	240,000	1,200,000
Subtotal	41.44	acres		$ 9,840,000
Building Construction				
Community Building - Metro Bakersfield	4,000	sq. ft.	$ 351	$ 1,404,000
Community Building - Rosamond	4,000	sq. ft.	351	1,404,000
Community Building - Lebec	4,000	sq. ft.	351	1,404,000
Community Building - Kernville	4,000	sq. ft.	351	1,404,000
Glennville	-	sq. ft.	-	-
Subtotal	16,000	sq. ft.		$ 5,616,000
Restrooms and Equipment				
Metro Bakersfield				$ 640,000
Rosamond				640,000
Lebec				640,000
Kernville				-
Glennville				-
Subtotal				$ 1,920,000
Total Planned Park and Recreation Facilities				$ 23,647,500

[1] Site planned to include only a community center and not general park improvements.

Sources: Kern County; Willdan Financial Services.

The CIP does not identify any planned regional parks projects. Regional parks are typically added through sporadic acquisitions of large parcels of land. Opportunities to purchase land suitable for regional parks are rare. The proposed impact fee for regional parks facilities will allow the County to acquire and develop regional park facilities to maintain the existing standard of regional park acres per capita when those opportunities arise.

The County is presently preparing a Parks and Recreation Master Plan. More precise facility plans will be identified in that document. Should the park standards in the Master Plan differ from those in the CIP, the County should revisit this fee analysis.

Table 7.5 shows the estimated average cost per acre of community and regional park facilities. Land costs vary among the different places in Kern County where the Parks Department will develop new park facilities. The estimated land cost for community parks is based on the average land cost for planned community park projects in the Kern County CIP. The CIP does not identify all of the projects that will be needed to accommodate new development through 2030 at the adopted standard, but Parks Department staff indicates that the location and land value of currently planned projects is reasonably representative of the additional facilities that are likely be developed through 2030.

The estimated cost per acre of regional park facilities is based on the average value of existing regional park land. There are no regional park projects currently included in the CIP. The average land value of existing facilities is likely to be reasonably representative of the cost of park land that will be acquired in the future. Regional parks tend to be on larger land parcels and in more remote areas than community parks. Correspondingly, the average cost per acre is much lower for regional parks than community parks.

The improvement cost per acre for community and regional parks is based on an estimate provided by Kern County Parks Department staff. Community parks will be intensively developed with recreation and sports facilities, resulting in an estimated improvement cost per acre of $240,000.

Regional parks will have varying levels of development, depending on location and planned usage. Parks Department staff has identified three tiers of regional park development, with improvement costs ranging from $25,000 to $100,000 per acre. Improvement costs for the middle tier of development are $60,000 per acre. This is a reasonable estimate for the average improvement cost for future regional parks.

Table 7.5: County Parks and Recreation Facilities Unit Costs

Community Parks		
Estimated Cost of Planned Community Park Land	$	6,271,400
Planned Community Park Acres		41.44
Average Community Park Land Cost per Acre	$	151,300
Community Park Improvement Cost per Acre	$	240,000
Regional Parks		
Value of Existing Regional Park Land	$	49,389,500
Existing Regional Park Acres		4,456
Average Regional Park Land Cost per Acre	$	11,100
Regional Park Improvement Cost per Acre	$	60,000

Sources: Tables 2.4, 7.2 and 7.4; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 7.6 shows the acreage and cost of community and regional parks that will be needed to accommodate anticipated new development through the 2030 planning horizon. Table 7.6 also calculates the facility cost standard for new park land and improvements for both community and regional parks.

Table 7.6: County Parks and Recreation Facilities to Serve New Development

	Community Parks		Regional Parks	
Facility Standard (acres per thousand residents)		2.50		5.72
Service Population Growth (2009-2030)		42,900		422,300
Park Acres Needed to Serve New Development		107.3		2,415.6
Land Cost per Acre	$	151,300	$	11,100
Cost of Park Land to Serve New Development		16,234,490		26,813,160
Park Land Cost Standard (cost per capita)	$	378	$	63
Improvement Cost per Acre	$	240,000	$	60,000
Cost of Park Improvements to Serve New Development		25,752,000		144,936,000
Park Improvements Cost Standard (cost per capita)	$	600	$	343

Sources: Tables 7.1, 7.3 and 7.5; Kern County General Plan; Willdan Financial Services.

Fee Schedule

Table 7.7 shows the proposed community parks and regional parks impact fee schedule. The cost per capita is converted to a fee per unit of new development based on the dwelling unit densities (persons per dwelling unit) for Kern County shown in Table 2.3. The community park fees shown would be charged only in unincorporated areas that are outside of independent park districts, which is where the Kern County Parks Department will provide community park facilities. The regional park fees would be charged to all new residential development countywide.

The fees are shown separately for park land and park improvements so that the County can charge only the improvement portion of the fee if the Parks Department negotiates with a developer to dedicate park land in lieu of paying the impact fee.

Table 7.7: County Parks and Recreation Impact Fees

	A Cost per Capita	B Density[1]	C=AxB Base Fee[2]	D=0.5%xC Admin. Charge[3]	E=C+D Fee
Community Parks[4]					
Single Family					
Land	$ 378	3.14	$ 1,188	$ 5.94	$ 1,193.94
Improvements	600	3.14	1,885	9.43	1,894.43
Total					$ 3,088.37
Multi-family					
Land	$ 378	2.08	$ 787	$ 3.94	$ 790.94
Improvements	600	2.08	1,249	6.25	1,255.25
Total					$ 2,046.19
Regional Parks[5]					
Single Family					
Land	$ 63	3.14	$ 199	$ 1.00	$ 200.00
Improvements	343	3.14	1,078	5.39	1,083.39
Total					$ 1,283.39
Multi-family					
Land	$ 63	2.08	$ 132	$ 0.66	$ 132.66
Improvements	343	2.08	714	3.57	717.57
Total					$ 850.23

[1] Persons per dwelling unit.

[2] Fee per dwelling unit.

[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

[4] Fee charged only in unincorporated areas that are not part of an independent park district.

[5] Fee charged countywide.

Sources: Tables 2.3 and 7.6; Willdan Financial Services.

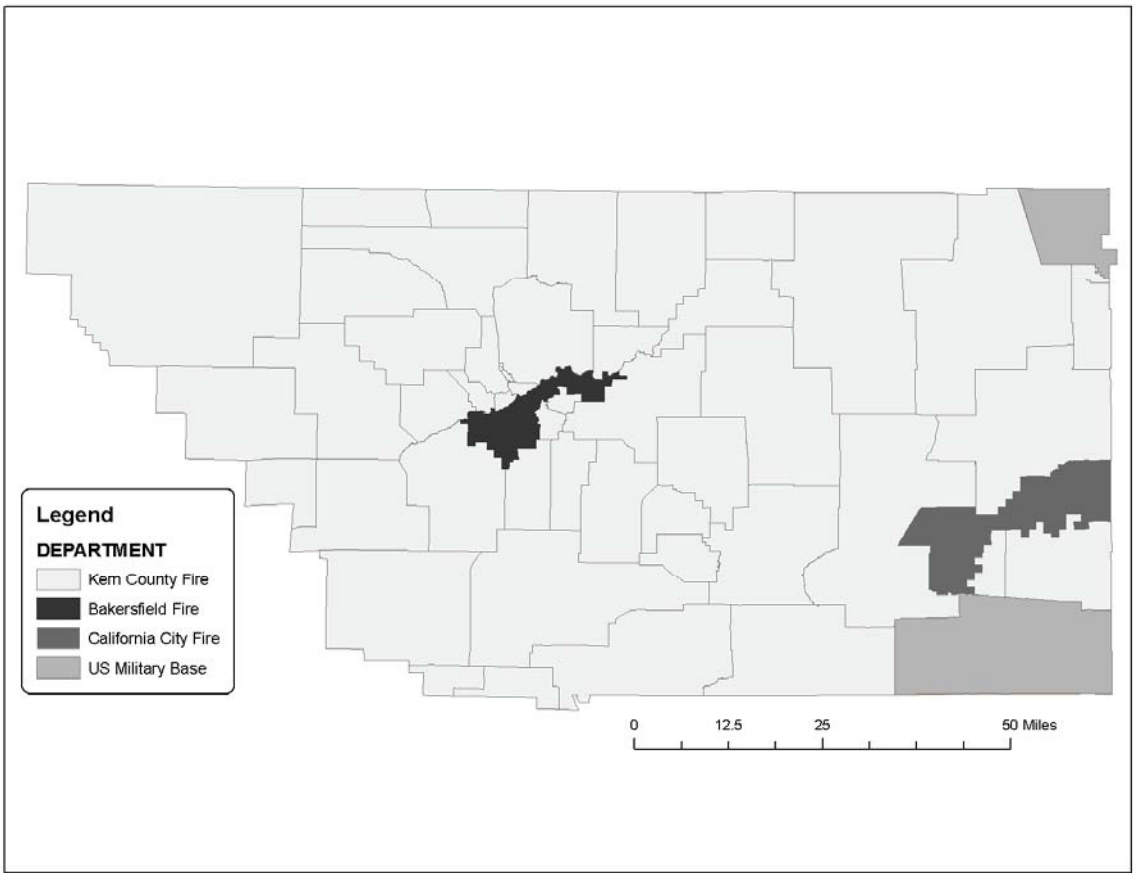
8. Fire Protection

The purpose of this fee is to ensure that new development in areas where the Kern County Fire Department (KCFD) provides fire protection services funds its fair share of fire protection facilities.

This chapter presents potential fire protection impact fees based on three separate fee zones. The fee zone boundaries are described in Chapter 2. By dividing the County into zones, the impact fees for each development project will be based on the standards at which fire protection facilities are needed in the part of the County where the project is located.

Figure 8.1 shows the KCFD primary service area and the service area of the other entities providing fire protection services in the County.

Figure 8.1: Kern County Fire Department Service Area



Service Population

The fire protection facilities service population is based on the number of residents and workers in the KCFD primary service area. Demand for services is based on population, and

not building size, because emergency medical calls typically make up the majority of responses provided by fire departments. As the number of residents and workers increases, the number of emergency medical calls and the need for fire protection and emergency response facilities is also expected to increase.

Table 8.1 shows the estimated service population in 2008 and 2030 the three fee zones. The distribution of residents and workers in unincorporated areas among the fee zones was determined based on demographic information for transportation analysis zones in the KernCOG traffic model.

To calculate the service population for fire protection facilities, residents are weighted at 1.00 and each worker is weighted at 0.69. The 0.69 per-worker weighting factor is based on an extensive study carried out by planning staff in the City of Phoenix. Data from that study were used to calculate a per capita factor that is independent of land use patterns. Because of the large geographical area covered by the Phoenix study, it is the best source of data for application to other areas. It is reasonable to assume that relative demand for fire service between residents and workers does not vary substantially on a per capita basis across communities, enabling this data to be used in other communities in the documentation of a fire protection facilities fee.

Table 8.1: KCFD Fire Protection Service Population

	Residents	Workers	Service Population	Percent of Total
Desert Zone				
Existing (2008)	63,000	13,100	72,000	
New Development (2009-2030)	29,800	9,400	36,300	
Total (2030)	92,800	22,500	108,300	11%
Mountain Zone				
Existing (2008)	69,600	14,000	79,300	
New Development (2009-2030)	33,000	7,600	38,200	
Total (2030)	102,600	21,600	117,500	12%
Valley Zone				
Existing (2008)	347,000	100,800	416,600	
New Development (2009-2030)	265,400	110,800	341,900	
Total (2030)	612,400	211,600	758,500	77%
Countywide				
Existing (2008)	479,600	127,900	567,900	
New Development (2009-2030)	328,200	127,800	416,400	
Total (2030)	807,800	255,700	984,300	
Weighting Factor[1]	1.00	0.69		

[1] Worker weighting factor based on a survey of fire call data from the City of Phoenix, AZ. The study surveyed the relative demand for fire services from residential and nonresidential land use sources and determined the extent to which residential sources have a higher per capita demand.

