URS

DOCKET	
07-AFC-8	
DATE	FEB 27 2009
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February 27, 2009

Mr. John Kessler
Project Manager
Attn: Docket No. 07-AFC-8
California Energy Commission
1516 Ninth Street, MS-15
Sacramento, CA 95814-5512

Subject: Carrizo Energy Solar Farm (07-AFC-8)
Revised Hydrology and Hydrogeology Report for the Vicinity of the Proposed Carrizo Energy Solar Farm
URS Project No. 27658060.01805

Dear Mr. Kessler:

On behalf of Ausra CA II, LLC (dba Carrizo Energy, LLC), URS Corporation Americas (URS) hereby submits the Revised Hydrology and Hydrogeology Report for the Vicinity of the Proposed Carrizo Energy Solar Farm (CESF).

I certify under penalty of perjury that the foregoing is true, correct, and complete to the best of my knowledge. I also certify that I am authorized to submit the Revised Hydrology and Hydrogeology Report for the Vicinity of the Proposed Carrizo Energy Solar Farm on behalf of Carrizo Energy, LLC.

Sincerely,

URS CORPORATION

Angela Leiba
Project Manager

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108
Tel: 619.294.9400
Fax: 619.293.7920

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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 *CARRIZO ENERGY SOLAR FARM PROJECT*	**Docket No. 07-AFC-8** **PROOF OF SERVICE** **(Revised 2/18/2009)**

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Declaration of Service

I, Kristen E. Walker, declare that on March 2, 2009, I served and filed copies of the attached CESF Revised Hydrology/Hydrogeology Report. 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/carrizo/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:

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

_____by personal delivery or by depositing in the United States mail at Sacramento, California with first-class postage thereon fully prepaid and addressed as provided on the Proof of Service list above 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. 07-AFC-8
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.

____

*indicates change



HYDROLOGY AND HYDROGEOLOGY REPORT FOR THE VICINITY OF THE PROPOSED CARRIZO ENERGY SOLAR FARM (CESF)

SAN LUIS OBISPO COUNTY, CALIFORNIA

Submitted to:
California Energy Commission

Submitted by:
Carrizo Energy, LLC

With Support from:

URS

1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108

June 26, 2008
Revised: September 24, 2008
Revised: February 27, 2009

URS

February 27, 2009

Mr. John Kessler
California Energy Commission
1516 Ninth Street
Sacramento, CA 95814-5512

Subject: Hydrology and Hydrogeology Report for the Vicinity of the Proposed Carrizo Energy Solar Farm (CESF)
San Luis Obispo County, California
URS Project No. 27658060.01805

Dear Mr. Kessler:

On behalf of Carrizo Energy, LLC ("Carrizo"), URS Corporation Americas (URS) is pleased to provide the California Energy Commission (CEC) the following revised report presenting a summary and evaluation of existing data related to the hydrology and hydrogeology of the proposed Carrizo Energy Solar Farm (CESF) and vicinity. Hydrologic and hydrogeologic information related to the site and vicinity that has been presented to the CEC and public to date are provided in this single document, as well as additional information collected in support of our evaluations provided herein. This report was prepared at the request of the CEC specific to its comments during public workshops held on March 12 and December 15, 2008. The report was originally issued June 26, 2008, revised September 24, 2008 and has been revised again to address:

- CEC Preliminary Staff Assessment (PSA) issues listed in the Soil and Water Resources Section on page 4.9-1 of the PSA.
- Public comments resulting from a data response workshop held on December 15, 2008.
- Additional public comments forwarded to the CEC subsequent to the last workshop.

The table below summarizes where PSA and public comments have been addressed in the document. This submittal includes revised report text, tables, figures, and appendices.

URS Corporation
1615 Murray Canyon Road, Suite 1000
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Comment	Response
PSA:	
Two proposed crossings of "Carriza Creek" may increase flooding upstream of the crossings. The applicant should re-examine the need for these crossings to determine if the project can be successfully constructed without placing fill in an existing stream channel. The crossing designs need to be updated to ensure that upstream flood elevations are not increased as compared to existing conditions.	This issue has been addressed in Section 2.2.2 and 2.2.2.2 of this report. Final design of the crossings will facilitate drainage flow and eliminate upstream or downstream impacts from flooding, erosion, and sedimentation.
Staff believes that it would be preferable to locate the construction fueling area outside of the existing 100-year FEMA floodplain. Relocating the fueling area to the north and east of "Carriza Creek" could eliminate the need for the two creek crossings and the placement of fill in the creek.	This issue has been addressed in Section 2.2.2.2 of this report. The proposed fueling area was relocated away from the floodplain.
Water supply for construction appears to be significantly under-estimated. The applicant should provide clear documentation demonstrating that all construction requirements (including dust suppression) can be successfully accomplished with the estimated (20.8 acre-feet per year) water supply.	This issue has been addressed in Section 1.2.1 of this report. Revised construction water use estimates are approximately 144 afy, 72 afy, and 38 afy for the first, second, and third years of construction, respectively.
The applicant indicates that the proposed perimeter swales will capture and detain the first 117 acre-feet of runoff from two up-gradient watersheds. On the Carrizo Plain, with extremely limited water resources, capturing and detaining up-gradient surface water resources including "Carriza Creek" and Soda Lake and groundwater users. The applicant should include provisions for this runoff to pass through the CESF project site.	This issue has been addressed in Section 2.2.2 and 2.2.2.1 of this report. Final project design will allow for drainage of the perimeter swales.
Potable water supply estimates are 5.3 gpm for average annual (averaged over 8,760 hours) and maximum daily usage. The applicant should confirm the average annual and maximum daily potable water supply estimates.	This issue has been addressed in Section 1.2.2 of this report.
The proposed sanitary waste water system includes a 1,000-gallon septic tank and leach field. However, the septic tank appears to be undersized given the number of employees and the applicant's estimate of potable water supply. The applicant should provide clear documentation demonstrating that the septic system has been designed in accordance with San Luis Obispo County and California Plumbing Code standards.	This issue has been addressed in Section 1.2.2 of this report. The proposed septic tank size has been revised to 2,500 gallons.
Infiltration BMPs should be added to the detention/infiltration areas to limit the potential for extended shallow ponding to increase mosquito production.	This issue has been addressed in Section 2.2.2 of this report. Infiltration BMPS will be included for the detention/infiltration areas.
Post construction BMPs should be identified to stabilize soils in the laydown area and at the Solar Field.	This issue has been addressed in Section 2.2.2 of this report. Post construction BMPs will be provided for the laydown area and solar field.

Comment	Response
December 15, 2008 Workshop:	
CEC Comment: One concern that CEC staff had was that there would be enough water available during construction to control dust at the site, and to provide for the moisture conditioning for compaction required for the cut-and-fill operations...Is this mass grading really necessary?	See response above regarding updated construction water use estimates. Additionally, see Carrizo Energy response to comments from CEC workshop held March 12, 2008 (Response #65 regarding valley fever and dust control).
CEC comment: Stormwater management is one area where the applicant and staff have, I think, some issues to work out still. Staff was particularly concerned with the crossings on, the proposed crossings of Carriza Creek….As far as soil and water impacts, I just need to make sure that we can move a hundred-year storm through there without causing flooding upstream, and, you know, flooding on somebody's home or property.	See response above regarding the "Carriza Creek" crossing design.
CEC Comment: "Another area that staff was concerned about was the perimeter swales that go around the project site, around the 640-acre solar site...And we think that in order to mitigate that impact, runoff that's captured in the perimeter swales needs to be routed to the other side of state route 58 so that you don't detain runoff within those perimeter swales. There should be positive drainage to transfer any runoff that's captured in those perimeter swales downstream of the project site."	See response above regarding the perimeter swale design.
Public Comment (M. Strobridge): "You guys stated that you ran a pump test on this well, right? You ran a pump test on this well?...What size submersible did you use? I'm under the understanding that this well has a turbine situated on the top of it, a very old one. And it's very hard to drop a submersible into a hole with a turbine that has a steel rod that goes all the way to the bottom. So, I was just curious as to what size submersible pump you guys used, and what depth...But I would like information on that onsite well, whether the turbine was removed or not, and the size of the submersible that you guys pumped at, rates." "You just drop it in there and then state that this well puts out 50 gallons a minute. Am I right, 50 gallons a minute?"	See response below regarding the water quality testing procedure and setup.
Public Comment (M. Strobridge): "And they identify 86 wells on the Carriza Plain, including the irrigation wells. And they put a one-acre-foot-a-year rate to the domestic wells, and a 35 percent duty cycle to the irrigation wells. According to the San Luis Obispo County master water plan, they classify ranchettes differently than residential homes in town. Ranchettes are classified as 2.5 acres to 20 acres and more. And they use more water than a conventional home. The average water usage for a ranchette, according to San Luis Obispo County, is 1.8 acre-feet a year for inland areas. So URS' groundwater model is inaccurate."	The model already accounts for this additional rate of pumping because it has been run using lower and higher pumpage for the basin.

Comment	Response
Public Comments:	
Public comment (M. Strobridge) regarding Ausra's on-site well test, requesting submersible pump size, depth it was set at and how the well was pumped with a turbine installed.	This comment has been addressed in Section 3.4.3.1 of this report. Groundwater quality sampling was performed by URS using a Schafer 5hp pump set at a depth of approximately 120 feet bgs, pumped at rates between 95 gpm and 108 gpm over a period of 4 hours to purge water from the well prior to sampling. Field documentation is provided in Appendix F. This activity was not an aquifer test.
Public comment (M. Strobridge) requesting that the proposed SunPower California Valley Solar Ranch water consumption be factored in to the CESF water studies.	This comment has been addressed in Section 3.6.2.3 of this report. The proposed SunPower pumping was not included in the revised groundwater model because the well is located approximately 6 miles east of the CESF project and this well is accounted for when considering the range of groundwater extraction that is estimated for the basin. In addition, water use for SunPower is expected to be similar to that initially modeled for a residential well (12 afy) that suggested that there would be no significant effects on groundwater levels.
Public comment (M. Strobridge) regarding discrepancies between rainfall values listed in this report and the SunPower California Valley Solar Ranch CUP Application.	This comment has been addressed in Section 2.1.1.1 of this report. The SunPower CUP Application states an average annual rainfall of 1.5 inches. All available information collected for the CESF from a variety of sources indicates that the average annual rainfall in the project vicinity is approximately 7 to 10 inches.
Public comment (M. Strobridge) regarding differences in reported seasonal temperature variations from the SunPower report.	Temperatures reported in Section 2.1.1.1 are typical seasonal values for the area and do not reflect extreme record high and low values.

Comment	Response
Public comment (M. Strobridge) regarding cumulative impacts on water resources related to the Ausra CESF, Topaz OptiSolar, and SunPower California Valley Solar Ranch projects in light of the SLO County Master Water Plan that indicates this area is an overdraft condition.	The overdraft issue is addressed in the first paragraph of Section 3.5 of the report. Furthermore, the Topaz OptiSolar project was included in the combined projects (cumulative) groundwater scenario.
Public comments (M. Strobridge) regarding Lewis family well test information and Ausra/URS well test information. "It has been brought to my attention that some well tests were done on this well by the Lewis family only a few years ago. The well had been "sanded in" and the pump company blew the well out as good as they could. Where are these pump tests? The Lewis family is currently selling to Ausra. I am upset that no one has brought this up. A well that is sanded in could easily lose a couple hundred feet of depth. I would appreciate a response on this well report. If it has not been provided then URS or the Lewis family should be required to supply the well test. I have also been told this well has already been sleeved once."	Discussions with the property owner do not indicate that aquifer testing has been conducted with respect to the proposed pumping well. The activities that Mr. Strobridge references are maintenance activities that would not involve measuring water levels during an extended period of pumping. Carrizo Energy will observe the condition of the well and identify its suitability for use to provide a water supply.
Public comments (J. Ruskovich) in letter dated January 6, 2009 to the CEC:	
"We have proof that the Well Test (Calscience Work Order) that was supposedly done on 2-15-08 is inaccurate, as we know the test was not pulled out of the big Well on the Lottie King Ranch (Asura's Site)."	To clarify, the activities conducted on 2-15-08 consisted of purging and groundwater sampling of the well. The turbine had been removed by the property owner to remove the pump for repairs. URS placed a temporary pump in the well to conduct groundwater sampling while the well pump was being serviced.
"Please re-read the Water Report and look into the many problems/misinformation in this report, the first being that it is a 40 years old report done in 1967."	The report to which you are referring is the only available basin-wide study of groundwater in the Carrizo Plain and served as a starting point for analysis. Groundwater evaluations rely on the available information regardless of when it was completed, as subsurface geology has not changed.
"Remember the water report for the California Spring Lodge & Resort that was submitted to Ausra (sic). The report was supposedly done on 7-2-02, that stated there were Well drilled on my land, which never happened."	URS has only relied on this report for groundwater quality information. We are aware that the wells are shown as being located on your property. Locations are specified on the driller's logs provided in Appendix D. Regardless of whether or not the well is shown on our map on your property, it does not affect the results of the modeling completed for this project.