Sources: Table 2.1; Kern County Fire Department; KernCOG Traffic Model; Willdan Financial Services.

Facility Standards

The Kern County CIP identifies an adopted facility standard of 0.78 fire protection building square feet per capita. This standard is based on the square footage of existing and planned fire facilities identified in the CIP and the estimated service population at the 2030 planning horizon. Fire station needs were identified in the CIP based on a needs assessment conducted by KCFD staff. The needs assessment identified facilities that would be needed to maintain the Department's response time standards, given the geographic distribution of anticipated growth.

Existing and Planned Facilities

The proposed fire protection facilities impact fees are based on the inventory of existing and planned fire protection facilities. **Table 8.2** presents the inventory of existing fire protection

land and building facilities in Kern County along with each facility's current value based on the unit costs shown in Table 2.4. Land value estimates for the existing fire protection facilities were provided by County staff.

The total value is shown for each of the three fee zones. Some facilities are used to support fire protection services in the entire KCFD service area and not in a particular zone. The value of these facilities is allocated in proportion to the future service population in each zone.

Table 8.2: Existing Fire Protection Facilities

	Land		Unit Cost[1]	Land Value	Buildings		Unit Cost[1]	Bldg Value	Total Value	Zone[2]
Arvin Fire Sta #54	1.00	acres	$ 13,242	$ 13,200	4,987	sq. ft.	$ 424	$ 2,112,500	$ 2,125,700	Valley
Bear Valley Fire Sta #16	1.05	acres	3,833	4,000	2,648	sq. ft.	424	1,121,700	1,125,700	Mountain
Boron Fire Sta #17	4.87	acres	11,500	56,000	2,914	sq. ft.	424	1,234,400	1,290,400	Desert
Buttonwillow Fire Sta #25	0.50	acres	138,695	69,300	4,566	sq. ft.	424	1,934,200	2,003,500	Valley
Communications Facility[6,7]	-	acres	-	-	2,890	sq. ft.	-	-	-	General
Delano Fire Sta #343[4]	-	acres	-	-	1,080	sq. ft.	-	-	-	Valley
Delano West Fire Sta #37[4]	-	acres	-	-	2,900	sq. ft.	-	-	-	Valley
Derby Acres Call Fire Sta[4]	-	acres	-	-	567	sq. ft.	-	-	-	Mountain
Edison Fire Back Shed	0.46	acres	28,924	13,300	10,000	sq. ft.	50	500,000	513,300	Valley
Edison Fire Shed - Main	0.09	acres	28,924	2,600	72,000	sq. ft.	50	3,600,000	3,602,600	Valley
Edison Fire Sta #45	0.46	acres	28,924	13,300	2,972	sq. ft.	424	1,258,900	1,272,200	Valley
Edison Sta #92/Hvy Equip	0.46	acres	28,924	13,300	4,400	sq. ft.	100	440,000	453,300	Valley
Fellows Fire Sta #23	0.63	acres	4,879	3,100	4,109	sq. ft.	424	1,740,600	1,743,700	Mountain
Fire Administration Bldg.[5]	-	acres	-	-	14,694	sq. ft.	351	5,157,600	5,157,600	General
Fire Auto Shop[5]	-	acres	-	-	21,060	sq. ft.	100	2,106,000	2,106,000	General
Fire Engine House/Storage Bldg[5]	-	acres	-	-	4,049	sq. ft.	424	1,715,200	1,715,200	General
Fire Training - Olive Dr.	22.30	acres	9,757	217,600	8,691	sq. ft.	424	3,681,500	3,899,100	General
Fire Warehouse[5]	-	acres	-	-	9,153	sq. ft.	100	915,300	915,300	General
Frazier Park Fire Sta #57[4]	-	acres	-	-	1,296	sq. ft.	-	-	-	Mountain
Glennville Fire Sta #36	0.95	acres	40,772	38,700	2,452	sq. ft.	424	1,038,700	1,077,400	Mountain
Greenacres Fire Sta #65	0.34	acres	179,816	61,100	2,397	sq. ft.	424	1,015,400	1,099,800	Valley
Greenfield Fire Sta #52	0.59	acres	19,515	11,500	5,388	sq. ft.	424	2,282,400	2,293,900	Valley
Highland Fire Sta #63	0.52	acres	6,621	3,400	3,989	sq. ft.	424	1,689,700	1,693,100	Valley
Inyokern Fire Sta #73	1.50	acres	3,833	5,700	4,850	sq. ft.	424	2,054,500	2,060,200	Desert
Keene Fire Sta #11	2.00	acres	10,106	20,200	9,667	sq. ft.	424	4,094,900	4,115,100	Mountain
Kernville Fire Sta #76	0.50	acres	65,863	32,900	2,885	sq. ft.	424	1,222,100	1,255,000	Mountain
Lake Isabella Fire Sta #72	0.69	acres	53,317	36,800	4,448	sq. ft.	424	1,884,200	1,921,000	Mountain
Lamont Fire Sta #51	1.06	acres	66,908	70,900	4,080	sq. ft.	424	1,728,300	1,799,200	Valley
Landco Fire Sta #66	0.62	acres	37,984	23,600	4,987	sq. ft.	424	2,112,500	2,136,100	Valley
Lebec Fire Sta #56[7]	1.85	acres	-	-	4,435	sq. ft.	-	-	2,112,500	Mountain
Lost Hills Fire Sta #26	0.72	acres	29,272	21,200	4,709	sq. ft.	424	1,994,700	2,015,900	Valley
Maricopa Fire Sta #22	0.80	acres	4,182	3,300	4,566	sq. ft.	424	1,934,200	1,937,500	Valley
McFarland Fire Sta #33	0.63	acres	15,333	9,700	5,388	sq. ft.	424	2,282,400	2,292,100	Valley
McKittrick Fire Sta #24	1.47	acres	2,091	3,100	4,566	sq. ft.	424	1,934,200	1,937,300	Mountain
Meadows Field Fire Sta #62	2.06	acres	50,878	104,800	1,694	sq. ft.	424	717,600	822,400	Valley
Mettler Fire Sta #55	0.57	acres	38,681	22,000	2,048	sq. ft.	424	867,500	739,600	Valley
Mojave Fire Sta #14	1.00	acres	42,515	42,500	3,642	sq. ft.	424	1,542,800	1,585,300	Desert
Niles St. Fire Sta #42	0.63	acres	31,363	19,800	4,566	sq. ft.	424	1,934,200	1,954,000	Valley

Table 8.2: Existing Fire Protection Facilities *(continued)*

	Land		Unit Cost[1]	Land Value	Buildings		Unit Cost[1]	Bldg Value	Total Value	Zone[2]
Norris Fire Sta #61	0.52	acres	$ 9,757	$ 5,100	4,080	sq. ft.	$ 424	$ 1,728,300	$ 1,733,400	Valley
North Edwards Call Fire Sta[4]	-	acres	-	-	450	sq. ft.	424	190,600	190,600	Desert
Old River Fire Sta #53[7]	0.69	acres	-	-	1,861	sq. ft.	-	-	190,600	Valley
Pine Mountain Fire Sta #58	0.85	acres	547,811	465,600	1,332	sq. ft.	424	564,200	465,600	Mountain
Piute Fire Sta #78	2.18	acres	10,106	22,000	3,304	sq. ft.	424	1,399,600	1,421,600	Mountain
Public Services Building[8]	-	acres	-	-	708	sq. ft.	351	248,500	248,500	General
Randsburg Fire Sta #75	0.32	acres	10,106	3,200	1,344	sq. ft.	424	569,300	572,500	Desert
Ridgecrest Fire Sta #74[3]	-	acres	-	-	3,543	sq. ft.	424	1,500,800	1,500,800	Desert
Ridgecrest Heights Sta #77	0.93	acres	3,833	3,600	5,388	sq. ft.	424	2,282,400	2,286,000	Desert
River View Fire Sta #64	0.81	acres	55,408	44,900	3,758	sq. ft.	424	1,591,900	1,636,800	Valley
Rosamond Fire Sta #15	2.59	acres	19,515	50,500	3,078	sq. ft.	424	1,303,800	1,354,300	Desert
Rosedale Fire Sta #67	2.04	acres	21,954	44,800	4,850	sq. ft.	424	2,054,500	2,099,300	Valley
Shafter Fire Sta #32	0.34	acres	141,831	48,200	4,978	sq. ft.	424	2,108,700	2,156,900	Valley
Southlake Fire Sta #71	0.76	acres	95,484	72,600	5,874	sq. ft.	424	2,488,200	2,560,800	Mountain
Stallion Springs Sta #18[7]	0.60	acres	-	-	4,500	sq. ft.	-	-	-	Mountain
Stallion Springs-Engine House[7]	0.60	acres	-	-	750	sq. ft.	-	-	-	Mountain
Taft Fire Sta #21	0.62	acres	63,075	39,100	6,316	sq. ft.	424	2,675,500	2,714,600	Valley
Tehachapi Fire Sta #12	1.50	acres	11,848	17,800	5,839	sq. ft.	424	2,473,400	2,491,200	Mountain
Uhler Fire Drill Grounds/Shed[4]	-	acres	-	-	250	sq. ft.	-	-	-	Valley
Valley Acres Call Fire Sta[4]	-	acres	-	-	567	sq. ft.	-	-	-	Valley
Virginia Colony Fire #41	0.57	acres	13,242	7,500	4,080	sq. ft.	424	1,728,300	1,735,800	Valley
Wasco Fire #31	1.73	acres	14,985	25,900	5,180	sq. ft.	424	2,194,200	2,220,100	Valley
Woody Fire Sta #35	0.63	acres	4,879	3,100	3,188	sq. ft.	424	1,350,400	1,353,500	Mountain
Total	68.60	acres		$ 1,790,800	330,951	sq. ft.		$ 88,300,800	**$ 91,703,900**	
Desert Zone					31,946	sq. ft.	10%		**$ 12,384,687**	
Mountain Zone					69,209	sq. ft.	21%		**25,265,404**	
Valley Zone					229,796	sq. ft.	69%		**54,053,809**	

[1] Based on estimated replacement cost.
[2] Facilities categorized as "General" are used for administrative or other Countywide functions. These facilities are allocated to the fee zones based on future service population.
[3] Located at Ridgecrest Justice Facility.
[4] Facility is leased, not owned, by the County.
[5] Land accounted for under Fire Training Center.
[6] Communications Facility parcel included in Public Protection inventory.
[7] No value included in existing inventory because CIP includes planned facility replacement/expansion.
[8] Public Services Building not primarily used by KCFD. Land accounted for elsewhere.

Sources: Kern County; Willdan Financial Services.

Table 8.3 shows the existing inventory of fire protection apparatus. The allocation of existing fire apparatus value among the three potential fee zones is based on the square footage of existing buildings in each zone, as shown in Table 8.2. The distribution of fire apparatus is likely to be roughly proportional to the square footage of stations and other buildings in each zone where apparatus are based and stored.