URS

Mr. John Kessler
California Energy Commission
February 27, 2009
Page 6

Comment	Response
"You keep referencing the 2 big Ag Wells: • The 1100 gallon per minute Well on Section 3 collapsed in the early 90's. • The 600 gallon per minute well on Section 2 collapsed in the late 80's. • The Well listed on Section 27 does not exist.	We believe that you are referring to wells on Sections 33 and 28 for the first two bullets. Comment noted. As indicated in response to Mr. Strobridge's comments, a range of pumpage from the basin has been modeled to reflect various pumping conditions.
"In conclusion, where is the 14 inch cast, 620 foot deep Well. It is not anywhere on the old Arco section of land at all. Check our map and pictures (see attachments 1 & 2); do you see a well anywhere?"	Section 3.4.4 indicates that the ARCO site was dismantled. To meet DWR requirements the well was likely destroyed/abandoned.

This report has been peer reviewed by Dr. Eric La Bolle, P.E., hydrologist with the Hydrologic Studies Program at the University of California, Davis. Dr. La Bolle also conducted the modeling appearing herein based on hydrogeologic data available for the site vicinity. If you have any questions, please contact us at (619) 294-9400.

Sincerely,

URS CORPORATION

REGISTERED GEOLOGIST ROBERT K. SCOTT No. 734 CERTIFIED HYDROGEOLOGIST STATE OF CALIFORNIA

REGISTERED PROFESSIONAL ENGINEER MATTHEW C. MOORE C-56780 Exp. 06/09 CIVIL STATE OF CALIFORNIA

Robert K. Scott, P.G., C.Hg. No. 734
Vice President and Principal Geologist

Matthew C. Moore, P.E., CPESC, CPSWQ
Senior Project Engineer

RKS/MCM:kl

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Tables

Figures

Appendices

ACC	air-cooled condensers
ACOE	Army Corps of Engineers
af	acre-feet
AFC	Application for Certification
afy	acre-feet/year
AMC I	Antecedent Soil Moisture Condition
AMC II	Average Antecedent Soil Moisture Condition
ARCO	Atlantic Richfield Corporation
Bechtel	Bechtel Civil & Minerals, Inc.
BFE	Base Flood Elevations
bgs	below ground surface
Calscience	Calscience Environmental Laboratories, Inc.
Carrizo	Carrizo Energy, LLC
CEC	California Energy Commission
CESF	Carrizo Energy Solar Farm
CGMG	California Division of Mines and Geology
CGS	California Geological Survey
CIMIS	California Irrigation Management Information System
CLFR	Compact Linear Fresnel reflector
CN	Runoff Curve Number
CUP	Conditional Use Permit
CWA	Clean Water Act
DWR	California Department of Water Resources
ET	Evapotranspiration
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
GHB	general head boundaries
gpd	gallons per day
gpd/ft	gallons per day per foot
gpm	gallons per minute
GPS	Global Positioning System
HEC-HMS	Hydrologic Engineering Center-Hydrologic Modeling System
HEC-RAS	Hydrologic Engineering Center-River Analysis System
HFB	horizontal flow barrier
hp	horsepower
K_h	horizontal hydraulic conductivities
kV	kilovolt
K_v	vertical hydraulic conductivity
MCL	Maximum Contaminant Levels
MSL	mean sea level
MW	megawatt
NOAA	National Oceanic and Atmospheric Administration
NRCS	Natural Resources Conservation Service
OptiSolar	Topaz Solar Farm LLC/OptiSolar, Inc.
ORP	oxidation-reduction potential

OWS	oil/water separator
P	Total Precipitation
PG&E	Pacific Gas & Electric
pH	potential of Hydrogen
PSA	Preliminary Staff Assessment
RCB	reinforced concrete box
RWQCB	Regional Water Quality Control Board
SCS	Soil Conservation Service
SR	State Route
STG	steam turbine generators
SVOC	Semivolatile organic compounds
TDS	total dissolved solids
TSS	Total Suspended Solids
U.S. EPA	United States Environmental Protection Agency
URS	URS Corporation Americas
USDA	United States Department of Agriculture
USGS	United States Geographic Survey
VOC	Volatile organic compounds
WSEL	Water surface elevation
WUS	Waters of the United States

URS Corporation Americas (URS) has prepared this report to serve as a summary of hydrologic and hydrogeologic information that has been presented to the California Energy Commission (CEC) and the public during the facility permitting process for the Carrizo Energy Solar Farm (CESF). The site is located on the Carrizo Plain, which is an unincorporated area of San Luis Obispo County near the towns of Simmler and California Valley, California.

This report was requested by the CEC during a Public Workshop held on March 12, 2008 and was submitted on June 26, 2008. The report was revised September 24, 2008 to address CEC Data Requests and public comments resulting from a data response workshop on August 5, 2008. On November 21, 2008, the CEC issued its Preliminary Staff Assessment (PSA). This report has been revised to address comments appearing in the Soil and Water Resources Section on page 4.9-1 of the PSA and public comments provided during and following a December 15, 2008 data response workshop.

INTRODUCTION

Carrizo Energy, LLC (Carrizo Energy) is considering an entire section (640 acres) for future development as a solar-powered electrical generation station that will produce up to a nominal 177 megawatt (MW) net. The facility will be dry (air) cooled; therefore, its estimated water use for the facility is considerably less than other solar and conventional power generating facilities. It is estimated that the facility will use approximately 20.8 acre-feet/year (afy) for the following purposes: Makeup to the steam turbine system, washing of solar system reflectors and collector, potable water, service water, and fire protection. The maximum water use is estimated for the first year of construction (144 afy, or an average annual rate of 89 gpm).

Historically, the site vicinity has been used for agriculture, including dry farming of wheat and barley, alfalfa, carrots and potatoes. Cattle and sheep ranching are also common on the Carrizo Plain. Recently, there has been some planting of grape vineyards and olive groves on the plains. Data sources indicate that these intensive agricultural activities use considerably more water than the proposed CESF on a per-acre basis. Discussions with local residents suggest that groundwater usage on the plains has become less intensive with time.

SURFACE WATER HYDROLOGY

The average annual precipitation ranges from approximately 7 to 9 inches in the Carrizo Plain basin, but may be closer to 10 inches (San Luis Obispo County Department of Public Works). Most rainfall occurs from November through May. The Carrizo Plain basin is one of internal drainage (closed to surface water outflow), such that surface water runoff accumulates in Soda Lake, a playa in the center of the basin that is dry for part of the year.

The CESF is located within the Central Coast Hydrologic Region that covers approximately 11,300 square miles in central California. The Carrizo Plain watershed is approximately 54 miles long and 6 miles wide, and covers approximately 414 square miles, or 263,680 acres. The watershed areas tributary to the site include the main Carrizo Plain drainage channel, ("Carriza Creek" Basin 1, 31.6 square miles) and Basins 2 and 3 are directly tributary to the northerly site area (approximately 3.9 and 4.3 square miles, respectively), for a total of 41.3 square miles. The total watershed area tributary to the north end of

Soda Lake is approximately 152 square miles. The site and construction laydown area occupy approximately one percent of the watershed tributary to the north end of Soda Lake.

The project site currently consists primarily of 1,024 acres of disturbed farmland/ranchland. The portion of stormwater runoff that does not infiltrate into the ground, moves via sheet flow and follows the terrain to the south and west, and then is tributary to Soda Lake over 10 miles downstream. The Carrizo Plain drainage ("Carriza Creek") within the temporary construction staging area has been identified as a jurisdictional Waters of the United States (WUS). Carrizo Energy has received notice from the U.S. Army Corps of Engineers (ACOE) that it has initiated the Section 7 Consultation permitting process with the U.S. Fish and Wildlife Service.

Post-construction, the stormwater will be directed from the paved and non-paved areas to local collection swales and infiltration areas where it will percolate and evaporate. The infiltration areas will store and infiltrate the stormwater runoff. The flows generated from the offsite watershed will be directed around the site via the proposed perimeter drainage swales. Ultimately, the runoff will flow across State Route (SR) 58, confluence with the existing creek, traverse Section 33 and continue on its historical flow path in the southeasterly direction.

URS performed a surface water hydrology analysis of total runoff and surface water infiltration for pre- and post-project scenarios, considering upgradient basins, site drainage and Soda Lake. The results have been included in the groundwater modeling conducted for the post-project scenario. The Rational Method and the Soil Conservation Service (SCS) Curve Number Method with HEC-HMS were used to evaluate on-site hydrology. The SCS Curve Number Method was used to provide realistic runoff flow volume and rates that account for antecedent moisture conditions, while the Rational Method was used for flood control infiltration basin sizing calculations. San Luis Obispo County hydrology and hydraulic standards were used for preliminary design of onsite stormwater facilities.

The flow rates estimated for on-site runoff for the pre- and post-project scenario using both methods were relatively similar for the 100-year event. The potential stormwater volume generated on site was also evaluated on an average annual basis. Under existing conditions, approximately 316 afy of stormwater could be generated on the site, including the construction laydown area. Under post-project conditions, the on-site stormwater volume that could be generated would be approximately 388 afy; however, there would be no surface runoff from the site under normal conditions.

The off-site hydrology calculations were performed using the SCS Curve Number method to provide runoff estimates. The results of that analysis were used in the HEC-HMS hydrology model to estimate the volume of runoff generated from the upstream, off-site watershed. This analysis evaluated the 6- and 24-hour storm duration to estimate the range of potential runoff from individual storm events. The surface water runoff rate reduction due to infiltration in the solar field is minimal compared to the overall watershed surface water runoff rates. Therefore, significant impacts to water resources downstream of the project and in the regional area are not anticipated for 6-hour and 24-hour storm events. There will be no significant change in post-construction runoff to Soda Lake.

The primary purpose of the perimeter swales is to convey off-site runoff around the site and ultimately to Soda Lake. The swales will be designed to drain and convey runoff downstream by either sheet flow across State Route 58 or by placement of one or more culverts under State Route 58. This approach would minimize infiltration in the perimeter swales and would allow collected upstream runoff to drain to "Carriza Creek".

A similar volume analysis for the watershed downstream of the project to Soda Lake indicates similar results in terms of surface water volume reduction due to infiltration and evaporation of annual rainfall onsite. The pre-project potential surface stormwater volume for the total watershed that drains to the north end of Soda Lake is approximately 23,584 afy. The corresponding post-project rainfall volume is approximately 23,429 afy. Therefore, the reduction in the overall potential annual surface water flow volume to Soda Lake is approximately 1 percent. Therefore, no significant impacts to water resources downstream of the site are anticipated, dependent upon annual surface water flow volumes.

An analysis was conducted for the site using HEC-HMS to estimate rainfall infiltration to the Upper Aquifer for pre- and post-project scenarios. Daily rainfall data from a nearby rainfall gage served as the basis for the rainfall, evapotranspiration, and infiltration calculations. The SCS Curve Number Method was used for the analysis. Two antecedent soil moisture conditions were analyzed: dry (AMC I) and average (AMC II) to provide a range of potential infiltration values prior to rainfall. Evapotranspiration rates were based on California Irrigation Management Information System (CIMIS) Reference Evapotranspiration (ET) Map (Zone 10) and were prorated based on the number of days of rainfall per month.

For the post-project scenario, the site will be terraced with multiple infiltration areas that should also provide increased potential for recharge to the Upper Aquifer. In addition, the constructed site will have reduced plant transpiration and evapotranspiration compared to the pre-project scenario due to increased shading from the mirrors. Based on the geometry of the solar field and mirror layout, the initial abstraction and ET rates for the post-project scenario were reduced by 70% to account for these changes.

Results of the infiltration analysis assuming average antecedent moisture conditions (AMC II) were the following:

- Existing Onsite Infiltration = 144 afy
- Proposed Onsite Infiltration = 230 afy

The anticipated infiltration rates for the site for the post-project scenario a (230 afy) is over ten times greater than the estimated groundwater use for the CESF of 20.8 afy and approximately 1.5 times greater than the maximum water use projected for construction during Year 1 (144 afy).

HYDROGEOLOGY

Many studies have been done regarding the geology of the Carrizo Plain; however, few hydrogeological studies have been conducted. The primary aquifers in the Carrizo Plain are found in alluvium, the Paso Robles and Morales Formations. Kemnitzer (1967) described two water bodies beneath the Carrizo Plain. The poorest quality groundwater lies beneath Soda Lake, 10 miles south of the site. This is hydraulically isolated from the water body with better water quality. The better quality groundwater is probably best at the margins of the basin and away from Soda Lake.

Our study indicates that groundwater supply is generally produced from two zones, an upper zone (Upper Aquifer) that is generally less than 300 feet and a lower zone (Lower Aquifer) that exists at the site at a depth of approximately 450 to 600 feet below the ground surface (bgs). Limited well information indicates that potable water supplied to most residences and ranches is derived from wells within a depth of about 175 feet bgs in the Upper Aquifer. Kemnitzer (1967) identified 89 wells penetrating the Upper Aquifer, and estimated their average production to be about 6 afy (4 gallons per minute (gpm) with continuous pumping). Based on a well survey in March 2008, these wells penetrating the Upper Aquifer probably yield from a few gpm up to 40 gpm. Wells in the Lower Aquifer typically yield on the order of 500 to 1,100 gpm (Kemnitzer, 1967). He identified 11 irrigation wells in 1967 and of these, it appears that six were generally greater than 300 feet deep. It is from this zone that the CESF would derive its water supply.

URS conducted a well survey within approximately 3 miles of the proposed site, and visited residents to identify the characteristics of their wells. Although a well may have been identified during the survey, discussion with residents indicate some are no longer operating. This information was considered in the groundwater modeling conducted to evaluate the effects groundwater pumping related to this project. As a result of the survey and other data sources, 86 wells have been identified and included in the model. URS requested well data from California Department of Water Resources (DWR); however, release of this information is considered proprietary under California Water Code Section 13752 and our request was denied.

Groundwater quality appears to be variable within each of the aquifer zones, and is generally inferior in the Lower Aquifer, based on the limited water quality data available. URS evaluated the groundwater quality of the proposed CESF pumping well. Some constituents exceeded their respective Primary or Secondary Maximum Contaminant Levels (MCLs) for drinking water established by the State indicating that it is not suitable for drinking water without further treatment. The CESF will be using this inferior quality water from the Lower Aquifer for its water supply.

Pump testing data are available for a Lower Aquifer well that was located immediately adjacent to the site on the western edge of Section 27 at the former ARCO solar site. These data were considered in the groundwater modeling conducted to evaluate the potential affects of pumping and substantiate accounts that previous pumpage at the site at similar rates had no observable affects on neighboring wells. The United State Geographic Survey (USGS) model, MODFLOW was used for the groundwater modeling to simulate the potential affect of site pumping on neighboring wells and the Carrizo Basin. Actual geologic and hydrogeologic conditions were used in the model including data derived from the URS well survey, Kemnitzer (1967), information provided by the public and other available sources.

The model simulated groundwater flow in six layers for the basin. An inset model was used to be able to more accurately simulate and identify estimated drawdown and groundwater elevations in the site vicinity. The Upper Aquifer was Layer 1 and the Lower Aquifer was Layer 3 (greater than 400 ft below land surface). No-flow and general head boundaries were set to approximate basin conditions. Average annual recharge was applied to Layer 1 (60,000 afy), consistent with Kemnitzer (1967). Pumping from the basin was simulated using the locations and available data for 86 wells identified in the basin. Of these wells, it was assumed that the domestic supply wells penetrating the Upper Aquifer were pumped at an average rate of 0.62 gpm or approximately 1 afy, consistent with residential water use expected on the plains. The actual rates of pumping for the irrigation wells were estimated based on discussions with local residents, land use or reported well yields at the time of installation. The degree of irrigation well pumpage in Layer 3 has some degree of uncertainty. To account for this uncertainty, a lower and upper range of total pumpage was modeled for the basin. Those wells known to penetrate the Lower Aquifer were included in Layer 3.

The model was run for Construction, Project and No-project Scenarios. A Combined Projects Scenario was also performed including the Topaz Solar Farm LLC/Optisolar, Inc. (OptiSolar) facility. There is also a SunPower facility proposed at least 6 miles east of CESF. This was not included in the model because previous modeling using similar pumpage showed that the effects were not significant.

The Construction Scenario included pumping from the proposed CESF well at three different average annual rates for the three years of the construction phase. The maximum average annual water use is estimated to be 144 af [128,500 gallons per day (gpd), or approximately 89 gpm] for Year 1. The water use for Years 2 and 3 decreases considerably to 72 af (64,300 gpd or approximately 45 gpm) in Year 2 and 38 af (33,900 gpd or 24 gpm) in Year 3. The construction scenario was simulated for transient flow conditions. Both the Combined Projects and Project Scenario includes pumping from the proposed CESF well at 18,500 gallons per day (gpd), approximately 13 gpm, the estimated average for operations. The Combined Projects Scenario also assumed pumping at the OptiSolar site at the maximum proposed water use appearing in its Conditional Use Permit Application. It was assumed that OptiSolar would also pump from the Lower Aquifer at a location between (north) both sites. This is the most conservative scenario, since there are residential wells between the sites. The overall pumpage in the model for the wells identified is 2,678 afy, which is 30% less than the Kemnitzer estimate (Kemnitzer 1967). This is consistent with the change in water use related to agriculture that has been reported by a number of long-time residents of the plains. Each of the post-construction model scenarios was conservatively run to steady state conditions to simulate the effects of long-term pumping.

In constructing the model, it was assumed that the proposed pumping well will be screened in the Lower Aquifer only. Therefore, if the existing CESF well were to be used, then the existing screen above the Lower Aquifer would be sleeved. The sleeve would serve to block flow from the Upper Aquifer into the well so that flow would only come from the Lower Aquifer. Additional No Project scenarios were run wherein the CESF well was included in Layers 1, 2 and 3 with no pumping to estimate borehole flow. Borehole flow, the transfer of water between aquifers through flow within the wellbore, was simulated in these scenarios using the multimodal well package of MODFLOW. A reduction in potential borehole flow associated with installation of the sleeve has the potential to mitigate drawdown in the Upper Aquifer.

Uncertainty in the hydrogeologic conditions was addressed through a sensitivity analysis that simulated the response of the system (groundwater elevations) for a wide range of input parameters and an alternative conceptual model for the basin. The differences in the resulting heads (groundwater elevations) between the No Projects (no pumping from the proposed CESF and OptiSolar wells) and Project and Construction scenarios (with pumping from the proposed CESF well and OptiSolar wells) indicates a plausible range of drawdown in the basin associated with pumping from the proposed CESF well. The results of these model runs for a range of hydrogeologic conditions indicated that the estimated change in head (drawdown) at the CESF property boundary were as follows:

- Construction Scenario (for the end of Year 1 at the maximum pumping rate of 89 gpm): Upper Aquifer, negligible to 1.5 feet; Lower Aquifer, about 2.0 to 7.0 feet. The drawdown estimated after Year 1 is temporary. During subsequent years of construction, the pumping rate will decrease and the estimated drawdown is predicted to be even less than that estimated for Year 1.
- Project Scenario: Upper Aquifer, about –-0.5 (water level rise) to -1.0 feet (water level rise), Lower Aquifer -0.5 (water level rise) to 4.0 feet (drawdown).

The potential for an increase in groundwater levels in the Upper Aquifer during the Project Scenario arises from both elimination of borehole flow from the Upper to the Lower Aquifer when the proposed well sleeve is installed and an increase in the localized infiltration of surface water runoff resulting from the project.

Overall, the modeling results indicate that pumping from the CESF well under the Project, Combined Projects and Construction Scenarios will have a less than significant affect beyond the property boundary on neighboring wells and groundwater levels in the basin. In addition, the water supplied to the proposed pumping well in each of the scenarios will not be drawn from great distances (for example, poor quality water from the Soda Lake area ten miles away). Therefore, pumping of the CESF well will not have a significant effect on water quality in the site vicinity or the basin.

SECTION 1 INTRODUCTION

URS Corporation Americas (URS) has prepared this report to serve as a summary of hydrologic and hydrogeologic information that has been presented to the California Energy Commission (CEC) and the public during the facility permitting process for the Carrizo Energy Solar Farm (CESF). The site is located on the Carrizo Plain, which is an unincorporated area of San Luis Obispo County near the towns of Simmler and California Valley, California. The location of the site is shown on the vicinity map provided as Figure 1-1.

This report was requested by the CEC during a public workshop held on March 12, 2008, and was submitted to CEC on June 26, 2008. Where applicable, responses to CEC Data Requests and public comments specific to water resources are included in this document. This report was revised on September 24, 2008 to address:

- CEC Data Request Set 3, dated July 25, 2008, Comment #105 through #111.
- CEC Data Request Set 4, dated August 29, 2008, Comment #122 through #125.
- Public comments during a data response workshop held on August 5, 2008 appearing in the transcript of that meeting.

On November 21, 2008, the CEC issued its Preliminary Staff Assessment (PSA). This report has been revised to address comments appearing in the Soil and Water Resources Section on page 4.9-1 of the PSA and public comments provided during and following a data response workshop held on December 15, 2008.

In order to meet the CEC's and public's request for a report summarizing hydrologic and hydrogeologic information for the site and vicinity, URS' services included:

- Conducting a survey of the site vicinity to identify the locations of water wells.
- Obtaining available well information from residents.
- Conducting an additional review of readily available data in support of our hydrogeological evaluation and reviewing well information that may be provided by the public.
- Completing a surface water hydrology study.
- Tabulating chemistry data available for the site vicinity for the Upper and Lower Aquifers, as available.
- Preparing a simple water budget (recharge/discharge) for the basin based on available information.
- Reevaluating the input parameters to the groundwater model to address CEC, public and PSA comments.
- Summarizing hydrological and hydrogeological data, the results of the model and water budget in this report.

1.1 PROJECT DESCRIPTION

URS understands that Carrizo Energy, LLC (Carrizo) is considering the site for future development as a solar-powered electrical generation station. We understand the project will consist of approximately 195 Compact Linear Fresnel reflector (CLFR) solar concentrating lines, and associated steam drums, steam turbine generators (STGs), air-cooled condensers (ACCs) and associated infrastructure producing up to a nominal 177 megawatt (MW) net. A new single-circuit 230 kiloVolt (kV) overhead transmission line will interconnect the facility with Pacific Gas & Electric's (PG&E's) existing Midway Substation by looping into the existing Morro Bay–Midway 230 kV line located north and adjacent to the CESF site.

The 640 acres (one square mile) required for the power plant footprint is planned to be located on one section of land (Section 28) north of State Route (SR) 58/Carrisa Highway. The solar arrays will cover the majority of Section 28 and the steam drums will be located across the solar field. Most of the other components, as well as a warehouse and workshops, water tanks, a switchyard and other equipment, will be located within the 'power block' at the north-central side of the Section. A portion of Section 33 immediately to the south will be used as a construction laydown area.

Site grading will be performed to create level pads for the equipment and reflectors (arrays) with cuts and fills across most of the site expected to be approximately 5 feet or less, with larger cuts and fills in isolated areas. Localized grading with minor cuts and fills may be performed in the construction laydown area.

Untreated raw water for the Project will be obtained from groundwater via an existing onsite well. The design of the Project minimizes use and maximizes the recovery of process water. Blowdown and oil/water separator (OWS) clear discharge are routed to the onsite raw water storage tank for reuse. Stormwater will be collected onsite and directed to swales and detention areas for percolation into the ground. The sanitary system will consist of a buried septic tank and sanitary leach field.

1.2 PROJECTED WATER USE

Groundwater will serve as a source of water during the construction and operation of the facility. Alternative water sources such as agricultural wastewater, recycled water and surface water runoff were evaluated in the Application for Certification (AFC) and were identified as not feasible. Due to the remote location of the site and sparse population in its vicinity, there is no infrastructure (wastewater treatment facilities) that could serve as a source of reclaimed water. Additionally, there are no sources of agricultural wastewater in the vicinity of the site. Although precipitation on the Carrizo Plain is reported to be approximately 7 to 10 inches per year, it is sporadic, infrequent and undependable. Infiltration of a portion of the stormwater that falls on the site will offset the makeup water requirement for the facility and also serve to recharge the Upper Aquifer that is used by the local community as a drinking water supply. CESF is committed to using groundwater from the Lower Aquifer for its water supply, which is of lesser quality compared to the Upper Aquifer. Projected water use during construction and operation is described in the sections below.

1.2.1 Construction

Water will be needed during the three-year construction phase of the project. Water will be used primarily for dust control, compaction during grading, and mixing concrete. It was previously estimated that the total volume of water used during construction would be less than the total estimated volume of water that will be used during the operation of the facility each year (20.8 acre-feet per year [afy]). In the PSA, CEC staff commented that this construction water use estimate appeared to be underestimated based on the amount of grading and dust control required. Subsequently, the construction water use estimates were reevaluated for the three year construction period. Table 1-1 includes the estimated construction water use for dust control, grading, and concrete hydration. A table providing calculation details is provided in Appendix A.

Table 1-1
CESF Construction Water Use Estimates

Construction Activity	Estimated Water Use (af)
A. Dust Control	68.7 (for full grading operations)
B. Grading Compaction	71.6 (grading during one year)
C. Concrete Hydration	11 (total over three years)
Total for Year 1	144 (89 gpm yearly average)
Total for Year 2	72 (45 gpm yearly average)
Total for Year 3	38 (24 gpm yearly average)

Notes:

1. These estimates reflect construction related water uses and no partial operations use during the three-year construction period. Potable drinking water is estimated at 0.23 afy, but is not included in the estimate totals because it is currently assumed that potable drinking water will be supplied through bottled water.
2. Year 1 total = Dust control for full grading (69 af) + Full Grading (72 af) + one-third concrete hydration (3.7 af).
3. Year 2 total = Dust control for full grading (69 af) + one-third concrete hydration (3.7 af).
4. Year 3 total = Dust control for partial grading (34.5 af) + one-third concrete hydration (3.7 af).