Table 8.3: Existing Fire Protection Apparatuses

	Qty.	Unit Cost[1]	Value
Engines			
Type 1	79	$ 363,750	$ 28,736,250
Type 2 (I/F)	12	285,000	3,420,000
Type 3	10	210,000	2,100,000
Type 4	50	75,000	3,750,000
Trucks			
Ladder Truck - 100 ft. Platform	2	$ 675,000	$ 1,350,000
Ladder Truck - 85 ft. Platform	1	637,500	637,500
Ladder Truck - 75 ft. w/o Plat.	1	401,250	401,250
Water Tenders			
Water Tender, 2000 gal.	1	$ 180,000	$ 180,000
Water Tender, 1500 gal.	1	168,750	168,750
Water Tender, 1800 gal.	2	180,000	360,000
Command Vehicles			
4x4 Pickup	12	$ 30,000	$ 360,000
4x4 Pickup Ext. Cab	12	31,500	378,000
4x4 SUV	6	37,500	225,000
4x4 Large SUV	18	48,750	877,500
Sedan	12	24,000	288,000
Command/Communications	1	30,000	30,000
Crew Resource Vehicles			
Crew Superintendent Vehicles	5	$ 45,000	$ 225,000
Crew Carrying Vehicle	6	90,000	540,000
Crew Carrying Vehicle, small	4	150,000	600,000
Pickup, 6 Passenger	3	138,750	416,250
Van, 6 Passenger	2	108,750	217,500
Van, 12 Passenger	6	-	-
Helicopter Support Vehicles			
Crew Superintendent Vehicles	1	$ 45,000	$ 45,000
Crew Carrying Vehicle	1	90,000	90,000
Fuel Tender, 3500 gal. Jet A	1	150,000	150,000
Fuel Tender, 2000 gal. Jet A	1	138,750	138,750
Helitack Truck	1	108,750	108,750

	Qty.	Unit Cost[1]	Value[2]
Heavy Equipment			
Bulldozer Type 2	6	$ 240,000	$ 1,440,000
Dozer Tender	6	45,000	270,000
Tractor, 2 axle	2	67,500	135,000
Tractor, 3 axle	4	99,750	399,000
Transport, 3S2 Combo	6	135,000	810,000
Trailer, LoBed	4	36,000	144,000
Trailer, Flat Bed	2	22,500	45,000
Motor Grader	3	165,000	495,000
Backhoe	1	75,000	75,000
Front Loader - Wheeled	1	180,000	180,000
Front Loader - Tracked	1	187,500	187,500
Dump Truck	4	112,500	450,000
Forklift, Large	3	75,000	225,000
Support Equipment			
Fuel Tender, 1200 Gal	1	$ 138,750	$ 138,750
Mechanics Service Truck	3	90,000	270,000
Pickup 3/4 Ton 2x4	6	22,500	135,000
Pickup 1 Ton 4x4	3	26,250	78,750
Generator Trailer	2	30,000	60,000
Forklift, Medium	3	52,500	157,500
Terra Torch	1	45,000	45,000
Terra/Heli-Torch	1	48,750	48,750
Mobile Kitchen			
Mobile Kitchen Tractors	4	$ 75,000	$ 300,000
Mobile Kitchen Unit, Large	1	562,500	562,500
Mobile Kitchen Unit, Sonoma	1	112,500	112,500
Mobile Kitchen Refer Trailer	2	60,000	120,000
Stakeside Truck	5	52,500	262,500
Enclosed Delivery Vehicle	2	45,000	90,000
Total Value, Existing Apparatus			$ 53,030,300
Desert Zone		10%	$ 5,303,030
Mountain Zone		21%	11,136,363
Valley Zone		69%	36,590,907

[1] Based on estimated replacement cost. Because the vehicles listed are of varying ages, and because there is a viable secondary market for fire apparatus, full replacement costs for new vehicles have been discounted by 25%.
[2] Existing apparatus value is allocated among the three fee zones in proportion to the building square footage located in each zone. (See Table 8.2.)

Sources: Kern County Fire Department; Willdan Financial Services.

Table 8.4 shows the value of existing fire protection equipment owned by KCFD. As with fire apparatus, the value of equipment allocated to each of the fee zones is based on the proportion of existing building square footage in each zone.

Table 8.4: Existing Fire Protection Equipment

		Total Value[1]
Personal Protective Equipment		$ 714,532
Air Bag System, Rescue Tools, Chain Saws and Other Equipment		586,189
Computer Equipment		420,699
SCBAs and Cylinders		310,669
Station and Office Furnishings and Other Equipment		215,931
Station Appliances		102,447
Exercise Equipment		91,256
Radio Equipment (Fire Department)		83,852
Radio Communications (General Services)[2]		1,862,036
Air Compressor, Generators And Small Equipment		78,221
Total		$ 4,465,800
Desert Zone	10%	$ 446,580
Mountain Zone	21%	937,818
Valley Zone	69%	3,081,402

Note: Total may not add due to rounding.

[1] Existing equipment value is allocated among the three fee zones in proportion to the building square footage located in each zone. (See Table 8.2.)

[2] Most radio equipment in the County is controlled by General Services. Amount shown represents only the equipment value allocated to the Fire Department.

Source: Kern County Fire Department; Kern County General Services.

Planned Facilities

The County can use fire protection facilities fee revenue for the construction or purchase of new buildings, land, fire apparatus, equipment, and other facilities that expand the capacity of the system of fire protection facilities to accommodate new development. The Kern County CIP identifies new and expanded fire stations and other projects that will be needed to adequately provide fire protection services as new development occurs.

The need for the planned fire stations is based on an analysis by KCFD of where growth is projected to occur and where stations will be needed to maintain response time standards. Other facilities, such as training centers, a communications center, and administrative space, will be needed to support the increased number stations and firefighters that KCFD will employ.

Some of the planned facilities are replacements for existing fire stations that will be larger than the existing facilities. For these facilities, fee revenue should be used only for the portion of the facility that represents an increase in size compared to the existing facility. Impact fee revenue should not be used for facility replacements that do not expand the capacity of KCFD to accommodate new development.

KCFD has identified several aging facilities that will need to be replaced, but that will not expand the capacity of the Department to accommodate new development. The planned facility replacements are identified in Appendix 1 of the CIP. With the exception of the

Frazier Park station, these projects will not be funded with impact fee revenue, and are not included in the planned facility inventories shown below. The current Frazier Park station is leased, and not owned by KCFD. KCFD plans to replace the leased station with a station owned by the County. Since this represents new investment in facilities, impact fee revenue may be used to fund a portion of the cost of this station.

Table 8.5 shows the land needed for fire station projects included in the Kern County CIP.

Table 8.5: Planned Fire Protection Land

	Land		Unit Cost	Land Value	Zone
Headquarters[4,6]	-	acres	$ -	$ -	General
Golden Hills	1.50	acres	139,200	208,800	Mountain
Emergency Communications[1]	0.92	acres	350,000	322,000	General
Stallion Springs[2]	1.50	acres	139,200	208,800	Mountain
Helicopter Hangar - 55[4,6]	-	acres	-	-	General
Lebec	1.50	acres	69,600	104,400	Mountain
Cameron Point	1.50	acres	87,200	130,800	Valley
Alta Sierra	1.50	acres	121,600	182,400	Mountain
East Kern Training[3,5]	-	acres	-	-	Desert/Mountain
Delano	3.00	acres	226,500	679,500	Valley
NW Metro Bakersfield	3.00	acres	350,000	1,050,000	Valley
Ridgecrest	1.50	acres	190,480	285,700	Desert
Station 53-Taft Highway	1.50	acres	226,500	339,800	Valley
Meadows Field[1]	-	acres	-	-	Valley
Jawbone Canyon - Hwy 14	1.50	acres	31,400	47,100	Mountain
Shafter	3.00	acres	104,800	314,400	Valley
Rosamond[1]	1.50	acres	81,600	122,400	Desert
North Bakersfield - Hwy 65	1.50	acres	350,000	525,000	Valley
Helicopter Hangar - MF[4]	-	acres	-	-	General
Choctaw Valley	1.50	acres	31,400	47,100	Valley
Arvin/White Wolf	3.00	acres	86,400	259,200	Valley
North Kern Training	1.38	acres	226,500	312,600	Valley
Bear Mountain Training	1.38	acres	86,400	119,200	Valley
Bear Mountain Station	1.50	acres	86,400	129,600	Valley
Sand Canyon	1.50	acres	31,400	47,100	Mountain
Kecks Road	1.50	acres	52,000	78,000	Valley
Highway 65/155	1.50	acres	226,500	339,800	Valley
Frazier Park	1.50	acres	116,800	175,200	Mountain
Total	39.68	acres		$ 6,028,900	
Desert Zone	3.00	acres		$ 443,520	
Mountain Zone	10.50	acres		1,012,440	
Valley Zone	25.26	acres		4,572,940	

[1] Estimated using floor-area ratio of 0.25 and building square foot projections provided by Kern County.

[2] Possibility exists for a land donation from the Stallion Springs CSD.

[3] East Kern training facility may realize a donation of 15 acres from the Mojave District Airport, which is accounted for in this

[4] Headquarters and Helocopter Hangar costs allocated between the three zones in proportion to future service population.

[5] The East Kern training facility will be used for training by firefighters in both the Desert and Mountain Zones. The cost of this facility is allocated between the zones in proportion to the future service population of each zone.

[6] Facility to be located on land already owned by KCFD.

Sources: Kern County Fire Department; Willdan Financial Services.

Table 8.6 shows the fire protection buildings included in the CIP. The cost of facilities in each of the three potential fee zones is identified. The Fire Department Headquarters expansion and the Mather Field and Station 55 helicopter hangers are general facilities not allocated to any of the three fee zones. The cost of these projects is allocated according to the future service population in each zone.

Table 8.6: Planned Fire Protection Buildings

	Buildings		Unit Cost	Bldg. Value[1]	Zone
Headquarters[3]	41,000	sq. ft.	$ 424	$ 17,367,600	General
Golden Hills[2] (Hangar + Station)	22,525	sq. ft.	347	7,811,600	Mountain
Emergency Communications	10,000	sq. ft.	576	5,760,000	General
Stallion Springs	6,525	sq. ft.	424	2,764,000	Mountain
Helicopter Hangar - 55[3]	16,000	sq. ft.	180	2,887,700	General
Lebec	6,525	sq. ft.	424	2,764,000	Mountain
Cameron Point	6,525	sq. ft.	424	2,764,000	Valley
Alta Sierra	6,525	sq. ft.	424	2,764,000	Mountain
East Kern Training	15,000	sq. ft.	422	6,336,000	Desert/Mountain
Delano (2 stations)	14,050	sq. ft.	424	5,951,600	Valley
NW Metro Bakersfield (2 stations)	13,050	sq. ft.	424	5,528,000	Valley
Ridgecrest	6,525	sq. ft.	424	2,764,000	Desert
Station 53-Taft Highway	6,525	sq. ft.	424	2,764,000	Valley
Meadows Field Station	14,216	sq. ft.	424	6,021,800	Valley
Jawbone Canyon - Hwy 14	6,525	sq. ft.	424	2,764,000	Mountain
Shafter (2 stations)	13,050	sq. ft.	424	5,528,000	Valley
Rosamond	6,525	sq. ft.	424	2,764,000	Desert
North Bakersfield - Hwy 65	6,525	sq. ft.	424	2,764,000	Valley
Helicopter Hangar - MF[3]	30,000	sq. ft.	134	4,032,000	General
Choctaw Valley	6,525	sq. ft.	424	2,764,000	Valley
Arvin/White Wolf (2 stations)	13,050	sq. ft.	424	5,528,000	Valley
North Kern Training	15,000	sq. ft.	440	6,600,000	Valley
Bear Mountain Training	15,000	sq. ft.	440	6,600,000	Valley
Bear Mountain Station	6,525	sq. ft.	424	2,764,000	Valley
Sand Canyon	6,525	sq. ft.	424	2,764,000	Mountain
Kecks Road	6,525	sq. ft.	424	2,764,000	Valley
Highway 65/155	6,525	sq. ft.	424	2,764,000	Valley
Frazier Park	6,405	sq. ft.	424	2,713,000	Mountain
Total	329,696	sq. ft.		$ 127,361,300	
Desert Zone	30,894	sq. ft.		$ 11,863,464	
Mountain Zone	81,021	sq. ft.		31,256,015	
Valley Zone	217,781	sq. ft.		84,241,821	

[1] Construction cost includes 20% for architecture and engineering and other costs.