1.2.2 Operation

Groundwater will be used during operation of the facility for the following purposes:

- Makeup to the steam turbine system.
- Washing of solar system reflectors and collectors.
- Potable water: Potable water will be supplied from a potable water skid for use by plant personnel.
- Service Water: Untreated water will be required for general site uses.
- Fire protection.

Estimated water usage is summarized in Table 1-2 that also appears in the AFC, and the volume of process water used by the CESF is expected to be reasonably consistent. The expected average daily water consumption for the plant is approximately 18,500 gallons or 20.8 afy assuming a full operating load of 13 hours per day. The expected peak water consumption for the facility is approximately 51 gallons per minute (gpm) or 74,000 gallons per day (gpd). This is expected to occur one day per year to clean the air-cooled condensers; however, the condensers at a similar facility in Nevada have required cleaning only once in five years. This peak water consumption is included in the annual water consumption of 20.8 acre-feet (af).

On-site storage capacity is sufficient for two days of full load operation to accommodate maintenance on any of the water delivery and treatment equipment. However, in the event that the system is not operational, water will be transported temporarily to the site from off-site supply sources from surrounding areas, such as San Luis Obispo, Paso Robles, or Bakersfield. During such an event, approximately three tanker trucks per day would be sufficient to sustain operations assuming average daily usage of 18,500 gallons.

Potable Water Supply and Sanitary System Requirements

In the PSA, the CEC requested that the Applicant confirm the average annual and maximum daily potable water supply estimates. Carrizo Energy subsequently re-evaluated the potable water usage rates with the following assumptions and results. The potable water requirement of 5.3 gpm equates to approximately 100 gpd per person for 75 on-site workers during the operational phase. Estimates for average annual, average daily, and maximum daily are the same assuming workers have similar potable water needs each day. The average annual, average daily, and maximum daily water use differences (for not potable sources) apply to various assumptions on operating hours per day and per year. Updated assumptions and calculations for the sanitary waste water system using California Plumbing Code standards are provided in Appendix A. The California Plumbing Code (Table K-3) indicates an estimated demand of 35 gpd per person. This results in approximately 1,750 gpd of waste water using operation assumptions included in Appendix A, and would require a 2,500-gallon septic tank.

Table 1-2[1]
CESF Water Usage Rates

Water Use	Average Annual (gpm)[2]	Average Daily (gpm)[3]	Maximum Daily (gpm)[4]
Equipment Makeup Water Requirements			
Steam Cycle Makeup to DI Tank	27	27	50
Reflector Wash Water	5	7	13
ACC Wash Water	0.25	0.25	32
Media Filter Back Wash[5]	0.01	0.01	0.009
Misc. Drains, etc. to OWS	1.4	0.6	1
Potable Water[6]	5.3	5.3	5.3
Total Equipment Makeup Requirements	39	41	101
Recovered Water			
Steam Drum Flash Steam	3	3	6
Blowdown Flash Tank Condensate	24	24	44
Recovered from OWS (clear water)	1.4	0.6	1
NET RAW WATER REQUIREMENT	10.6	13	51

Notes:
1 Based on two units at rated steam flow.
2 "Average Annual" is based on 35 °C at 100 percent Load for 4,745 hours per year, reflector washing 250 days per year and ACC washing of all 50 cells, averaged over 8,760 hours.
3 "Average Daily" is based on 13 hours per day operation, averaged over 24 hours.
4 "Maximum Daily" is based on 13 hours per day, averaged over 13 hours, with ACC washing (10 cells over 10 hours).
5 Based on one 20-second back flush every eight days at 64.35 liters per flush.
6 Potable water includes water used for drinking, sanitation, and laboratory. Estimates are the same for average annual, average daily, and maximum daily during operations because it is assumed the same number of workers will be onsite each day consuming potable water.

1.3 WATER USE COMPARISONS

URS reviewed available water consumption data for other land uses to serve as a comparison to the water needs for the CESF. Some of these land uses are consistent with those that occur in the vicinity of the proposed site. The water uses included, residential, commercial, industrial, and agricultural for crops and livestock. Water use for other types of power generating facilities was also identified. These data appear in URS' "Responses to CEC Data Requests (#1-78)", dated February 26, 2008 (URS 2008) and have been supplemented with additional data that has become available. Water use for specific land use activities is provided below. The data were obtained through Internet sources and personal communications with experts in the agriculture and agronomy fields.

Tables 1-3 through 1-6 show the estimated volume of water that would be used on average annually, if the property were used for the other land uses described below. In almost all instances, the amount of water used by these other land uses is considerably greater than the anticipated water use for the operating facility (20.8 afy) on a per-acre basis.

1.3.1 Non-agricultural Land Uses

According to published information, the standard residential property in southern California uses on average, 0.52 afy. The water is approximately equally split between use for irrigation landscaping and other household water needs. Commercial/institutional facilities are reported on average to use 1.66 afy and industrial facilities average 3.2 afy for each acre. Average urban water use for the Fresno metropolitan area considering each of the above uses averages approximately 3.2 feet per acre.

Table 1-3
Water Use Comparisons for Non-agricultural Land Uses

Activity/Property Use	Water Use (afy)
Single-family Residential	0.52
Commercial/Institutional	1.66
Industrial	6.27
Urban	3.2

Note:
Integrated Water Resources Plan, MWD, Report No. 1107, March 1996. From Southern California Association of Governments and San Diego Association of Governments.

1.3.2 Agricultural Land Uses

1.3.2.1 Crops

Several sources of information were consulted to identify water use for areas with a similar climate, since the amount of water needed to sustain crops is dependent on evapotranspiration (ET). ET is the sum of the amount of water lost to evaporation from the soil and plant surfaces and that lost through plant transpiration. The data reported in Table 1-4 are for southern portions of the Central Valley, Imperial Valley and Arizona. Figure 1-2 is a graphical representation of agricultural water use for crops and livestock compared to the CESF on a per-acre basis and an area of equal size to the site (640 acres). Historically, the Carrizo Plain has been dry farmed to produce grain (wheat and barley), but some areas have been planted with grape vineyards and olive groves. Some cultivation of truck crops has occurred on a small scale on the Carrizo Plain. The previous owner had intended to plant truck crops on a portion of the section, including spinach, lettuce and carrots, but decided to forego these plans due to the 2006 E. Coli outbreak associated with spinach from the Salinas Valley that resulted in decreased demand (Pers. Comm.).

Table 1-4
Water Use Comparisons for Agricultural Uses

Activity/Property Use	Water Use (feet)	For 640 Acres (afy)
Alfalfa[a,e]	4.7 – 5.5	3,520
Cotton[a,e]	3.2 - 5.0	2,048 – 3,200
Barley[a]	1.3	832
Grapes[a]	2.9	1,856
Tomatoes[a,d]	3.9	2,496
Corn[a,d]	2.4	1,536
Deciduous Orchard[a]	3.5	2,240
Pasture (improved)[a]	4.5	2,880
Carrots[d]	5.4	3,467
Lettuce[d]	4.0	2,560
Spinach[d]	0.5 – 2.0	320 – 1,280
Dry Beans[d]	1.8	1,152
Olives (for oil)[d]	2.0	1,280
Olives (for eating)[d]	2.5	1,600
Dry Farming[e]	0.67	427
CESF	0.03	20.8

Notes:

[a] California Department of Water Resources, The California Water Plan Update, Bulletin 160-98. Value appearing for San Joaquin Valley unless noted.
[b] Mean based on information provided for California.
[c] “Power Plants in Arizona--an Emerging Industry, a New Water User”, http://ag.arizona.edu.
[d] www.vric.ucdavis.edu.
[e] Based on average annual precipitation.

1.3.2.2 Livestock

Much of the Carrizo Plain is open range used for cattle grazing that depends on the natural grasses for a food supply. The area does not include irrigated pastureland like areas of the Central Valley. Based on communication with Mr. Jim Oltjen, Professor in the Department of Animal Science at the University of California, Davis, full-grown cattle require on average roughly 20 gallons of drinking water on a daily basis. The amount of drinking water needed depends on daily average temperature. To calculate the total annual average drinking water needs for a single head of cattle, the average monthly temperatures were used for a weather station in Buttonwillow, California as shown in Table 1-4. Based on monthly average temperatures, this would be approximately 5,513 gallons (0.017 af) of drinking water per head of cattle for a year. If the number of cattle on the 640 acres were 100 head, the annual water consumption for the cattle would be approximately 1.7 afy. This does not include the water that evaporates from the water bodies that supply drinking water to the cattle.

Table 1-5
Cattle Drinking Water Requirements Based on Temperature
(for single head of cattle)

Month	Average Temperature (ºF)[a]	Daily Drinking Water Requirements (gallons)[b]	No. of Days	Monthly Drinking Water Requirements (gallons)
January	45	12.0	31	372.0
February	51	12.8	28	358.4
March	56	13.7	31	424.7
April	61	14.7	30	441.0
May	68	16.4	31	508.4
June	76	17.5	30	525.0
July	81	17.7	31	548.7
August	80	17.9	31	554.9
September	74	17.3	30	519.0
October	65	15.7	31	486.7
November	54	13.4	30	402.0
December	45	12.0	31	372.0
Total Annual Water (gallons per year)				5512.8
Total Annual Water (afy)				0.017
Total Annual Water (feet/year)[c]				0.42

Notes:
[a] Average monthly temperature for Buttonwillow, CA from http://countrystudies.us/united-states/weather.
[b] For single mature (lactating) cow, 900 pounds. From "Nutrient Requirements of Beef Cattle; Seventh Revised Edition: Update 2000", Board of Agriculture.
[c] Each head of cattle requires approximately 25 acres of open rangeland (Oltjen, J., Pers. Comm.) Assumes that there would be 25 head of cattle on the site (640 acres).

Drinking water for cattle is stored in stock ponds, shallow depressions and may be supplied by local springs. During the rainy season, the water in storage maybe partially derived from precipitation. At other times of the year, these ponds may be filled using groundwater. Evaporation from the water surface in these ponds in the arid environment of the Carrizo Plain would be expected to be 4 to 6 feet each year. As an example, a one-acre stockpond would lose approximately 4 to 6 afy to evaporation. This is roughly 25% of the water that will be used annually by the CESF facility.

1.3.3 Other Types of Power Generating Facilities

Conventional power generating facilities use large quantities of water for cooling. Many solar facilities do use water for cooling as these facilities are cheaper to construct compared to air-cooled facilities. Because the CESF designed to be air-cooled, the facility will use considerably less water per acre than a wet-cooled facility. An air-cooled facility uses about 40 times less water than a wet-cooled facility. When compared to the water used to generate a megawatt of power, the air-cooled solar facility will use the least amount of water compared to other types of power generating facilities, such as new hybrid types and those with flow through cooling, conventional cooling towers and conventional coal-fired plants.

Table 1-6
Water Use Comparisons for Other Power Generating Facilities

Power Generating Facility Type	Water Use (afy/MW)
CESF (Average Daily)	0.12
Ivanpah	0.25
Victorville 2 Hybrid	5.6
Solar, Parabolic Trough, Wet Cooling[a]	21.5 – 26.9
Solar, Parabolic Trough, Dry Cooling[a]	2.2
Former adjacent ARCO Facility[b]	30.9
Once Through Cooling[c]	8.1
Cooling Towers[c]	12.9
Conventional Coal-fired[d]	11.2
Stand-alone Steam[a]	20.2
Simple-cycle Gas Turbine[a]	4.0
Combined-cycle[a]	9.4
Combined-cycle, Dry Cooling[a]	3.0
Stand-alone Steam, Dry Cooling[a]	0.81

Notes:
a. National Renewable Energy Laboratory, Parabolic Trough FAQs, www.nrel.gov; .
b. Stewardship Council Land Conservation Plan, http://lcpstewardshipcouncil.org.
c. Freedman, P.L. and J.R. Wolfe, "Thermal Electric Power Plant Water Uses; Improvements Promote Sustainability and Increase Profits", LimnoTech, Canadian-U.S. Water Policy Workshop, October 2, 2007.
d. A 880-MW plant reportedly uses an average of 11 million gpd, of which 80% is lost to atmosphere as steam. www.deq.virginia.gov.

One acre-foot of water equals approximately 326,000 gallons.

1.4 HISTORICAL USES OF GROUNDWATER

The following information is based on a review of historical documents and anecdotal information provided by property owners on the plains. Agricultural development on the Carrizo Plain began prior to the turn of the 20th Century and many ranches conducted some degree of irrigated agriculture that was supported by the extraction of large volumes of groundwater. Current agricultural land uses primarily dry farming of wheat and barley and raising cattle and sheep. It is our understanding based on discussion with long-time residents that irrigation wells are typically pumped for a period of a few months to support the cultivation of spring hay.