[2] Square feet calculation includes space for living quarters (2,550 sf), apparatus and equipment (3,975 sf), and vehicle hangar

[3] Headquarters and Helocopter Hangar costs allocated between the three zones in proportion to future service population.

[4] The East Kern training facility will be used for training by firefighters in both the Desert and Mountain Zones. The cost of this facility is allocated between the zones in proportion to the future service population of each zone.

Sources: Kern County Fire Department; Willdan Financial Services.

Table 8.7 shows the cost of furnishing, vehicles, and equipment planned for each of the planned facilities in the CIP. As with the building space, the cost of these furnishings, vehicles, and equipment for the headquarters and the two helicopter hangar projects is allocated according to the future service population in each zone.

Table 8.7: Planned Fire Protection Furnishings, Vehicles and Equipment

	Furnishings	Vehicles and Equipment	Total Value	Zone
Headquarters	$ 1,000,000	$ 250,000	$ 1,250,000	General
Golden Hills	90,000	1,685,000	1,775,000	Mountain
Emergency Communications	1,000,000	-	1,000,000	General
Stallion Springs	15,000	785,000	800,000	Mountain
Helicopter Hangar - 55	50,000	-	50,000	General
Lebec	15,000	785,000	800,000	Mountain
Cameron Point	15,000	1,485,000	1,500,000	Valley
Alta Sierra	15,000	585,000	600,000	Mountain
East Kern Training	412,500	200,000	612,500	Desert/Mountain
Delano	30,000	2,070,000	2,100,000	Valley
NW Metro Bakersfield	30,000	1,170,000	1,200,000	Valley
Ridgecrest	15,000	585,000	600,000	Desert
Station 53-Taft Highway	15,000	585,000	600,000	Valley
Meadows Field	30,000	2,885,000	2,915,000	Valley
Jawbone Canyon - Hwy 14	15,000	585,000	600,000	Mountain
Shafter	30,000	2,070,000	2,100,000	Valley
Rosamond	15,000	1,785,000	1,800,000	Desert
North Bakersfield - Hwy 65	15,000	585,000	600,000	Valley
Helicopter Hangar - MF	75,000	-	75,000	General
Choctaw Valley	15,000	785,000	800,000	Valley
Arvin/White Wolf	30,000	2,270,000	2,300,000	Valley
North Kern Training	800,000	200,000	1,000,000	Valley
Bear Mountain Training	800,000	200,000	1,000,000	Valley
Bear Mountain Station	15,000	585,000	600,000	Valley
Sand Canyon	15,000	585,000	600,000	Mountain
Kecks Road	15,000	585,000	600,000	Valley
Highway 65/155	15,000	585,000	600,000	Valley
Frazier Park	15,000	-	15,000	Mountain
Total	$ 4,602,500	$ 23,890,000	$ 28,492,500	
Desert Zone	$ 461,033	$ 2,493,152	$ 2,954,185	
Mountain Zone	635,217	5,144,348	5,779,565	
Valley Zone	3,491,250	16,252,500	19,743,750	

[1] Headquarters and Helocopter Hangar costs allocated between the three zones in proportion to future service population.

[2] The East Kern training facility will be used for training by firefighters in both the Desert and Mountain Zones. The cost of this facility is allocated between the zones in proportion to the future service population of each zone.

Sources: Kern County Fire Department; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 8.8 shows the fire protection facilities cost standard in each of the three fee zones. These cost standards include the value of both existing and planned facilities and are based on the projected service population at the 2030 planning horizon. These cost standards are used as the basis for the proposed fire protection facilities impact fees. For each of the three fee zones, the cost standard of fire facilities at the 2030 planning horizon will be higher than the current value of facilities per capita.

Table 8.8: Fire Protection Facilities Cost Standards

	Desert Zone	Mountain Zone	Valley Zone
Value of Existing Buildings and Land	$ 12,384,687	$ 25,265,404	$ 54,053,809
Value of Existing Apparatus	5,303,030	11,136,363	36,590,907
Value of Existing Equipment	446,580	937,818	3,081,402
Total Value Existing Facilities	$ 18,134,297	$ 37,339,585	$ 93,726,118
Value of Planned Land	$ 443,520	$ 1,012,440	$ 4,572,940
Value of Planned Buildings	11,863,464	31,256,015	84,241,821
Value of Planned Apparatus and Equipment	2,954,185	5,779,565	19,743,750
Total Value Planned Facilities	$ 15,261,169	$ 38,048,020	$ 108,558,511
Total 2030 Fire Protection Facilities	$ 33,395,466	$ 75,387,605	$ 202,284,629
2030 Service Population	108,300	117,500	758,500
Facility Cost Standard (Cost per Capita)	$ 308	$ 642	$ 267
Cost Per Resident	$ 308	$ 642	$ 267
Cost Per Worker[1]	213	443	184

[1] Workers weighted at 0.69 of residents.

Sources: Tables 8.1-8.7; Willdan Financial Services.

Fee Schedule

Table 8.9 shows the fire protection facilities fee schedule. The cost per capita is converted to a fee per unit of new development based on the dwelling unit and employment densities (persons per dwelling unit or employees per 1,000 square feet of nonresidential building space) shown in Table 2.3.

Table 8.9: Fire Protection Facilities Impact Fee

	A	B	C=AxB	D=0.5%xC	E=C+D
	Cost per Capita	Density[1]	Base Fee[2]	Admin. Charge[3]	Fee
Desert Zone					
Residential					
Single Family Unit	$ 308	3.14	$ 968	$ 4.84	$ 972.84
Multi-family Unit	308	2.08	641	3.21	644.21
Nonresidential					
Retail	$ 213	2.50	$ 532	$ 2.66	$ 534.66
Office	213	3.33	709	3.55	712.55
Industrial	213	1.67	355	1.78	356.78
Mountain Zone					
Residential					
Single Family Unit	$ 642	3.14	$ 2,015	$ 10.08	$ 2,025.08
Multi-family Unit	642	2.08	1,335	6.68	1,341.68
Nonresidential					
Retail	$ 443	2.50	$ 1,107	$ 5.54	$ 1,112.54
Office	443	3.33	1,474	7.37	1,481.37
Industrial	443	1.67	739	3.70	742.70
Valley Zone					
Residential					
Single Family Unit	$ 267	3.14	$ 837	$ 4.19	$ 841.19
Multi-family Unit	267	2.08	555	2.78	557.78
Nonresidential					
Retail	$ 184	2.50	$ 460	$ 2.30	$ 462.30
Office	184	3.33	613	3.07	616.07
Industrial	184	1.67	307	1.54	308.54

[1] Persons per dwelling unit or workers per 1,000 square feet.
[2] Fee per dwelling unit or per 1,000 square feet.
[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 8.8; Willdan Financial Services.

Additional Funding

Table 8.10 displays projected fee revenue and non-fee funding required through 2030. Because the future facilities cost standard is higher than the current value of facilities per capita, non-fee revenue will be needed to fund the planned facilities. This non-fee revenue corresponds to the cost of raising the value per capita of fire protection facilities provided to existing development.

Table 8.10: Allocation of Fire Protection Facility Costs to New Development

	Desert Zone	Mountain Zone	Valley Zone
Facility Cost Standard (Cost per Capita)	$ 308	$ 642	$ 267
New Development Service Population (2009-2030)	36,300	38,200	341,900
New Development Contribution to Planned Facilities	$ 11,180,400	$ 24,524,400	$ 91,287,300
Total Cost of Planned Facilities	15,261,169	38,048,020	108,558,511
Non-Fee Funding Required	$ 4,080,769	$ 13,523,620	$ 17,271,211

Sources: Tables 8.1 and 8.8; Willdan Financial Services.

The County will need to develop alternative funding sources to fund existing development's share of the planned facilities. Potential sources of revenue include existing or new general fund revenues, new special or general taxes, special assessments, or grants.

9. Waste Management

The purpose of this fee is to ensure that new development funds its fair share of waste management facilities, primarily landfills and transfer stations. The Waste Management Department provides landfill services countywide. The fee is calculated using the planned facilities method based on the share of future waste management facility needs generated by new development.

Service Population

Waste management facilities collect refuse from both residents and businesses countywide. **Table 9.1** shows the estimated service population for waste management facilities in 2008 and 2030. It is reasonable to assume that demand for these services is less for one employee compared to one resident, because nonresidential buildings are typically occupied less intensively than dwelling units. The 0.24-weighting factor for workers is based on a 40-hour workweek divided by the total number of hours in a week (168) and reflects the degree to which nonresidential development yields a lesser demand for waste management facilities.

Table 9.1: Waste Management Service Population

	Residents	Workers	Service Population
Existing - Countywide (2008)	779,100	252,050	839,600
New Development - Countywide (2008-2030)	422,300	109,220	448,500
Total - Countywide (2030)	1,201,400	361,270	1,288,100
Weighting Factor	1.00	0.24	

Sources: Table 2.1; Willdan Financial Services

Facility Standards

The County's waste management facility standard adopted in the CIP is 38.45 tons of landfill capacity per capita. This standard is based on the existing per capita landfill capacity.

The waste management impact fee is based on the facilities needs identified in the CIP, which are derived from the Solid Waste Infrastructure Plan produced by the Waste Management Department and the Department's Ten-Year Financial Forecast for Capital Projects. Overall, these projects are part of a planned system-wide transition from several local sanitary landfill sites to regional sanitary landfills supplemented by local transfer stations. The Kern County Waste Management Department presently has plans for eleven new facilities, several facility closures, and numerous miscellaneous capital projects. These projects expand existing disposal facilities, consolidate local disposal sites to three regional

disposal sites, and protect landfills from encroachment of incompatible land uses by acquiring buffer zones around disposal sites.

Planned Facilities

The County can use waste management facilities fee revenues for the construction or purchase of waste management facilities that expand the capacity of waste management facilities to accommodate new development. The proposed waste management impact fees are based on the cost of planned waste management facilities needed to accommodate new development using the planned facilities approach (see *Introduction* for further information). **Table 9.2** shows the total cost of planned waste management capital improvement projects. Table 9.2 includes projects fully or partially needed to accommodate new development, as well as some projects not related to new development.

Table 9.2: Planned Waste Management Facilities

Facility (Location)	Projected Future Expenditures
Bakersfield Metro Transfer Station	$ 20,000,000
Bena Regional Sanitary Landfill	71,731,309
Grapevine Transfer Station	4,000,000
Kern Valley Transfer Station	1,841,644
Lebec, New Transfer Station	5,836,900
McFarland-Delano Transfer Station	459,607
Mojave Regional Sanitary Landfill	31,730,252
Ridgecrest Sanitary Landfill and Transfer Station	5,888,000
Shafter-Wasco Regional Sanitary Landfill	10,141,000
Taft Sanitary Landfill	7,777,510
Tehachapi Transfer Station	8,059,432
Misc. Capital Projects	29,781,939
Total Planned Facilities	$ 197,247,593

Sources: Kern County; Willdan Financial Services.

The Waste Management Department's capital planning consultant, Roland Consulting, estimated the percentage of capital improvement project costs that should be allocated to new development. The cost allocation is based on the percentage of waste disposal at each facility that will be generated by new development through the 2030 planning horizon. **Table 9.3** shows the cost of facilities needed to serve new development. Some of the projects shown in Table 9.2 are needed for reasons other than the need to accommodate new development. Of the projects shown in Table 9.2, only those with a portion of costs allocated to new development are shown in Table 9.3.