Previous property owners grew wheat on Section 28 and wheat and barley were grown on Section 33. According to the previous property owner, in addition to the two current wells on site, one that served the residences at the ranch and an irrigation well, there were two other irrigation wells on the property that each produced approximately 1,000 to 1,200 gpm. Water from these irrigation wells was used to supply water for growing alfalfa, carrots and potatoes. One local resident indicates that potatoes were only grown on the property sometime in the 1930s. However, the irrigation wells experienced some caving, and required abandonment. It is our understanding in discussions with some long-time local residents that during the period of time when these wells pumped groundwater for the purposes of irrigation, no nearby residents experienced any difficulties associated with their wells (water quality, water level or well yields) except when the wells were pumped at the highest rates (1,000 to 1,200 gpm). This preceded the subdivision of land into 40-acre residential parcels that are currently supported by water wells penetrating the Upper Aquifer.

A long-time resident also indicated that 80 acres at the southeast corner of Section 28 was used historically for growing wheat, and approximately 0.5 feet of water was used annually. This would equal approximately 40 afy, which is approximately twice the volume of water that will be used by CESF. If it were assumed that this water (40 afy or 13 million gallons) was applied over a 6-month period, the estimated pumping rate that would be required would be approximately 50 gpm. This pumping rate is approximately four times the flowrate expected for the operating CESF facility. According to a long-time resident of the site vicinity, it is our understanding that when the site was used for growing wheat, there was no evidence that adjacent wells experienced any difficulties with low water levels, decreased flowrates/yields or water quality. The projected long-term water use for the CESF is similar to that used historically at the site, and based on this and other historical accounts, pumpage at these rates had no effect on neighboring wells. Therefore, the proposed project is not likely to have a significant effect on neighboring wells.

SECTION 2 SURFACE WATER HYDROLOGY

2.1 REGIONAL HYDROLOGY SETTING

2.1.1 Climate, Precipitation and Evapotranspiration

Unless otherwise noted, the following information was excerpted from “Groundwater in the Carrizo Plain”, an unpublished study by William J. Kemnitzer (1967). A copy of the Kemnitzer report is provided in Appendix B.

2.1.1.1 Climate and Precipitation

The climate of the Carrizo Plain has some of the features of a desert basin notwithstanding that it is a plain within the Coastal Ranges. This anomaly is because the uplifted plain is on the inland side of the Coastal Ranges near the southern end of the San Joaquin Valley and is flanked by moderately high mountains.

Rainfall over the Carrizo Plain and its watershed, although variable, averages a little more than 8 inches annually. Nearly all of the precipitation is in the form of rain which falls mostly during the months of December through February. However, isolated thundershowers sometimes occur during the summer. Snow rarely falls on the basin floor, but does rather frequently during the winter on the peaks of the adjoining mountains.

The DWR Bulletin 118 indicates that the average annual precipitation ranges from approximately 7 to 9 inches in the Carrizo Plain basin. The County provides access to active and historic rainfall data from other voluntary sources. Evaluation of this data indicates that the average annual precipitation in the vicinity of the CESF is closer to 10 inches. Most of the rainfall occurs from November through May with minimal rainfall during the summer months. The historic rainfall distribution for the closest (inactive) rainfall gauge to the CESF is provided in Table 2-1. The records from a nearby County gage, Simmler #71, are included in AFC Section 5.05 which has similar monthly averages as shown in Table 2-1. Additional County historic rainfall summary data is provided in Appendix C that confirms the historic average annual precipitation on the plain of approximately 10 inches.

During the winter, temperatures below freezing are common. During the summer months daytime temperatures are frequently in the 90°F range and are occasionally above 100 °F. Nights are usually cool even in the summer. The long dry summers provide an adequate growing season for most crops, but the relatively high altitude of the plain results in a shorter growing season, which limits the types of crops that can be cultivated. The time between frosts averages around 200 days.

Table 2-1
Historic Seasonal Rainfall

Month	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Yearly Total
Average	0.03	0.03	0.14	0.33	0.85	1.51	2.01	1.93	1.68	0.95	0.21	0.03	9.68
Maximum	0.52	0.63	2.07	1.76	3.06	4.90	8.62	7.21	5.10	4.60	1.44	0.34	22.30
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.88

Reference: San Luis Obispo County Public Works, Volunteer Precipitation Gauge Station, Monthly Precipitation Report.

Notes:
Station Name: Cavanaugh Ranch #78 (Inactive).
Station Location - Lat 35º21'30", Long 120º02'30", Water Years 1938/39 to 1981/82.

2.1.1.2 Evaporation

Because the Carrizo Plain basin is one of internal drainage (closed to surface water outflow), precipitation that does not infiltrate the soil accumulates in Soda Lake, a playa in the center of the basin. These surface waters typically evaporate before the end of the summer, leaving the lake bed dry during most of the year.

Evaporation discharge of groundwater may by divided into (a) vegetal discharge and (b) soil discharge. Vegetal discharge of groundwater occurs as a result of the physiological functioning of plants. The water may be taken into the roots of plants directly from the zone of saturation or from the capillary fringe, which in turn is supplied from the zone of saturation. It is discharged from the plants by a process of transpiration. Soil discharge of groundwater occurs through evaporation directly from the soil or rocks. Discharge of this kind can only take place where the water table is close to the surface.

The above evaporation discharges apply to groundwater only. In the Carrizo Plain basin, discharges must also include evaporation of surface waters, nearly all of which accumulate in Soda Lake and are prevented from any extensive downward percolation by the presence of a thick and largely impermeable mud and clay bottom (at Soda Lake). Most of the surface water in Soda Lake is evaporated before the end of the summer season. It is estimated that an average of nearly 45,000 af, or more than 25 percent of the total water falling upon the Carrizo Plain watershed annually, evaporates from this lake.

The losses through natural vegetal transpiration are comparatively small, but those through planted non-irrigated vegetal transpiration are large. Soil discharge of subsurface water is large due mainly to the arid conditions prevailing in the Carrizo Plain during most of the year. Together, vegetal and soil discharge is estimated to range from 46,000 to 72,000 afy, depending on the extent of non-irrigated crops.

2.1.2 Watershed Boundaries

The CESF is located within the Central Coast Hydrologic Region that covers approximately 11,300 square miles in central California including the Carrizo Plain. A map showing the Carrizo basin watershed is provided as Figure 2-1. The boundaries of the basin appearing on this map include the area considered in the hydrologic and hydrogeologic model included in this study. The Carrizo Plain is a semi-arid area dominated by flat topography with sloping, and rolling hills on its margins in the southeastern part of San Luis Obispo County, California. The alluvial floor of this topographic basin is approximately 54 miles long and 6 miles wide. It is elongated in a northwest-southeast direction between two coastal ranges, the Temblor Range on the east and the Caliente-San Juan Range on the west. Elevation of the basin floor averages about 2,200 feet above mean sea level (MSL). Elevation of the Temblor Range is approximately 3,000 feet and that of the Caliente-San Juan Range is about 4,000 feet, while the San Juan section of this latter range is considerably lower at about 2,500 feet.

The Carrizo Plain watershed, including the floor of the plain, covers approximately 414 square miles, or 263,680 acres based on watershed delineation using recent United States Geographic Survey (USGS) topographic maps of the area. Kemnitzer (1967) estimated the area of the watershed to be approximately 418 square miles.

The watershed areas that are tributary to and upstream of the site include three areas shown on Figure 2-2. Basin 1 (as shown on Figure 2-2) includes the main Carrizo Plain drainage channel (referred to as "Carriza Creek" in the PSA) that runs through the construction laydown area and is approximately 31.6 square miles. Basins 2 and 3 are directly tributary to the northerly site area and are approximately 3.9 and 4.3 square miles, respectively, for a total of 41.3 square miles including the solar field and construction laydown area. The total watershed area tributary to the north end of Soda Lake is approximately 152 square miles (see Figure 2-1). The site and construction laydown area occupy approximately one percent of the watershed tributary to the north end of Soda Lake.

2.2 SURFACE DRAINAGE AND HYDROLOGY

2.2.1 Pre-Construction Drainage Patterns

The project site currently consists primarily of disturbed farmland/ranchland. The Project site is generally flat, sloping gently to the southwest with elevations ranging from approximately 2,064 feet to 2,014 feet MSL. The portion of stormwater runoff that does not infiltrate into the ground moves via sheet flow and follows the terrain to the south and west, is tributary to the main Carrizo Plain ephemeral drainage channel ("Carriza Creek") that crosses through the southern portion of the construction laydown area, and then is tributary to Soda Lake over ten miles downstream. The Carrizo Plain drainage ("Carriza Creek") within the temporary construction staging area has been identified as a jurisdictional Waters of the United States (WUS). Carrizo Energy has received notice from the U.S. Army Corps of Engineers (ACOE) that it has initiated the Section 7 Consultation permitting process with the U.S. Fish and Wildlife Service.

Federal Emergency Management Agency (FEMA) Flood Insurance Rate Map (FIRM) Community Panel Numbers 0603040550B and 0603040575B (1982) show that the CESF and temporary construction laydown area are within FEMA designated 100-year 'Zone A' floodplain areas within Sections 28 and 33. As discussed in the project description, the CESF site is generally not subject to flooding; however, an area along Tracy Lane beginning approximately 174 meters (570 feet) onto Section 28 is within the 100-year flood zone. Additionally, the main Carrizo Plain drainage feature ("Carriza Creek") running through the southern portion of Section 33 within the temporary construction laydown area is within a FEMA designated 'Zone 'A' floodplain boundary. Base Flood Elevations (BFE) and hazard factors have not been determined for these areas. The BFE will be established during final engineering design if necessary for design purposes.

2.2.2 Post-Construction Drainage Patterns

Stormwater runoff on the CESF will be directed from the paved (*i.e.*, roads and parking lots) and non-paved areas to local collection swales and infiltration areas and allowed to percolate and evaporate. Area grading will be used to direct the runoff into a number of localized detention/infiltration areas located throughout the solar farm. Given its desert nature and the very limited rainfall that occurs on the Carrizo Plain, the majority of the water from this low intensity rainfall will be absorbed into the ground. The detention/infiltration basins are integrated with the solar farm equipment and throughout the solar field to collect excess rainwater that is not absorbed into the ground. The infiltration areas will be used to store and infiltrate the stormwater runoff. Infiltration BMPs will be used such that ponding of on-site runoff volume will not occur. The BMP will ensure that the runoff volume will infiltrate within 72 hours to limit the potential for increased mosquito production. Additionally, post-construction BMPs, such as hydroseeding and hydraulic mulch, or an equivalent, will be used to stabilize soils to control erosion for both the solar farm and construction laydown area.

Rain falling in the power block area will be collected and directed to the surrounding solar field using a system of swales integrated with the site grading plan. Rainfall from vehicle parking and paved areas in the power block will be collected and directed to an OWS prior to discharge to the raw water tank for recovery. Rainwater collected from active areas (*i.e.*, potentially contaminated by oil) is routed to an OWS. Following inspection, water from the OWS is sent to the wastewater tank and then to the water treatment system for recovery.

2.2.2.1 Perimeter Swales

In the existing condition, runoff generated up gradient of the site sheet flows across it, either infiltrating into the ground or sheet flowing across State Route 58 to the Carriza Creek downstream. The proposed swales will direct flows from the upstream off-site watershed around the site and convey the off-site runoff volume downstream to Soda Lake. The drainage swales will be constructed adjacent to the sides of Section 28. The swales will direct the runoff to SR 58. Ultimately, the runoff will flow across SR 58, confluence with the existing creek, traverse Section 33 and continue on its historical flow path in the southeasterly direction toward Soda Lake.

Upgradient flows that cannot be contained in the perimeter swales will sheet flow across the site (excluding the power block) and either infiltrate or sheet flow to the southwest corner as it does under the existing conditions. The perimeter swales are not designed to convey significant runoff from the multiple on-site detention/infiltration areas.

Based on the preliminary design of the swales, the total estimated swale volume is approximately 117 af. Slopes vary from approximately one percent to less than one-tenth of one percent. As designed, the capacity and velocity control provided by the perimeter swales provide the capability of channeling typical annual upgradient storm water around the site. The final swale design will facilitate the conveyance of up gradient surface storm water downstream to the creek either by sheet flow across State Route 58 or the installation of pipe culverts under State Route 58 to facilitate swale drainage.

Ultimately, the off-site runoff and any excess on-site runoff that is not infiltrated on site will be conveyed into "Carriza Creek". Excess flows will sheet flow across the site (with the exception of the power production area) and be captured in the onsite detention/infiltration areas.

2.2.2.2 "Carriza Creek" Crossings

Carrizo Energy has determined that the two proposed creek crossings are a necessary component of the project for it to be successfully completed and operated. Construction of the access road and two permanent crossings will serve as a turnaround onto SR 58 for large construction vehicles during construction of the CESF.

A hydraulic model, using the HEC-RAS program, was used to simulate potential changes in water surface elevation (WSEL) in the creek that could result from construction of the crossings. The analysis was based on available data from field photos and topographic maps. The assumed dimensions for the "Carriza Creek" channel were a 20-foot bottom width, side slopes varying from 2:1 to 4:1 and Manning's N Value of 0.035. Preliminary design suggests that three, 3-foot by 5-foot reinforced concrete boxes (RCBs) will be sufficient to convey the average annual runoff or the 2-year Design Storm from the "Carriza Creek" at each of the two crossings with little increase to the WSELs. The upstream crossing will be designed to ensure that no negative impacts will occur in the up gradient property adjacent to the construction laydown area.

This general analysis suggests that the greater flow rates will have little increase in WSEL resulting from construction of the two crossings. For final design, a detailed survey will be conducted to obtain final design-level data on "Carriza Creek" within the construction laydown area. It should be noted that the FEMA FIRM Panel 0603040575B, effective date July 5, 1982, has designated "Carriza Creek" as Zone 'A'. Zone 'A' is "the flood insurance rate zone that corresponds to the 1-percent annual chance floodplains that are determined in the Flood Insurance Study by approximate methods of analysis. Because detailed hydraulic analyses are not performed for such areas, no Base Flood Elevations or depths are shown within this zone..." A second HEC-RAS analysis will be conducted prior to final design in order to further refine the impacts analysis of the proposed crossings on the creek and neighboring properties. The design of these crossings is not finalized, but the final crossing design will be updated accordingly, based upon further detailed survey of "Carriza Creek" so that there will be no significant impacts on surrounding properties with respect to upstream sedimentation or downstream erosion.

The proposed location of the temporary fueling area within the construction laydown area has been relocated outside the area of the FEMA designated 100-year Zone 'A' floodplain and is now proposed to be located in its northeast corner, as shown on Figure 2-3. The permanent fueling facility on the power block (and all other facilities on the power block) will be elevated above the 100-year flood level.

Per the biological analysis, there are no vernal pools or vernal pool habitat areas on the project site or construction laydown area. Additionally, there are no wetlands associated with the jurisdictional WUS delineation. The jurisdictional WUS delineation area is not a wetland or vernal pool that relies on annual flows. Therefore, the proposed hydrology condition will not adversely affect this area from a biological standpoint.

2.2.3 Surface Water Hydrology Analysis

The following sections provide a basis and results for an analysis of total runoff and surface water infiltration for pre- and post-project scenarios, considering upgradient basins and Soda Lake. Calculations related to this analysis are provided in Appendix C. This section of the report has been revised to address CEC Data Request Sets 3 and 4, and the results of the on-site infiltration analysis have been included in the groundwater modeling conducted for the post-project scenario.

2.2.3.1 On-site Runoff Analysis

Two methods were used to evaluate on-site hydrology. These included the Rational Method and the Soil Conservation Service (SCS) Curve Number Method with HEC-HMS. The SCS Curve Number Method was used to provide realistic runoff flow volume and rates that account for antecedent moisture conditions, while the Rational Method was used for flood control infiltration basin sizing calculations.

The site is located in an unincorporated area of San Luis Obispo County, therefore, San Luis Obispo County hydrology and hydraulic standards were used for preliminary design of onsite stormwater facilities. San Luis Obispo County standards require the 100-year design for drainage areas greater than 4 square miles, the 50-year design storm for drainage areas from 1 to 4 square miles, and the 25-year design storm for drainage areas less than 1 square mile.

Based on the project design, some onsite rainfall may be captured in the terrace detention/infiltration areas and allowed to infiltrate and evaporate. The proposed site design includes detention/infiltration areas that will capture the generated stormwater runoff. The retention requirement for the County of San Luis Obispo is based on holding the 50-year storm, 10-hour intensity for 10-hour duration. Calculations were performed to verify that the multiple onsite detention/infiltration areas have adequate volume to store the stormwater runoff generated from a 50-year storm per San Luis Obispo County standards. Based on these calculations, all proposed onsite runoff up through the 50-year storm can be stored onsite without generating runoff to the perimeter swales. The Rational Method hydrology analysis was used to compute pre- and post-project runoff volumes and flow rates onsite. The following information summarizes the pre- and post-Rational Method hydrology runoff coefficients ('C' Values) used in the on-site Rational Method Analysis and includes the following:

- Total site area (including construction laydown area) = 1020 acres
- Percentage impervious area before construction <1%
- Runoff coefficient before construction = 0.38
- Percentage impervious area after construction* <5%
- Runoff coefficient after construction = 0.40

* Percentage impervious conservatively assumes entire power block, access road, and parking areas are impervious. Areas under the reflectors are pervious.

Table 2-2a presents the results of the on-site Rational Method runoff flow rate calculations. This table was prepared in response to CEC Data Request 39.

Table 2-2a
On-site Stormwater Runoff Flows Using Rational Method

Storm Event (yr)	Intensity (in/hr)	Total Existing Onsite Flows* (cfs)	Total Proposed Onsite Flows* (cfs)
2	0.50	122	128
5	0.70	170	179
10	0.80	195	205
25	1.00	243	256
50	1.10	268	282
100	1.20	292	307

Notes:
* These runoff values are based on the Rational Method and are conservative estimates of flow for comparison purposes.
yr = year
in/hr = inches per hour
cfs = cubic feet per second

The SCS (now called the Natural Resources Conservation Service [NRCS]) hydrologic method requires basic data similar to the Rational Method: drainage area, a “runoff curve number” (CN) describing the proportion of rainfall that runs off, time to peak, the elapsed time from the beginning of unit effective rainfall to the peak flow for the point of concentration, and total precipitation (P). This approach considers the time distribution of the rainfall, the initial rainfall losses to interception and depression storage, and an infiltration rate that decreases during the course of a storm event. The SCS hydrologic method is typically used for study areas approximately 1 square mile or greater.

The SCS unit hydrograph method was originally developed from observed data collected in small, agricultural watersheds. The hydrograph of storm runoff from a drainage area is also based in part on the physical characteristics of the watershed. The principal physical watershed characteristics affecting the relationship between rainfall and runoff are land use, land treatment, soil types, and land slope. The SCS method uses a combination of soil conditions and land uses (ground cover) and land treatment (generally agricultural practices) to assign a runoff factor to an area. The runoff factors, or CNs, indicate the runoff potential of an area. The runoff potential increases with increasing value of CN. The CN does not account for land slope; however, watershed lag time accounts for land slope in the SCS Method. In general, the CN assumed for the analysis for this site was 85, based on Hydrologic Soil Group Type “C”. The Initial Abstraction Rate for the pre-project condition, based on a CN of 85, is 0.35. The Initial Abstraction Rate for the post-project condition, based on a CN of 91, is 0.20. The 2- through 100-year storm event rainfall depths were obtained from the National Oceanic and Atmospheric Administration (NOAA) isopluvial map for the southern half of California. Use of the NOAA isopluvial map to estimate these data are more representative of basinwide conditions as compared to using rainfall data from nearby rain gauges. The results of the on-site analysis using the SCS Method are summarized in Table 2-2b.

Table 2-2b
On-site Stormwater Runoff Flows Using HEC-HMS (SCS Curve Number Method)

Location	Basin Area (square miles)	2-year Storm (cfs)	5-year Storm (cfs)	10-year Storm (cfs)	25-year Storm (cfs)	50-year Storm (cfs)	100-year Storm (cfs)
Basin 4 (Site)	1.6	63	78	121	167	265	316
Basin 4 (Site) Post-Project	1.6	105	124	175	227	334	388

Based on the results appearing in Tables 2-2a and 2-2b, the flow rates estimated for the pre- and post-project using both methods are relatively similar for the 100-year event. The amount of potential stormwater volume generated onsite was also evaluated on an average annual basis. Under existing conditions, approximately 316 afy of stormwater could be generated on the 1,024-acre project site, including the construction laydown area. The site would generate approximately 388 af of stormwater annually for the post-project scenario; however, there would be no surface runoff from the site under normal conditions.

2.2.3.2 Off-site Runoff Analysis

The off-site hydrology calculations were performed initially using USGS Regression Equations to quantify runoff generated from off-site, upstream watersheds. In Data Request Set 4, the CEC requested that the SCS Curve Number method be used to provide runoff estimates. A description of the method and its input parameters for this site are provided in the previous section. The results of that analysis were used in the HEC-HMS hydrology model to estimate the volume of runoff generated from the upgradient, off-site watershed areas.

The total watershed including the project site and construction laydown area comprises approximately 41.3 square miles of predominantly agricultural and undeveloped land. Of the 41.3 square miles, 31.6 square miles are tributary to the western boundary of the construction laydown area. Table 2-3 updates the table that previously presented in response to CEC Data Request 38. This includes more refined basin area delineations, the watershed basin downstream of the project to Soda Lake, as well as the entire Soda Lake watershed basin.

This analysis evaluated the 6- and 24-hour storm duration in order to estimate the range of potential runoff from individual storm events. Table 2-3 provides the anticipated pre- and post-project surface runoff flow rates for a 6-hour storm event at the following three locations within the watershed: project construction laydown area; north end of Soda Lake; and entire Soda Lake watershed. Table 2-4 provides the anticipated pre- and post-project runoff flow rates for a 24-hour storm event for the same watershed locations.

The watershed boundary tributary to the north end of Soda Lake is approximately 152 square miles, whereas the total Soda Lake Watershed is approximately 414 square miles as shown on Figures 2-1 and 2-2. The surface water runoff rate reduction due to infiltration in the solar field area is minimal in comparison to the overall watershed surface water runoff rates, and therefore, significant impacts to water resources downstream of the project and in the regional area are not anticipated for 6-hour and 24-hour storm events, as indicated in Tables 2-3 and 2-4. There will be no significant change in the volume of post-construction runoff to Soda Lake.

Table 2-3
Pre- and Post-Project Off-site Flow Rates (6-Hour Duration), HEC-HMS Model Results for the SCS Curve Number Method

Location	Basin Area (square miles)	2-year Storm (cfs)	5-year Storm (cfs)	10-year Storm (cfs)	25-year Storm (cfs)	50-year Storm (cfs)	100-year Storm (cfs)
Basin 1	31.6	109	243	322	406	495	734
Basin 2	3.9	23	51	68	86	105	156
Basin 3	4.3	27	61	82	104	127	190
Basin 4 (Site)	1.6	14	35	48	63	78	121
Basin 4 (Site) Post-Project	1.6	35	68	86	105	124	175
Pre-project Total at the Site	41.3	139	311	412	520	634	939
Post-project Total at the Site	40.3	136	303	402	507	618	916
Pre-project Total at North End of Soda Lake	152	365	820	1086	1372	1673	2480
Post-project Total at North End of Soda Lake	151	363	815	1079	1363	1662	2464
Pre-project Total Soda Lake Watershed	414	1183	2653	3513	4436	5410	8019
Post-project Total Soda Lake Watershed	413	1180	2647	3505	4425	5397	8000

Notes:
1. Post-project total basin area does not include the approximately 0.6-square mile construction laydown area because that area is not part of the permanent solar field.
2. The runoff pre- and post-project runoff flow rates presented in the table assume that all rainfall on the site will be detained and infiltrated onsite.

Table 2-4
Pre- and Post-project Off-site Flow Rates (24-Hour Duration), HEC-HMS Model Results for the SCS Curve Number Method

Location	Basin Area (square miles)	2-year Storm (cfs)	5-year Storm (cfs)	10-year Storm (cfs)	25-year Storm (cfs)	50-year Storm (cfs)	100-year Storm (cfs)
Basin 1	31.6	406	495	734	989	1529	1810
Basin 2	3.9	86	105	156	211	327	388
Basin 3	4.3	104	127	190	258	403	478
Basin 4 (Site)	1.6	63	78	121	167	265	316
Basin 4 (Site) Post-project	1.6	105	124	175	227	334	388
Pre-project Total at the Site	41.3	520	634	939	1266	1958	2317
Post-project Total at the Site	40.3	507	618	916	1235	1911	2261
Pre-project Total at North End of Soda Lake	152	1372	1673	2480	3343	5172	6121
Post-project Total at North End of Soda Lake	151	1363	1662	2464	3321	5138	6081
Pre-project Total Soda Lake Watershed	414	4436	5410	8019	10809	16727	19798
Post-project Total Soda Lake Watershed	413	4425	5397	8000	10783	16687	19750

Notes:
1. Post-project total basin area does not include the approximately 0.6-square mile construction laydown area, because that area is not part of the permanent solar field.
2. The runoff pre- and post-project runoff flow rates presented in the table assume that all rainfall on the site will be detained and infiltrated onsite.

2.2.3.3 Runoff Volume Analysis

The CEC previously requested the total runoff that could be captured by the perimeter swales. The swale volumes were provided in the September 24, 2008 version of the report. However, the primary purpose of the perimeter swales is to convey off-site runoff around the site and ultimately to Soda Lake. There is no intention for the project to capture surface water runoff within the perimeter swales. In addition, in response to comments appearing in the PSA, the project will be designed to either grade the swales back to natural grade near SR 58 to allow for natural conditions, or install pipe culverts beneath SR 58 to facilitate drainage to "Carriza Creek". Therefore, the perimeter swale capture volume analysis was removed from the report as it no longer applies to the proposed swale condition (no detention).

Three off-site areas and the site were considered in the 100-year, 24-hour runoff volume analysis summarized in Table 2-5. These included the off-site areas west, north and east of the site and also the project site.