Table 9.3: Waste Management Facility Requirements to Serve New Development

		Total Cost	Share Needed to Accommodate New Development[1]	Cost to Serve New Development
Bakersfield Metro TS	Design and Construction	$ 20,000,000	22.7%	$ 4,540,000
Kern Valley Transfer Station	Building Expansion	$ 403,000	100%	$ 403,000
Lebec	New Transfer Station	$ 4,000,000	42.0%	$ 1,680,000
Bena Regional Sanitary Landfill				
Phase 2A Mod. 3 Liner Design & Construction		$ 15,401,990	22.7%	$ 3,496,252
All Weather Roads From S. Access to Mod 3		80,000	22.7%	18,160
Mod 2 Horizontal Gas Collectors (Lift 6)		96,000	22.7%	21,792
Mod 2 Horizontal Gas Collectors (Lift 8)		78,000	22.7%	17,706
Mod 2 Gas Header Extension		259,000	22.7%	58,793
Phase 2A Mod. 4 Liner Design & Construction		15,000,000	22.7%	3,405,000
Phase 2A Mod. 5 Liner Design & Construction		15,000,000	22.7%	3,405,000
Phase 2A Mod. 6 Liner Design & Construction		15,000,000	22.7%	3,405,000
Subtotal - Bena Regional Sanitary Landfill		$ 60,914,990		$ 13,827,703
Mojave Regional Sanitary Landfill				
Phase 1, Module 1 Liner		$ 9,624,000	45.6%	$ 4,388,544
Phase 1, Module 2 Liner		4,789,000	45.6%	2,183,784
Phase 1 Access Road		823,130	45.6%	375,347
Phase 1 Fence & Preliminary Grading		291,940	45.6%	133,125
Phase 1 Water System & Power Supply		44,000	45.6%	20,064
Phase 1 Power Supply Construction		113,300	45.6%	51,665
Phase 1 Water System Supply		114,950	45.6%	52,417
Phase 1 Gatehouse & Scale		168,300	45.6%	76,745
Phase 1 Recovery LCRS System		103,000	45.6%	46,968
Phase 1, Module 3 Liner		4,789,000	45.6%	2,183,784
Phase 1, Module 4 Liner		4,789,000	45.6%	2,183,784
Subtotal - Mojave Regional Sanitary Landfill		$ 25,649,620		$ 11,696,227
Ridgecrest SL and TS	Lined Module	$ 4,130,000	19.9%	$ 821,870
Shafter-Wasco Regional Sanitary Landfill				
Module 4 Liner		$ 4,318,000	25.3%	$ 1,092,454
Module 5 Liner		4,318,000	25.3%	1,092,454
Subtotal - Shafter-Wasco Regional Sanitary Landfill		$ 8,636,000		$ 2,184,908
Taft Sanitary Landfill	Module 2 Liner	$ 6,221,700	30.3%	$ 1,885,175
Total Cost of Projects Needed to Accommodate New Development		$ 129,955,310		$ 37,038,883

[1] Share of projects needed to provide additional waste management capacity to serve new development determined by Roland Consulting and Waste Management Department staff based on waste generation forecasts by service area.

Sources: Kern County Capital Improvement Plan; Kern County Waste Management Department, Roland Consulting; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 9.4 shows the waste management facility cost standard. The facility standard is based on the cost of planned facilities allocated to new development and the projected service population growth through 2030. This facility standard is used as the basis for the proposed waste management facilities impact fee.

Table 9.4: Waste Management Facilities Cost Standard

Total Cost of Facilities to Serve New Development	$	37,038,883
Service Population Growth (2008-2030)		448,500
Facility Standard (Cost per Capita)	$	83
Cost Per Resident	$	83
Cost Per Worker[1]		20

[1] Workers weighted at 0.24 of residents.

Sources: Tables 9.1 and 9.3.

Fee Schedule

Table 9.5 shows the waste management facilities fee schedule. The cost per capita is converted to a fee per unit of new development based on the dwelling unit and employment densities (persons per dwelling unit or employees per 1,000 square feet of nonresidential building space) shown in Table 2.3.

Table 9.5: Waste Management Facility Impact Fees

	A	*B*	*C=AxB*	*D=0.5%xC*	*E=C+D*
	Cost per Capita	**Density[1]**	**Base Fee[2]**	**Admin. Charge[3]**	**Fee**
Residential					
Single Family Unit	$ 83	3.14	$ 259	$ 1.30	$ 260.30
Multi-family Unit	83	2.08	172	0.86	172.86
Nonresidential					
Commercial	$ 20	2.50	$ 50	$ 0.25	$ 50.25
Office	20	3.33	66	0.33	66.33
Industrial	20	1.67	33	0.17	33.17

[1] Persons per dwelling unit or workers per 1,000 square feet.

[2] Fee per dwelling unit (residential) or per 1,000 square feet (nonresidential).

[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 9.4; Willdan Financial Services.

Additional Funding

Table 9.6 displays projected fee revenue and non-fee funding required through 2030. Because there is a large amount of facility needs that are not related to providing capacity to accommodate new development, a significant amount of non-fee revenue will be needed to fund the planned facilities.

Table 9.6: Allocation of Waste Management Facility Costs to New Development

Total Facility Costs	$ 197,247,593
Facility Cost Allocated to New Development (2009-2030)	37,038,883
Non-Fee Funding Required	$ 160,208,710

Sources: Tables 9.2 and 9.3.

The Waste Management Department that facilities will be funded with also be funded with waste disposal fees. The Department plans to finance facilities needed before sufficient revenue is available in reserve funds and impact fee funds using certificates of participation. The availability of impact fees to fund the cost of facilities needed to accommodate new development will reduce the amount of fee increases and certificates of participation that would otherwise be needed.

10. Public Health

The purpose of this fee is to ensure that new development funds its fair share of public health facilities. The Department of Public Health Services provides services throughout the County. Thus, the public health impact fee would be charged to new development in both cities and unincorporated areas.

Service Population

The public health facilities service population is based on the number of residents and workers in Kern County. It is reasonable to assume that demand for these services is less for one employee compared to one resident, because nonresidential buildings are typically occupied less intensively than dwelling units. The 0.24-weighting factor for workers is based on a 40-hour workweek divided by the total number of hours in a week (168) and reflects the degree to which nonresidential development yields a lesser demand for public health facilities. **Table 10.1** shows the public health facilities service population.

Table 10.1: Public Health Service Population

	Residents	Workers	Service Population
Existing - Countywide (2008)	779,100	252,050	839,600
New Development - Countywide (2008-2030)	422,300	109,220	448,500
Total - Countywide (2030)	1,201,400	361,270	1,288,100
Weighting Factor	1.00	0.24	

Sources: Table 2.1; Willdan Financial Services.

Facility Standards

The Kern County CIP identifies a public health facility standard of 0.12 building square feet per capita, which was the existing standard of public health facilities at the time the CIP was adopted. The proposed public health impact fees are based on the existing inventory of public health facilities per capita.

The Kern County CIP identifies several public health projects that will be needed to replace aging facilities and to accommodate new development. The CIP indicated that the Department of Public Health Services would need to identify additional facilities in future planning processes to accommodate all of the new development projected through 2030. In addition to the facilities identified in the CIP, the Department has identified several other new facilities that will be needed to accommodate new development.

Existing and Planned Facilities

Existing Facilities

Table 10.2 shows the inventory of existing public health facilities.

Table 10.2: Public Health Existing Facilities

Facility (Location)	Inventory		Unit Cost[1]	Total Value
Land[2]				
Arvin Health Building (204 S. Hill)	0.18	acres	$ 86,400	$ 15,700
Delano County Building (455 Lexington St)	0.22	acres	226,500	50,900
Kern River Valley Complex	0.10	acres	87,200	8,300
Mojave County Building (1775 Hwy 58)	0.71	acres	87,200	61,800
NOR Health Center (125 El Tejon Ave)	0.17	acres	350,000	58,600
Public Health Facility (1800 Mt. Vernon Ave)	2.50	acres	350,000	875,000
Ridgecrest Health Dept. (250 W. Ridgecrest Blvd)	0.14	acres	190,480	26,500
Shafter/Wasco Admin (329 Central Valley Hwy)	0.79	acres	170,200	133,600
Taft Administration Building (315 Lincoln St)	1.72	acres	223,200	383,300
Tehachapi County Building (125 E. F St)	0.08	acres	139,200	11,700
Wasco County Building (810 8th St)	0.02	acres	170,200	3,000
Subtotal - Land	6.62	acres		$ 1,628,400
Buildings				
Arvin Health Building	2,378	sq. ft.	$ 373	$ 886,000
Delano County Building	2,936	sq. ft.	351	1,030,500
Kern River Valley Complex	972	sq. ft.	351	341,200
Mojave County Building	1,243	sq. ft.	351	436,300
NOR Health Center	2,188	sq. ft.	373	815,200
Public Health Facility	61,000	sq. ft.	373	22,728,600
Ridgecrest Health Dept.	1,816	sq. ft.	373	676,600
S.E. Bakersfield Community Svcs.[3]	17,737	sq. ft.	-	-
Shafter/Wasco Admin	2,924	sq. ft.	351	1,026,300
Taft Administration Building	1,103	sq. ft.	351	387,200
Tehachapi County Building	512	sq. ft.	351	179,700
Wasco County Building	1,110	sq. ft.	351	389,600
Subtotal - Buildings	95,919	sq. ft.		$ 28,897,200
Equipment and Furnishings				
Arvin Health Building				$ 87,200
Delano County Building				100,000
Kern River Valley Complex				40,000
Mojave County Building				10,000
NOR Health Center				40,900
Public Health Facility				3,161,300
Ridgecrest Health Dept.				33,900
S.E. Bksfld Community Svcs.				819,100
Shafter/Wasco Admin				10,000
Taft Administration Building				10,000
Tehachapi County Building				5,000
Wasco County Building				50,000
Subtotal - Buildings				$ 4,367,400
Total Value of Existing Facilities				$ 34,893,000

[1] Based on estimated replacement cost.

[2] For shared facilities that house multiple departments, public health credited with a share of the total parcel equal to its share of total building square footage. For some facilities, no land parcel size was available and a 0.30 FAR is assumed.

[3] Facility is leased, not owned, by the County.

Sources: Tables 2.4 and 2.5; Kern County; Willdan Financial Services.

Planned Facilities

The County can use public health facilities fee revenues for the construction or purchase of new buildings, land, equipment, and other facilities that expand the capacity of the system of public facilities to accommodate new development. **Table 10.3** shows the planned facilities that will be used to accommodate projected development through 2030. The facilities include new and expanded Health Department offices in several cities around the County. In addition, the Department plans to develop new storage space and a parking garage at the main Health Department building on Mt. Vernon Street in Bakersfield.

The following facilities are included in the CIP: new Public Health facilities in Frazier Park and Mojave; replacement facilities Ridgecrest, Tehachapi, and Wasco; and storage space and a parking structure at the main Public Health building on Mt. Vernon Street in Bakersfield. Needs for new facilities in Southwest Bakersfield and Lamont, and replacements for the North of the River and Delano facilities were identified after the CIP was adopted. These facilities are not included in the current CIP.

To the extent that these facilities represent new capacity of the Department of Public Health Services to serve new development, and not replacement of existing facilities, they may be funded with impact fee revenue. For example, the CIP includes plans for a new 3,200 square foot facility to replace the 1,110 square feet used by the Department of Public Health Services in the Wasco County Building. Based on this increase in square footage, roughly two-thirds of the Wasco public health facility could be funded with impact fees. Other funding should be used for the remaining costs of the facility.