Table 2-5
Annual Off-site Runoff Volumes,
HEC-HMS Model Results for the SCS Curve Number Method

Location	Area (sq. mi.)	Volume (af)	Project Boundary
Basin 1	31.6	4,902	West
Basin 2	3.9	605	North
Basin 3	4.3	667	East
Project Site (post-project)	1.6	299	East
TOTAL	- -	6,473	- -

Note:
Project site area includes both the 1.0 sq. mi. permanent operations area and the 0.6 sq. mi. temporary construction staging area (to be restored after construction). Volume for the permanent project site area is approximately 187 af.

The pre- and post-project annual runoff volumes for the site and Soda Lake are summarized in Table 2-6.

Table 2-6
Pre- and Post-project Annual
Project Site and Soda Lake Runoff Volumes

Location	10 Inches Annual Rainfall	
	Pre-project Annual Runoff Volume (afy)	Post-project Annual Runoff Volume (afy)
Project Site	6,473	6,286
Entering Soda Lake	23,584	23,429

The total tributary area to the jurisdictional WUS within the construction laydown area is approximately 41.3 square miles. The associated total potential runoff flow volume is approximately 6,473 afy, assuming 10 inches annual rainfall. This is a conservative flow volume that does not consider storage and infiltration areas within the watershed upstream of the construction laydown area. Under the proposed condition, the onsite average annual rainfall will be collected and infiltrated/evaporated onsite, and the existing upstream flows will be routed around the site and flow to the jurisdictional WUS. Under the proposed annual average condition, there will be a reduction in tributary area from 41.3 square miles to 40.3 square miles (a 2 percent decrease). Total runoff volume tributary to the WUS under this proposed condition, would be approximately 6,286 afy, a reduction of 187 afy (annual onsite project runoff volume from 1.0 square miles).

A similar volume analysis for the watershed downstream of the project to Soda Lake indicates similar results in terms of surface water volume reduction due to infiltration and evaporation of annual rainfall onsite. The total tributary area to the north end of Soda Lake is approximately 152 square miles, resulting in pre-project potential surface stormwater volume of approximately 23,584 afy. The corresponding post-project volume is approximately 23,429 afy. Therefore, the reduction in the overall potential annual surface water flow volume is approximately 1 percent. Therefore, no significant impacts to water resources, dependent upon annual surface water flow volumes, are anticipated downstream of the site.

2.2.3.4 On-site Infiltration Analysis

An infiltration analysis was conducted for the site using HEC-HMS to estimate infiltration to the Upper Aquifer from rainfall on the CESF project site (both on-site and perimeter drainage swales) for pre- and post-project scenarios. Daily rainfall data from a nearby rainfall gage served as the basis for the rainfall, evapotranspiration, and infiltration calculations. The goal of the analysis was to provide an estimate of the annual average infiltration onsite as a result of rainfall, evapotranspiration, and runoff processes.

In order to approximate the infiltration rate for the project area, daily rainfall data was used from the San Luis Obispo County Simmler Rain Gage #71, located approximately 3 miles southeast of the center of the proposed site (Lat: 35° 21’ 06” Long: 119° 59’ 51”). The continuous daily rainfall records are available for this gage since the 1930s (see Appendix C) and the analysis used data for the period from 1981/1982 to 1993/1994 (12 years). Maximum and minimum yearly rainfall ranged from 4.7 to 17.0 inches, with an average annual rainfall of 10 inches. The annual average rainfall amount of 10.1 inches was calculated based on twelve years of continuous daily rainfall data, which are comparable to the precipitation data provided in Table 2-1.

The CEC requested that the project evaluate the infiltration condition using the SCS Curve Number Method. Soil types and land use in the area were evaluated using existing soil maps, topographic maps and aerial photos to establish the average runoff CN for the area. Two antecedent soil moisture conditions were analyzed. A dry antecedent soil moisture condition (AMC I) and an average antecedent soil moisture condition (AMC II) were used in the analysis to provide a range of potential infiltration values based on different soil moisture conditions preceding rainfall. The CNs allow calculation of the Initial Soil Abstraction, or the amount of rainfall that is absorbed by the ground prior to runoff. AMC I and AMC II conditions result in CNs of 70 and 85, respectively, and Initial Abstraction Values of 0.85 and 0.35 inches, respectively.

The initial abstraction consists of interception, surface detention, evaporation, and infiltration. The water held by interception, surface detention, and the infiltration at the beginning of a storm returns to the atmosphere through evaporation. The higher the amount of initial abstraction, the lower the runoff will be for a given rainfall amount in a watershed. Thus, the initial abstraction reduces the runoff potential of the watershed and the CN.

ET rates were based on California Irrigation Management Information System (CIMIS) Reference Evapo-transpiration Map (Zone 10). The CIMIS map provides a table indicating maximum potential ET rates per month for various areas throughout California. The ET rates are maximum potential rates assuming available water supply. In this case, water supply is available only after storm events, so the ET amounts were prorated based on the number of days of rainfall per month.

Calculation of potential infiltration into the Upper Aquifer is based on the following assumptions:

- Rainfall – initial abstraction = runoff
- Initial abstraction – evapotranspiration = actual infiltration

The water balance for the daily values were calculated in spreadsheets and averaged for each year to determine the average yearly rainfall, runoff, and infiltration values for the project site (in inches). The values were converted to afy by multiplying the various values in inches by the total site area. Calculations are included in Appendix C.

The CEC requested an evaluation of the potential infiltration into the proposed perimeter swales. The perimeter swales are designed to function first as flood control facilities to route upstream, off-site stormwater around the site and convey the water downstream. The perimeter swales, as currently designed, would be unlined, graded and compacted. The total estimated swale volume is approximately 117 af. However, it is not currently anticipated that the swales will function as infiltration areas, but primarily as stormwater conveyance facilities.

Potential infiltration within the swales was calculated based on the swale dimensions (the capacity appearing in Section 2.2.3.3) and assumed saturated infiltration rate (clay soils with Hydrologic Soil Group D and saturated infiltration rate of 0.05 inch/hour) assuming a total of 5 days (120 hours) of infiltration time. This results in approximately 7.3 af of groundwater recharge, assuming that ET in the swales is negligible due to the short residence time of the water.

For the post-project scenario, the site will also be terraced with multiple infiltration areas onsite that should provide increased opportunity for recharge to the Upper Aquifer. In addition, the constructed site will have reduced plant transpiration and ET compared to the pre-project scenario resulting from increased shading from the mirrors. Based on the geometry of the solar field and mirror layout, the initial abstraction and ET rates for the post-project scenario were reduced by 70% to account for the changes.

Results of the analysis assuming average antecedent moisture conditions (AMC II) indicated the following infiltration values for the site and the perimeter swales:

- Existing Onsite Infiltration = 144 afy
- Proposed Onsite Infiltration (without perimeter swales) = 230 afy

The anticipated infiltration rates for the site for the post-project scenario is over ten times greater than the estimated groundwater use for the CESF of 20.8 afy.

SECTION 3 HYDROGEOLOGY

There has been only one comprehensive, basin-wide evaluation of groundwater that was conducted on the Carrizo Plain by William J. Kemnitzer in 1967. This unpublished document serves as the basis for the regional hydrogeologic setting for the site vicinity. Other studies have been conducted by Jon Cooper specific to the area surrounding California Valley (Cooper 1990). Some information of a hydrogeologic nature performed by Mr. Cooper was provided by Mr. Kenny Tab of California Valley and has been included in our evaluation of hydrogeology and is provided in Appendix D. Another source of hydrogeologic information was a letter report prepared by Bechtel Civil & Minerals, Inc. (Bechtel) to evaluate water quality and availability for the Atlantic Richfield Corporation (ARCO) Carrizo Plain Solar Project that was located on the northwest corner of the adjacent section immediately to the east of the project site. At the time of the preparation of the AFC, this was the most informative document regarding local aquifer characteristics near the site. Appendix K from the AFC includes these reports and this information is provided in Appendix E of this document. URS has supplemented this information with the results of a well survey for an area within approximately 3 miles of the site. The CEC requested URS to conduct a 2-mile radius search for well information at the March 12, 2008 Public Workshop.

3.1 GEOLOGIC AND HYDROGEOLOGIC SETTING

Many studies have been done regarding the geology of the Carrizo Plain. The primary geologic sources of published information used for this report include the USGS, the California Geological Survey (CGS) (formerly California Division of Mines and Geology, CGMG) and the United States Department of Agriculture (USDA), Much of the geologic information in this region is based on geologic mapping performed by Tom Dibblee, Jr. The geology described herein appears in Dibblee, Jr. (1962). Specific references include: “Regional Geologic Map of San Andreas and related faults in Carrizo Plain, Temblor, Caliente, La Panza Ranges, and vicinity, California: A Digital Database” (USGS 1999); and the “Soil Survey of San Luis Obispo County, California, Carrizo Plain Area” (USDA 2003). URS also performed a preliminary geotechnical investigation. The results were presented in a report titled, “Preliminary Geotechnical Investigation, CESF, San Luis Obispo County, California,” dated October 1, 2007 (final). The stratigraphy and structure presented below is rather elementary to set the framework for the hydrogeology that appears in this report. Some of this information was provided in the AFC for the subject project.

A regional geologic map is presented on Figure 3-1 and the associated legend is included as Figure 3-2 (Dibblee, Jr. 1999). As shown on the map, the San Andreas Fault dominates the geology in the Carrizo Plain and significantly affects the movement of groundwater in the Carrizo Plain basin. It forms the northeast boundary of the Carrizo Plain, passing through the foothills of the Temblor Range. The San Juan, Big Spring, and Morales faults pass through the hills to the west and southwest of the plain. Faulting has caused deformation and uplift of the hills, which have been subsequently eroded.

A stratigraphic column showing the geologic units of the Carrizo Plain is provided in Appendix E. The majority of the Temblor and Caliente Ranges are composed of Miocene-age sedimentary rocks consisting of sandstone, shale, conglomerate, and siltstone that have been folded. These materials were originally deposited in marine and non-marine environments. These Tertiary-age sedimentary rocks and Cretaceous-age strata overlie a granitic complex of Mesozoic age. Similarly, fault movements, uplift, folding and erosion of these formations has resulted in a complicated stratigraphic sequence.

The primary aquifers in the Carrizo Plain are found in alluvium, the Paso Robles and Morales Formations. Each water-bearing stratigraphic unit is described below.

Alluvium: Quaternary-age alluvium blankets the Carrizo Plain. It is up to several hundred feet thick, and is thickest at Soda Lake. The upper Pleistocene- to Holocene-age alluvium consists of unconsolidated to loosely consolidated sands, gravels, and silts with a few beds of compacted clays. The alluvium is highly variable in composition, and based on the preliminary geotechnical investigation conducted by URS; these sediments consist primarily of clay and clayey sand to a depth of approximately 100 feet at the site.

Paso Robles Formation: The alluvium is underlain by the Paso Robles Formation, which outcrops in the hills along the northeast side of the plain. The Paso Robles Formation is a Pleistocene-age alluvial deposit and is about 3,000 feet thick near the San Andreas Fault (USDA 2003). It consists of poorly sorted, mostly loosely consolidated gravels, sands, and silts. Both the younger alluvium and the Paso Robles Formation are derived from material eroded off the surrounding mountains. According to Kemnitzer (1967), the western portion of the basin where the formation is thinnest, appears to have the best well yields based on well log information. The lower portion of the Paso Robles Formation is fine-grained and serves as an aquitard and barrier to the mixing of fresh water with poorer quality water that may be present at depth below this formation.

Morales Formation: The Paso Robles Formation unconformably overlies the Morales Formation. The upper Pliocene-age Morales Formation consists of sands, gravels, and silts, which are generally more stratified and compacted than those in the overlying Paso Robles. The Morales Formation ranges in thickness from just a few feet to more than 3,000 feet. The Morales is conformable with the underlying Miocene-age strata.

Kemnitzer (1967) described that there are two water bodies beneath the Carrizo Plain based on their quality. The groundwater with the poorest quality lies in the sediments immediately beneath Soda Lake. Kemnitzer (1967) referred to this aquifer as the Soda Lake. Soda Lake is the sink for this closed basin and repeated evaporation of surface inflows results in increased salinity of the groundwater in this area. These lacustrine sediments consist primarily of clay. As such, these highly saline waters present in the sediments beneath Soda Lake are hydraulically separated from better water quality at depth. Kemnitzer (1967) referred to this water body at depth the Carrizo (aquifer). The water quality of the Carrizo is probably best at the margins of the basin and further away from Soda Lake.

3.2 GROUNDWATER SUPPLY

Groundwater supply in the site vicinity is generally produced from two zones, an upper zone that is generally less than 300 feet and a lower zone that exists at the site at a depth of approximately 450 to 600 feet below the ground surface. These are referred to as the Upper and Lower Aquifers, respectively, in this document. There are water-bearing strata below these zones, as described in Section 3.6. This naming convention should not be construed to indicate that there are no aquifers below what is being described as the Lower Aquifer. It should be noted, some wells also produce groundwater in an interval from 100 to 200 feet bgs.