Table 10.3: Planned Public Health Facilities

Facility (Location)	Inventory		Unit Cost[1]	Total Value
Land				
Ridgecrest Replacement	0.24	acres	$ 190,480	$ 46,600
Tehachapi Replacement	0.24	acres	139,200	34,100
Wasco Replacement	0.24	acres	170,200	41,700
North of the River (NOR) Replacement	0.31	acres	350,000	107,100
Delano Replacement	0.31	acres	226,500	69,300
New Frazier Park Facility	0.24	acres	116,800	28,600
New Mojave Facility	0.24	acres	121,800	29,800
New Southwest Bakersfield Facility	0.31	acres	350,000	107,100
New Lamont Facility	0.24	acres	31,400	7,700
Mt. Vernon Street Parking Structure[2]	-	acres	-	-
Subtotal - Land	2.39	acres		472,000
Buildings				
Ridgecrest Replacement	3,200	sq. ft.	$ 373	$ 1,192,300
Tehachapi Replacement	3,200	sq. ft.	373	1,192,300
Wasco Replacement	3,200	sq. ft.	373	1,192,300
North of the River (NOR) Replacement	4,000	sq. ft.	373	1,490,400
Delano Replacement	4,000	sq. ft.	373	1,490,400
New Frazier Park Facility	3,200	sq. ft.	373	1,192,300
New Mojave Facility	3,200	sq. ft.	373	1,192,300
New Southwest Bakersfield Facility	4,000	sq. ft.	373	1,490,400
New Lamont Facility	3,200	sq. ft.	373	1,192,300
Mt. Vernon Street Storage	7,000	sq. ft.	351	2,457,000
Mt. Vernon Street Parking Structure[3]	300	spaces	20,400	6,120,000
Subtotal - Buildings	38,200	sq. ft.		$ 20,202,000
Equipment and Furnishings[4]				
Ridgecrest Replacement				$ 248,400
Tehachapi Replacement				248,400
Wasco Replacement				248,400
North of the River (NOR) Replacement				310,500
Delano Replacement				310,500
New Frazier Park Facility				248,400
New Mojave Facility				248,400
New Southwest Bakersfield Facility				310,500
New Lamont Facility				248,400
Mt. Vernon Street Parking Structure				-
Subtotal - Buildings				$ 2,421,900
Total Planned Facilities				$ 23,095,900

[1] Construction cost includes 20% for architecture and engineering and other costs. Base construction cost estimates at $311/square foot for public health facilities and $17,000 per space for the parking structure.

[2] Parking structure to be constructed on the site of the existing surface lot adjacent to the Public Health Facility. No land acquisition will be needed.

[3] Parking space unit cost based on average of recent construction costs in the following cities: Beverly Hills, Sacramento, Santa Barbara, Walnut Creek, and two sites in Santa Clarita.

[4] Estimated costs for equipment and furnishings based on average equipment and furnishings values for existing public health facilities as a percentage (25%) of base construction cost.

Sources: Tables 2.4 and 2.5; Kern County CIP; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 10.4 shows the public health facilities cost standard based on the existing inventory approach. The value per capita is used as a basis for the proposed public health impact fee.

Table 10.4: Public Health Facilities Cost Per Capita

Total Value Existing Facilities	$	34,893,000
Less Existing Buildings to be Replaced		(4,199,400)
Total Value Planned Facilities		23,095,900
Total Value Countywide Public Protection Facilities (2030)	$	53,789,500
2030 Service Population		1,288,100
Cost Per Capita	$	42
Cost Per Resident	$	42
Cost Per Worker[1]		10

[1] Workers weighted at 0.24 of residents.

Sources: Tables 10.1, 10.2 and 10.4; Willdan Financial Services.

Fee Schedule

Table 10.5 shows the public health facilities fee schedule. The cost per capita is converted to a fee per unit of new development based on the dwelling unit and employment densities (persons per dwelling unit or employees per 1,000 square feet of nonresidential building space) shown in Table 2.3.

Table 10.5: Public Health Facility Impact Fees

	A Cost per Capita	B Density[1]	C=AxB Base Fee[2]	D=0.5%xC Admin. Charge[3]	E=C+D Fee
Residential					
Single Family Unit	$ 42	3.14	$ 132	$ 0.66	$ 132.66
Multi-family Unit	42	2.08	87	0.44	87.44
Nonresidential					
Retail	$ 10	2.50	$ 25	$ 0.13	$ 25.13
Office	10	3.33	33	0.17	33.17
Industrial	10	1.67	17	0.09	17.09

[1] Persons per dwelling unit or workers per 1,000 square feet.
[2] Fee per dwelling unit (residential) or per 1,000 square feet (nonresidential).
[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

Sources: Tables 2.3 and 10.4; Willdan Financial Services.

Additional Funding

Table 10.6 displays projected fee revenue and non-fee funding required through 2030. Because the future facilities cost standard is higher than the current value of facilities per capita, non-fee revenue will be needed to fund the planned facilities. This non-fee revenue corresponds to the cost of raising the value per capita of public health facilities provided to existing development.

Table 10.6: Allocation of Public Health Facility Costs To New Development

Facility System Cost Per Capita	$ 42
New Development Service Population (2009-2030)	448,500
New Development Contribution to Planned Facilities	$ 18,837,000
Total Cost of Planned Facilities	$ 23,095,900
Non-Fee Revenue to be Identified	$ 4,258,900

Sources: Tables 10.1, 10.3 and 10.4; Willdan Financial Services.

The County will need to develop alternative funding sources to fund existing development's share of the planned facilities. Potential sources of revenue include existing or new general fund revenues, new special or general taxes, special assessments, or grants.

11. General Government

The purpose of this fee is to ensure that new development funds its fair share of general government facilities. General government facilities provide space for the Board of Supervisors and for general County administration. Some general government facilities are primarily used to provide services and administration in unincorporated areas, while others provide services on an equal basis countywide. Thus, the general government impact fee includes both a countywide component and an unincorporated only component to reflect the different levels of facility needs.

Service Population

Table 11.1 shows the general government facilities service population. The general government facilities service population is based on the number of residents and workers. Because facilities that are used to provide services that benefit all development Countywide are considered separately from facilities used to provide services benefitting the unincorporated area only, Table 11.1 identifies the number of current and projected residents and workers in unincorporated areas, as well as countywide.

It is reasonable to assume that demand for these services is less for one employee compared to one resident, because nonresidential buildings are typically occupied less intensively than dwelling units. The 0.24-weighting factor for workers is based on a 40-hour workweek divided by the total number of hours in a week (168) and reflects the degree to which nonresidential development yields a lesser demand for general government facilities.

Table 11.1: General Government Service Population

	Residents	Workers	Service Population
Existing - Countywide (2008)	779,100	252,050	839,600
New Development - Countywide (2008-2030)	422,300	109,220	448,500
Total - Countywide (2030)	1,201,400	361,270	1,288,100
Existing - Unincorporated (2008)	294,400	107,000	320,100
New Development - Unincorporated (2008-2030)	89,500	26,200	95,800
Total - Unincorporated (2030)	383,900	133,200	415,900
Weighting Factor	1.00	0.24	

Sources: Table 2.1; Willdan Financial Services.

Facility Standards

The Kern County CIP identifies a general government facility standard of 0.25 building square feet per capita, which was the existing standard of general government facilities at the

time the CIP was adopted. The CIP identifies several new general government facilities that will be needed to accommodate new development. However, the County anticipates that less than 0.25 general government building square feet per capita will be needed to accommodate new development through 2030. Therefore, the general government impact fee is based on the cost of planned facilities per capita. Using the planned facilities cost per capita, the impact fee will not generate more revenue than is needed to complete the planned facilities. Because the level of planned facilities per capita is lower than the existing standard of facilities per capita, there are no general government facility costs allocated to existing development. If, in the future, the County identifies additional general government facilities that will be needed to serve new development, this fee should be revised.

Existing and Planned Facilities

Table 11.2 shows the inventory of existing general government land and buildings.

Table 11.2: Existing General Government Facilities

	Land[1]		Unit Cost[2]	Land Value	Buildings		Unit Cost[2]	Bldg. Value	Total Value
Public Services Building	1.31	acres	$350,000	$ 457,700					$ 457,700
General Services					1,993	sq. ft.	$351	$ 699,543	699,543
Planning and Development Svcs[3]					8,816	sq. ft.	351	3,094,486	3,094,486
Engineering and Survey Services[4]					6,279	sq. ft.	351	2,203,940	2,203,940
Arvin/Lamont Admin	0.25	acres	86,400	21,700					21,700
BOS District 5					2,011	sq. ft.	351	705,861	705,861
General Services					225	sq. ft.	351	78,975	78,975
Buttonwillow County Building	0.08	acres	87,200	7,000	1,042	sq. ft.	351	365,742	372,742
County Administrative Center	10.32	acres	350,000	3,610,400					3,610,400
BOS District 1					680	sq. ft.	351	238,680	238,680
BOS District 2					686	sq. ft.	351	240,786	240,786
BOS District 3					728	sq. ft.	351	255,528	255,528
BOS District 4					707	sq. ft.	351	248,157	248,157
BOS District 5					680	sq. ft.	351	238,680	238,680
County Admin Office					2,356	sq. ft.	351	826,956	826,956
Clerk of the Board					3,893	sq. ft.	351	1,366,443	1,366,443
Auditor/Controller					13,105	sq. ft.	351	4,599,855	4,599,855
Treasurer/Tax Collector					20,483	sq. ft.	351	7,189,533	7,189,533
Assessor					42,470	sq. ft.	351	14,906,970	14,906,970
Information Technology Svcs					465	sq. ft.	351	163,215	163,215
County Counsel					25,330	sq. ft.	351	8,890,830	8,890,830
Personnel					13,358	sq. ft.	351	4,688,658	4,688,658
Elections					22,767	sq. ft.	351	7,991,217	7,991,217
General Services					16,897	sq. ft.	351	5,930,847	5,930,847
Bakersfield Justice Building[5]	-	acres	-	-					
General Services					2,050	sq. ft.	351	719,550	719,550
Information Technology Svcs					13,870	sq. ft.	351	4,868,370	4,868,370
Frazier Park County Building[6]	0.08	acres	-	-	1,060	sq. ft.	-	-	-
Kern River Valley Admin	1.36	acres	29,272	39,900					39,900
BOS District 1					2,181	sq. ft.	351	765,531	765,531
Assessor					339	sq. ft.	351	118,989	118,989
Mojave County Building	0.46	acres	42,515	19,600	807	sq. ft.	351	283,257	302,857
Ridgecrest County Building	4.44	acres	32,409	144,000					144,000
BOS District 1					563	sq. ft.	351	197,613	197,613
Assessor					576	sq. ft.	351	202,176	202,176
Shafter/Wasco Admin	0.22	acres	141,831	31,300					31,300
BOS District 1					257	sq. ft.	351	90,207	90,207
General Services					264	sq. ft.	351	92,664	92,664
Taft Administration Building	0.30	acres	87,200	26,300					26,300
BOS District 4					594	sq. ft.	351	208,494	208,494
General Services					300	sq. ft.	351	105,300	105,300
Wasco County Building	0.03	acres	45,999	1,500	416	sq. ft.	351	146,016	147,516
Subtotal	18.85	acres		$ 4,359,400	208,248	sq. ft.		$ 72,723,069	$ 77,082,469

[1] For shared facilities, the share of total parcel land acreage assigned to general government is equal to the share of building square footage devoted to general government facilities.

[2] Based on estimated replacement cost. Construction cost includes 10% for architecture and engineering and 10% for other additional costs.

[3] Actual building square footage is 16,910. Value has been reduced to reflect the share (52%) of Planning services funded by the General Fund rather than license and permit fees and other charges for services.

[4] Actual building square footage is 16,910. Value has been reduced to reflect the share (32%) of Engineering and Survey services funded by the General Fund rather than license and permit fees and other charges for services.

[5] Land accounted for under County Administrative Center.

[6] Facility is leased by the County.

Sources: Tables 2.4 and 2.5; Kern County; Willdan Financial Services.

While some general government functions serve all areas of the County equally, other functions provide a higher level of service to unincorporated areas. For example, the County Assessor serves all areas equally, but the Planning and Development Services Department primarily serves unincorporated areas because incorporated cities have their own planning departments.

Table 11.3 shows the allocation of the values of general government facilities between countywide and unincorporated service populations. The "% Countywide" column estimates the proportion of each facility attributed to serving all development with an equal level of service whether it is in an incorporated city or an unincorporated area. The "% Unincorporated Only" column estimates the proportion of each facility supporting a County service that serves only unincorporated areas. The value of general government land is allocated in proportion to the estimated building value used for each service population.

Table 11.3: Allocation of General Government Facilities Value by Service Area

Facility (Location)	Total Value	% County-wide	Countywide Allocation	% Uninc. Only	Uninc. Only Allocation
Public Services Building					
General Services	$ 699,543	100%	$ 699,543	0%	$ -
Planning and Development Svcs	3,094,486	0%	-	100%	3,094,486
Engineering and Survey Services	2,203,940	0%	-	100%	2,203,940
Arvin/Lamont Admin					
BOS District 5	705,861	100%	705,861	0%	-
General Services	78,975	100%	78,975	0%	-
Buttonwillow County Building	365,742	0%	-	100%	365,742
County Administrative Center					
BOS District 1	238,680	100%	238,680	0%	-
BOS District 2	240,786	100%	240,786	0%	-
BOS District 3	255,528	100%	255,528	0%	-
BOS District 4	248,157	100%	248,157	0%	-
BOS District 5	238,680	100%	238,680	0%	-
County Admin Office	826,956	100%	826,956	0%	-
Clerk of the Board	1,366,443	100%	1,366,443	0%	-
Auditor/Controller	4,599,855	100%	4,599,855	0%	-
Treasurer/Tax Collector	7,189,533	100%	7,189,533	0%	-
Assessor	14,906,970	100%	14,906,970	0%	-
Information Technology Svcs	163,215	100%	163,215	0%	-
County Counsel	8,890,830	100%	8,890,830	0%	-
Personnel	4,688,658	100%	4,688,658	0%	-
Elections	7,991,217	100%	7,991,217	0%	-
General Services	5,930,847	100%	5,930,847	0%	-
Bakersfield Justice Building					
General Services	719,550	100%	719,550	0%	-
Information Technology Svcs	4,868,370	100%	4,868,370	0%	-
Frazier Park County Building		100%	-	0%	-
Kern River Valley Admin					
BOS District 1	765,531	100%	765,531	0%	-
Assessor	118,989	100%	118,989	0%	-
Mojave County Building	283,257	100%	283,257	0%	-
Ridgecrest County Building					
BOS District 1	197,613	100%	197,613	0%	-
Assessor	202,176	100%	202,176	0%	-
Shafter/Wasco Admin					
BOS District 1	90,207	100%	90,207	0%	-
General Services	92,664	100%	92,664	0%	-
Taft Administration Building					
BOS District 4	208,494	100%	208,494	0%	-
General Services	105,300	100%	105,300	0%	-
Wasco County Building	146,016	100%	146,016	0%	-
Total Existing Buildings Facilities	$ 72,723,069	92%	$ 67,058,901	8%	$ 5,664,168
General Government Land	$ 4,359,400	92%	$ 4,019,860	8%	$ 339,540
Total General Government Facilities	$ 77,082,469		$ 71,078,761		$ 6,003,708

Note: Allocation of space between countywide and unincorporated service areas based on department estimates of time spent on services to each area. Totals may not add due to rounding. Land allocation based on allocation of constructed square feet.

Sources: Table 11.2; Kern County; Willdan Financial Services.

Planned Facilities

The County can use general government facilities fee revenues for the construction or purchase of new buildings, land, equipment, and other facilities that expand the capacity of the system of general government facilities to accommodate new development. The Kern County CIP identifies several facilities that will be needed to serve new development and can be funded with impact fee revenue. **Table 11.4** shows the planned general government facilities identified in the CIP.

Table 11.4: Planned General Government Facilities

	Land		Unit Cost	Value
Planned Land				
Frazier Park	0.38	acre	$ 116,800	$ 44,700
Tehachapi	0.38	acre	139,200	53,300
Mojave	0.38	acre	121,800	46,600
Lake Isabella	0.38	acre	90,400	34,600
Taft/Maricopa	0.38	acre	223,200	85,400
Subtotal - Land	1.91	acre		$ 264,600
Planned Buildings				
Frazier Park	5,000	sq. ft.	$ 351	$ 1,755,000
Tehachapi	5,000	sq. ft.	351	1,755,000
Mojave	5,000	sq. ft.	351	1,755,000
Lake Isabella	5,000	sq. ft.	351	1,755,000
Taft/Maricopa	5,000	sq. ft.	351	1,755,000
Subtotal - Building	25,000	sq. ft.		$ 8,775,000
Equipment and Furnishings				
Frazier Park				$ 50,000
Tehachapi				50,000
Mojave				50,000
Lake Isabella				50,000
Taft/Maricopa				50,000
Subtotal - Building				$ 250,000
Total Planned Government Facilities				$ 9,289,600
Countywide Value			92%	$ 8,566,100
Unincorporated Only Value			8%	723,500

Sources: Tables 2.4 and 2.5; Kern County CIP; Willdan Financial Services.

Cost Allocation and Fee Schedule

Cost per Capita

Table 11.5 shows the cost of general government facilities per capita in three ways. The existing standard cost per capita is based on the current inventory of general government facilities and the current service population. The system plan cost per capita is based on the combined value of existing facilities and planned additional facilities and the total service population at the 2030 planning horizon. The planned facilities cost per capita includes only the value of planned new facilities and the projected increase in service population.

Because the planned facilities cost per capita is lower than the existing value per capita, the planned facilities standard is used as the basis for the impact fee. By basing the fee on the planned facilities value per capita, the impact fee will not generate more revenue than is needed to fund planned facilities. Because the impact fee is based on a facility standard that is lower than the existing standard, the impact fee will not be used to increase the level of service provided to existing development.

The cost per capita is shown separately for facilities serving all development countywide and for facilities serving unincorporated areas only. The impact fee charged in incorporated cities will be based on the cost per capita of facilities serving all development countywide. The impact fee charged in unincorporated areas will include both the cost of facilities that serve all development in the County and the cost of facilities that provide services to unincorporated areas only.

Table 11.5: General Government Facilities Cost Per Capita

	Countywide [A]	Unincorp. Only [B]	Unincorp. Total = [A + B]
Existing Standard			
Total Value Existing of Facilities (2008)	$ 71,078,761	$ 6,003,708	
Service Population (2008)	839,600	320,100	
Cost Per Capita	$ 85	$ 19	
Cost Per Resident	$ 85	$ 19	$ 103
Cost Per Worker[1]	20	5	25
System Plan			
Total Value Existing of Facilities (2008)	$ 71,078,761	$ 6,003,708	
Total Value of Planned Facilities (2009-2030)	8,566,100	723,500	
Total Value General Government Facilities (2030)	$ 79,644,861	$ 6,727,208	
Service Population (2030)	1,288,100	415,900	
Cost Per Capita	$ 62	$ 16	$ 78
Cost Per Resident	$ 62	$ 16	$ 78
Cost Per Worker[1]	15	4	19
Planned Facilities			
Total Value of Planned Facilities (2009-2030)	$ 8,566,100	$ 723,500	
Service Population Growth (2009-2030)	448,500	95,800	
Cost Per Capita	$ 19	$ 8	$ 27
Cost Per Resident	$ 19	$ 8	$ 27
Cost Per Worker[1]	5	2	7

[1] Workers weighted at 0.24 of residents.

Sources: Tables 11.1, 11.3 and 11.4; Willdan Financial Services.

Fee Schedule

Table 11.6 shows the general government facilities fee schedule. Separate fees amounts are proposed for incorporated cities and unincorporated areas. The cost per capita is converted to a fee per unit of new development based on the dwelling unit and employment densities (persons per dwelling unit or employees per 1,000 square feet of nonresidential building space) shown in Table 2.3.

Table 11.6: General Government Facilities Impact Fees

	A Cost per Capita	B Density[1]	C=AxB Base Fee[2]	D=0.5%xC Admin. Charge[3]	E=C+D Fee
Incorporated Cities					
Residential					
Single Family Unit	$ 19	3.14	$ 60	$ 0.30	$ 60.30
Multi-family Unit	19	2.08	40	0.20	40.20
Nonresidential					
Retail	$ 5	2.50	$ 13	$ 0.07	$ 13.07
Office	5	3.33	17	0.09	17.09
Industrial	5	1.67	8	0.04	8.04
Unincorporated Areas [4]					
Residential					
Single Family Unit	$ 27	3.14	$ 84	$ 0.42	$ 84.42
Multi-family Unit	27	2.08	55	0.28	55.28
Nonresidential					
Retail	$ 7	2.50	$ 18	$ 0.09	$ 18.09
Office	7	3.33	23	0.12	23.12
Industrial	7	1.67	12	0.06	12.06

[1] Persons per dwelling unit or workers per 1,000 square feet.

[2] Fee per dwelling unit or per 1,000 square feet.

[3] Administrative charge of 0.5 percent to cover costs including fee collection, accounting, annual reporting, and facilities planning.

[4] Unincorporated area fee includes costs per capita for countywide plus costs per capita for unincoporated areas only.

Sources: Tables 2.3 and 11.5; Willdan Financial Services.

Estimated Revenue

Table 11.7 shows the estimated impact fee revenue through the 2030 planning horizon, based on the proposed impact fees per capita and projected new development. As shown, the proposed general government impact fees are estimated to generate revenue equal to the cost of planned facilities.

Table 11.7: Estimated General Government Fee Revenue

Countywide Facilities				
Countywide Facility Standard Per Capita	$	19		
New Development Service Population (2009-2030)		448,500		
Countywide Revenue			$	8,566,100
Unincorporated Only Facilities				
Unincorporated Only Facility Standard Per Capita	$	8		
New Development Service Population (2009-2030)		95,800		
Unincorporated Only Revenue			$	723,500
Total New Development Contribution to Planned Facilities			$	9,289,600
Cost of Planned General Government Facilities				9,289,600
Non-Fee Funding Required			$	-

Sources: Tables 11.1, 11.4 and 11.5; Willdan Financial Services.

12. Implementation

Impact Fee Program Adoption Process

Impact fee program adoption procedures are found in the *California Government Code* section 66016. Adoption of an impact fee program requires the Board of Supervisors to follow certain procedures including holding a public meeting. Data, such as an impact fee report, must be made available at least 10 days prior to the public meeting. The County's legal counsel should be consulted for any other procedural requirements as well as advice regarding adoption of an enabling ordinance and/or a resolution. After adoption there is a mandatory 60-day waiting period before the fees go into effect.

The Kern County Board of Supervisors may only impose impact fees on new development in unincorporated areas. The city councils of the incorporated cities in the County would need to adopt the fees on behalf of the County for the fees to be imposed in incorporated cities. Incorporated cities are anticipated to absorb nearly 80 percent of the projected population and employment growth in Kern County through 2030. Thus, incorporated development will generate most of the anticipated fee revenue for those fees that will be charged in incorporated areas.

The County should request that the city councils in Kern County adopt the public protection, library, animal control, regional parks and recreation, fire protection, waste management, public health, and general government impact fees on its behalf, as applicable to each individual city. The findings documented in this report should be sufficient to allow the cities to adopt the fees under the *Mitigation Fee Act*. The cities could collect the fees on behalf of the County through their building permitting processes and pass the collected fees on to the County. Alternatively, the cities could require that developers pay the fees directly to the County and provide proof of payment as a condition for receiving a city building permit.

Inflation Adjustment

The County should keep its impact fee program up to date by periodically adjusting the fees for inflation. Such adjustments should be completed regularly to ensure that new development will fully fund its share of needed facilities.

While fee updates using inflation indices are appropriate for periodic updates to ensure that fee revenues keep up with increases in the costs of public facilities, the County will also need to conduct more extensive updates of the fee documentation and calculation (such as this study) when significant new data on growth forecasts and/or facility plans become available.

Reporting Requirements

The County should comply with the annual and five-year reporting requirements of the *Mitigation Fee Act*. For facilities to be funded by a combination of public fees and other revenues, identification of the source and amount of these non-fee revenues is essential.

Identification of the timing of receipt of other revenues to fund the facilities is also important.

Programming Revenues and Projects with the CIP

The County maintains a Capital Improvements Program (CIP) to plan for future infrastructure needs. The CIP identifies costs and phasing for specific capital projects. The use of the CIP in this manner documents a reasonable relationship between new development and the use of those revenues.

The County may decide to alter the scope of the planned projects or to substitute new projects to be funded with impact fee revenue as long as those new projects continue to represent an expansion of the County's facilities. If the total cost of facilities varies substantially from the total cost used as a basis for the fees, the County should consider revising the fees accordingly.

13. Mitigation Fee Act Findings

Public facilities fees are one-time fees typically paid when a building permit is issued and imposed on development projects by local agencies responsible for regulating land use (cities and counties). To guide the widespread imposition of public facilities fees the State Legislature adopted the *Mitigation Fee Act* (the *Act*) with Assembly Bill 1600 in 1987 and subsequent amendments. The *Act,* contained in *California Government Code* Sections 66000 through 66025*,* establishes requirements on local agencies for the imposition and administration of fee programs. The *Act* requires local agencies to document five findings when adopting a fee.

The five statutory findings required for adoption of the maximum justified public facilities fees documented in this report are presented in this chapter and supported in detail by the report that follows. All statutory references are to the *Act*.

Purpose of Fee

- *Identify the purpose of the fee (§66001(a)(1) of the Act).*

Development impact fees are designed to ensure that new development will not burden the existing service population with the cost of facilities required to accommodate growth. The purpose of the fees proposed by this report is to implement this policy by providing a funding source from new development for capital improvements to serve that development. The fees advance a legitimate County interest by enabling the County to provide municipal services to new development.

Use of Fee Revenues

- *Identify the use to which the fees will be put. If the use is financing facilities, the facilities shall be identified. That identification may, but need not, be made by reference to a capital improvement plan as specified in §65403 or §66002, may be made in applicable general or specific plan requirements, or may be made in other public documents that identify the facilities for which the fees are charged (§66001(a)(2) of the Act).*

Fees proposed in this report, if enacted by the County, would be used to fund expanded facilities to serve new development. Facilities funded by these fees are designated to be located within the County. Fees addressed in this report have been identified by the County to be restricted to funding the following facility categories: public protection, Sheriff patrol and investigation, libraries, animal control, parks and recreation, fire protection, waste management, public health, and general government.

Benefit Relationship

- *Determine the reasonable relationship between the fees' use and the type of development project on which the fees are imposed (§66001(a)(3) of the Act).*

The County will restrict fee revenue to the acquisition of land, construction of facilities and buildings, and purchase of related equipment, furnishings, vehicles, and services used to serve new development. Facilities funded by the fees will be used to serve the additional residents and workers associated with new development. Under *the Act*, fees are not intended to fund planned facilities needed to correct existing deficiencies. Thus, a reasonable relationship exists between the use of fee revenue and the new residential and non-residential development that will pay the fees.

Burden Relationship

- *Determine the reasonable relationship between the need for the public facilities and the types of development on which the fees are imposed (§66001(a)(4) of the Act).*

Facilities need is based on a facility standard that represents the demand generated by new development for those facilities. For each facility category, demand is measured by a single facility standard that can be applied across land use types to ensure a reasonable relationship to the type of development. For most facility categories service population standards are calculated based upon the number of residents associated with residential development and the number of workers associated with non-residential development. To calculate a single, per capita standard, one worker is weighted less than one resident based on an analysis of the relative use demand between residential and non-residential development.

The standards used to identify growth needs are also used to determine if planned facilities will partially serve the existing service population by correcting existing deficiencies. This approach ensures that new development will only be responsible for its fair share of planned facilities, and that the fees will not unfairly burden new development with the cost of facilities associated with serving the existing service population.

Chapter 2, Growth Forecasts and Unit Cost Estimates provides a description of how service population and growth forecasts are calculated. Facility standards are described in the *Facility Standards* sections of each facility category chapter.

Proportionality

- *Determine how there is a reasonable relationship between the fees amount and the cost of the facilities or portion of the facilities attributable to the development on which the fee is imposed (§66001(b) of the Act).*

The reasonable relationship between each facilities fee for a specific new development project and the cost of the facilities attributable to that project is based on the estimated new development growth the project will accommodate. Fees for a specific project are based on the project's size. Larger development projects can result in a higher service population resulting in higher fee revenue than smaller projects in the same land use classification. Thus, the fees ensure a reasonable relationship between a specific new development project and the cost of the facilities attributable to that project.

See *Chapter 2, Growth Forecasts and Unit Cost Estimates,* or the *Service Population, or Trip Demand* sections in each facility category chapter for a description of how service populations or trip demand factors are determined for different types of land uses. See the *Fee Schedule* section of each facility category chapter for a presentation of the proposed facilities fees.

PLANNING DEPARTMENT

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RESOURCE MANAGEMENT AGENCY
Ted James, Interim , RMA DIRECTOR
Community & Economic Development Department
Engineering & Survey Services Department
Environmental Health Services Department
Planning Department
Roads Department

January 5, 2010

File: Ridgecrest Solar
Solar Millennium

California Energy Commission
Attn: Eric Solorio
1516 Ninth Street MS-15
Sacramento, California 95814

Bureau of Land Management
California Desert District Office
Attn: Hector Villalobos
c/o Ridgecrest Solar Power Project
22835 Calle San Juan de Los Lagos
Moreno Valley, CA 92553

RE: Kern County Planning Department Comments and Requests for Conditions Review of Ridgecrest Solar Power Project (09-AFC-9)

Dear Mr. Solario and Mr. Villalobos,

The Kern County Planning Department appreciates the participate in the permitting process and to provide comments and request conditions of approval on the application for certification by Beacon Solar, LLC for a proposed 250 MW solar electric generating facility in unincorporated eastern Kern County (Brown Road west of State Route 395) on Bureau of Land Management (BLM) land. The following are staff comments and requests for conditions based on our review of the project materials.

1. Brown Road is designated an arterial roadway by the Kern County General Plan. As such its ultimate width is 110 feet. All structures and any permanent installations shall be set back from the centerline of the road by 55 feet.

2. The Kern County Roads Department provides the following comments:

   a. All provisions of the attached memo dated October 14, 2009.
   b. Any improvements, realignments or other alterations to Brown Road shall be as determined by the Roads Department, including the length and design of the acceleration and deceleration lanes discussed in the Project Description.

c. The applicant shall be required to restore and reconstruct Brown Road to pre-project condition including complete structural sections if damage occurs from project related heavy equipment or vehicles.

3. Any relocation of El Paso Wash or other drainage features should be required to ensure no impacts to the full functioning of Brown Road or aggravate any flooding issues for surrounding properties or the Inyokern Community.

4. The offsite water pipeline referenced in 1.3.6 Land Use appears to contemplate use of the existing ROW on Brown Road. Such ROW is under the jurisdiction of the Kern County Board of Supervisors and requires the processing and approval of a franchise agreement.

5. The analysis fails to discuss the significant impacts on County public services from the introduction of this industrial power plant on BLM land. Section 2.5.5.7 acknowledges the jurisdiction of the Kern County Fire Department but does not include an analysis of the economic impacts. Kern County is very experienced with heavy industry, power plants and internal fire protection control measures. While important, they are not sufficient to protect the employees, traveling public and surrounding potential for wildfire without backup from Kern County Fire Department and other emergency service providers.

   No property taxes are provided to Kern County from BLM Land. The US Department of Interiors Payment in Lieu of Taxes (PILT) program provides funding for normal and customary response for fire, emergency response and sheriff for such activities as OHV use, search and rescue and grass fires. Industrial uses were not anticipated and are not included in the minimal amounts provided by PILT. .

   The Kern County Board of Supervisors authorized the development of a Capital Improvement Plan (CIP) that would provide information that represents the best current understanding of the new public facilities that will be needed to serve the county's projected development through 2030. The scope of services includes parks, libraries, sheriff (public protection and investigation), fire, animal control, public health, landfill/transfer stations, and general government. Roads and sewer costs and impacts are not part of this program. A CIP was approved by the Board on in 2008 and in March 2009, a Public Facilities Impact Fee Study was reviewed by the Board of Supervisors. A copy of this report has been provided to the CEC Staff. This report includes the fees necessary for residential, commercial and industrial projects, broken down into Mountain, Desert and Valley areas, to ensure that new development pays the capital costs associated with growth. This project as a solar thermal project will have impacts from the categories of countywide public protection, sheriff patrol and investigation and fire protection. The estimated fee was based on the 1440 acres of coverage ($576.88 per 1000 square feet) as $ 28,646,937.

Staff is requesting a condition of approval that requires this amount be allocated over 20 years, as a per year fee of $1,432,346.80 payable to the Kern County Auditor –Controller by April 15 of each calendar year.

If the CEC and BLM decline to require this mitigation, staff will recommend to the Board of Supervisors that the project be excluded from customary and normal services of the County. The BLM will be completely responsible for fire, law enforcement and emergency services response. Any support from the County service providers will become fee based and the applicant be billed for all and all requests for assistance and backup from the BLM to the County. As the BLM services are limited in the Ridgecrest area, the impacts on public services under CEQA and NEPA would have to be considered significant and unmitigated.

6. The following are recommended conditions of approval:

   a. All necessary building permits must be obtained
   b. The method of water supply and sewage disposal for any employees shall be as required and approved by the Kern County Environmental Health Services Department.
   c. Fire flows, access and fire protection facilities shall be as required and approved by the Kern County Fire Department
   d. The development shall comply with any requirements of the Kern County Air Pollution Control District..
   e. All exterior lighting shall be directed away from adjacent properties and roads. The lighting standards shall be equipped with glare shields or baffles and shall not exceed 40 feet in height above grade. Light fixtures shall be maintained in sound operating conditions at all times.
   f. A comprehensive landscaping and irrigation plan shall be approved by the Planning Director in accordance with the requirements of Chapter 19.86 of the Zoning Ordinance. A minimum of 5 % of the developed area shall be landscaped with xeriscape or drought tolerant plantings and continuously maintained in good condition. Landscaping shall be installed or bonded for prior to occupancy of the building or site. Given the remote nature of the project site, as an alternative requirement the project may contribute the equivalent cost of the landscaping to the Kern County Parks and Recreation District, school or other non-profit organization in Kern County.
   g. All signs shall comply with the signage regulations of the applicable base zone district and with Chapter 19.84 of the Zoning Ordinance.
   h. All signs shall be approved by the Director of the Kern County Planning Department prior to installation.
   i. Any area devoted to outside storage shall be treated with a dust binder or other dust control measure, as approved by the Director of the Kern County Planning Department.

Kern County supports all forms of renewable energy if appropriately sited with mitigation that provides protection for existing property owners and Kern County interests. Thank you for your partnership on this opportunity for Kern County to be a part of solar development in California.

Sincerely,

Lorelei H. Oviatt, AICP
Special Projects Division Chief

cc: Ted James, RMA Director (Interim), Planning Director
Supervisor McQuiston
Supervisor Maben
Roads Department
CAO – Adel Klein
Applicant – Solar Millennium LLC