3.2.1 Upper Aquifer

Based on a review of limited well information, potable water supplied to most residences and ranches for domestic use is derived from shallow wells typically within a depth of about 175 feet bgs. Kemnitzer (1967) refers to these wells as "Household and Livestock Wells". In 1967, he identified 89 wells penetrating the Upper Aquifer. No well yields were reported for these wells, however, based on a well survey conducted by URS in March 2008; these shallow wells penetrating the Upper Aquifer probably yield from a few gpm up to 40 gpm. There is much lateral variability in the grain-size of strata as evidenced by URS' geotechnical investigation. Much of the strata consist of clay and sandy clay with thin layers of sand. It is these thin sand layers that are responsible for the well yields. Problems with water availability have been noted by some residents. Many parcels have been subdivided into 40-acre parcels for residential use that derive water supply from this zone, thereby increasing demand. Because the permeable zones are relatively thin, additional pumping from the Upper Aquifer can result in lower water levels and decreasing well yields.

In the water budget of Kemnitzer (1967) for the basin, he assumed an average annual production from each of the 89 household and livestock wells to be approximately 6 afy. With continuous pumping, the average well yield for these wells would be approximately 4 gpm.

3.2.2 Lower Aquifer

The Lower Aquifer from which groundwater is derived for use by residents of the plains is typically present at a depth of greater than 450 feet. According to Kemnitzer (1967), these wells typically yield on the order of 500 to 1,100 gpm. He identified 11 irrigation wells in 1967 and of these; it appears that six were generally greater than 300 feet deep. It is from this zone that the CESF would derive its water supply. He also identified three community wells. One was drilled into this Lower Aquifer. The other two were located in California Valley, with depths of 1,019 and 1,865. No data on well yields for the community wells are noted by Kemnitzer (1967).

3.3 WELL SURVEY

3.3.1 Methods

URS personnel conducted a land use survey in March 2008 that included identifying the location of water wells within approximately 3 miles of the proposed site. The locations of wells were identified using a portable Global Positioning System (GPS) unit and marked on a field map. URS personnel visited residents to identify the characteristics of their wells. Many residents were not at home when URS personnel visited. Residents were asked of their knowledge regarding well depth, screen intervals and pumping rates for the wells on their property. It should be noted that although a well may have been identified during the survey, it is possible that it may no longer be operating. Some additional information was obtained following the August 5, 2008 workshop from residents regarding well location, construction, approximate yield and current operation. The information collected during the well survey and that obtained after the August 5, 2008 workshop was considered to evaluate the effects groundwater pumping related to this project will have on the surrounding area and the groundwater basin through groundwater modeling.

URS also made a well data request to the California Department of Water Resources (DWR) through completion of a Well Completion Report Release Agreement for an Agency Study under California Water Code Section 13752. Our request was denied because URS is not an agent for an Agency, in this case the CEC. No additional data were released to URS by the DWR.

3.3.2 Results

The locations of wells identified during the survey are shown on Figure 3-3. A limited set of data was obtained from the residents concerning well construction and yield information which has been included in Table 3-1. This includes wells identified on USGS topographic quadrangle maps for the site vicinity. These wells are shown with a number following the well symbol on Figure 3-3. It should be noted that although a well may have been identified during the survey, a local resident indicated after the August 5, 2008 workshop that some no longer operate. For example, Well G1 shown on the site has been abandoned. This information is noted in Table 3-1 and on Figure 3-3.

As a result of the survey and other data sources, 86 wells have been identified. Based on the information provided by residents, the wells that generally penetrate the uppermost zone to 100 to 200 feet below ground surface (bgs) have well yields ranging from 8 to 20 gpm. During one of the public hearings, one nearby resident to the proposed site indicated that his well that penetrates the Upper Aquifer has a well yield of approximately 12 gpm (M. Strobridge, April 14, 2008 Public Hearing). Some of the wells are screened through this interval to a depth of 200 to 300 feet. These wells appear to yield 40 to 150 gpm. The wells with higher yields appear to be used for irrigation. Of the limited information provided by residents, none of the wells appeared to be screened at a depth of 450 to 600 feet similar to the proposed pumping well at the CESF site. As indicated above, Kemnitzer (1967) identified six wells that penetrate to depths ranging from 300 to 700 feet bgs. These data served as a basis for the assumptions used in the groundwater model included in this study.

Table 3-1
Summary of Available Well Completion Data

Township, T##S	Range, R##E	Section	Quarter/ Other Indicator	Zone	Northing	Easting	Approx. Depth to Water (feet)	Approx. Well Depth (feet)	Depth of Screen Interval (feet - feet)	Approx. Pumping Rate (gpm)
Well Survey Data										
---	---	---	---	10S	766991	3917437	20	300	100-300	100-150
---	---	---	---	10S	765654	3918034	---	250	---	40
---	---	---	---	10S	764165	3918391	30	250	---	30
---	---	---	---	10S	764002	3920573	20	250	100-250	40
---	---	---	---	10S	763990	3920704	20	200	100-200	40
---	---	---	---	10S	763990	3920704	20	200	100-200	40
---	---	---	---	10S	764775	3920692	20	140	20-100	25

Table 3-1
Summary of Available Well Completion Data
(Continued)

Township, T##S	Range, R##E	Section	Quarter/ Other Indicator	Zone	Northing	Easting	Approx. Depth to Water (feet)	Approx. Well Depth (feet)	Depth of Screen Interval (feet - feet)	Approx. Pumping Rate (gpm)
---	---	---	---	10S	772383	3912938	15	600	100-600	100
---	---	---	---	10S	772346	3912871	15	600	100-600	100
---	---	---	---	10S	227726	3914824	18	120	100-120	20
---	---	---	---	10S	227726	3914824	18	120	100-120	20
---	---	---	---	10S	227726	3914824	18	120	100-120	25
---	---	---	---	10S	227391	3915931	20	150	80-150	20
---	---	---	---	10S	228532	3915275	20	160	100-160	8
---	---	---	---	10S	228532	3915275	20	80(?)	UNK	8
Other Available Well Completion Data										
29	17	25	---	---	---	---	155	263	180 - 260	15
29	17	25	---	---	---	---	177	300	140 - 300	10
29	18	16	---	---	---	---	37	150	55 - 151	UNK
29	18	18	---	---	---	---	18	150	72 - 150	UNK
29	18	28	---	---	---	---	30	630	75 - 630	500
29	18	29	---	---	---	---	10	610	100 - 360	300
29	18	29	---	---	---	---	15	260	115 - 255	150
29	18	29	---	---	---	---	20	250	130 - 250	150
29	18	29	---	---	---	---	15	340	40 - 300	300
29	18	30	---	---	---	---	30	263	100 - 260	150
29	18	30	Lot1	---	---	---	60	200	40 - 195	50
29	18	30	Lot2	---	---	---	40	180	60 - 180	75
29	18	30	Lot3	---	---	---	40	175	55 - 175	75
29	18	30	Lot4	---	---	---	55	160	40 - 160	50
29	18	33	---	---	---	---	44	103	43 - 103	UNK
29	18	34	---	---	---	---	UNK	460	155 - 380	UNK
29	18	34	---	---	---	---	15	102	42 - 102	UNK
29	18	34	NE1/4	---	---	---	40	204	66 - 204	UNK
29	18	35	---	---	---	---	15	160	60 - 160	200
29	19	19	NE1/4	---	---	---	26	101	30 - 102	UNK

Table 3-1
Summary of Available Well Completion Data
(Continued)

Township, T##S	Range, R##E	Section	Quarter/ Other Indicator	Zone	Northing	Easting	Approx. Depth to Water (feet)	Approx. Well Depth (feet)	Depth of Screen Interval (feet - feet)	Approx. Pumping Rate (gpm)
29	19	19	W	---	---	---	18	58	18 - 58	UNK
29	19	21	SW1/4	---	---	---	22	98	38 - 98	UNK
29	19	27	NE1/4	---	---	---	36	126	0 - 126	UNK
30	18	1	N	---	---	---	42	106	50 - 102	20
30	18	1	---	---	---	---	75	140	70 - 130	UNK
30	18	1	N	---	---	---	38	150	40 - 141	30
30	18	10	---	---	---	---	15	160	20 - 160	70
30	18	11	---	---	---	---	63	111	63 - 111	UNK
30	18	12	---	---	---	---	UNK	520	100 - 520	UNK
30	18	13	---	---	---	---	55	170	110 - 170	30
30	18	13	---	---	---	---	30	160	60 - 160	UNK
30	18	14	---	---	---	---	18	285	95 - 275	100
30	18	17	---	---	---	---	38	300	60 - 275	70
30	18	24	---	---	---	---	35	100	50 - 100	UNK

Notes:
Wells identified during the survey with well data are shown in yellow on Figure 3-3.
UNK: Unknown

3.4 AVAILABLE WELL INFORMATION

Publicly available well information for the Carrizo Plain is limited. The information provided below relies on the following:

- Kemnitzer (1967).
- Proposed pumping well data on the site.
- Data appearing in a hydrogeologic report prepared for the formerly adjacent ARCO solar facility.
- Well information provided by Mr. Kenny Tab for California Valley that is greater than 3 miles from the site (Tab 2008).
- Well information provided by Mr. John Ruskovich following the August 5, 2008 Workshop.

These data are provided in Appendices B. D and E.

3.4.1 Groundwater Quality

Limited groundwater quality data are available for the site vicinity. Data for two on-site wells, one that penetrates the Upper Aquifer (the ranch well, T29S/R18E-28L1), and a well that has been abandoned (T29S/R18E-28G1) that pumped from the Lower Aquifer are summarized in Table 3-2. Based on the review conducted by Bechtel for the ARCO groundwater availability study conducted in 1984, limited water quality data were available for 8 wells from DWR. The data are summarized in Table 3-3. Although not located within 2 miles of the site, water quality data from wells drilled for Mr. Kenny Tab are provided in Appendix D.

The total dissolved solids (TDS) in these wells ranged from 346 to 1,102 mg/l. Other than the data for the two wells located on site 29S/18E-28G1 (abandoned Lower Aquifer well) and 29S/18E-28L1 (ranch well, 100 feet bgs), it is not known what aquifers (Upper or Lower) these other wells represent. It is possible that these wells could be screened across both the Upper and Lower Aquifers.

Table 3-2
Available Groundwater Quality Data - Site Wells
(constituents reported in mg/l, unless noted otherwise)

Well ID	Date	pH (unit less)	EC (umhos/cm)	Ca	Mg	Na	K	Total Alk	SO_4	Cl	NO_3	B	F	TDS	Hardness Total	Hardness Non-Carbonate	SAR (%)
29S/18E-28G01*	10-22-68	7.4	1387	75	27	180	2.0	4	533	98	2.3	0.54	0.7	957	298	294	4.5
29S/18E-28L01**	10-22-65	7.9	1143	71	20	145	1.0	136	260	74	80.0	0.68	0.6	750	259	121	3.9
	10-11-66	8.0	1150	--	--	--	--	131	--	70	70.0	--	--	--	--	--	--
	11-04-67	8.2	1123	72	16	148	1.0	137	239	74	87.0	0.59	0.6	727	246	109	4.1
	10-22-68	8.1	875	39	15	125	1.0	127	119	81	70.0	0.57	0.8	564	151	24	4.4
	11-18-70	8.0	1191	81	18	143	--	147	223	65	130	0.75	0.6	805	276	129	3.7
	11-04-74	8.3	1111	71	17	148	1.2	148	215	75	104	0.67	0.6	727	247	90	3.9
	10-25-76	8.0	1156	78	20	142	0.8	155	236	80	97.0	0.69	0.5	797	274	122	3.7
	10-31-77	8.2	1040	80	19	150	0.2	167	239	77	88.2	0.65	0.6	847	278	111	3.9

Notes:

EC: Electrical Conductivity
Ca: Calcium — NO_3: Nitrate
Mg: Magnesium — B: Boron
Na: Sodium — F: Fluoride
Alk: Alkalinity — SiO_2 Silica
K: Potassium — TDS: Total Dissolved Solids
SO_4: Sulfate — SAR: Sodium Absorption Ratio
Cl: Chloride

* Abandoned site well with depth similar to proposed pumping well.
** Upper Aquifer well on the CESF property.

Table 3-3
Available Groundwater Quality Data - 2-Mile Radius
(constituents reported in mg/l, unless noted otherwise)

Well ID	Date	pH (unit less)	EC (umhos/cm)	Ca	Mg	Na	K	Total Alk.	SO_4	Cl	NO_3	B	F	SiO_2	TDS	Hardness Total	Hardness Non-Carbonate	SAR (%)
29S/18E-29E01	10-21-53	8.1	885	47	15	135	0	153	166	57	34.3	0.60	0.7	--	635	179	26	4.6
29S/18E-29G01	10-04-72	8.3	1053	49	16	147	1.6	142	197	69	33.0	0.64	0.8	--	691	169	47	4.7
30S/18E-02D01	10-22-68	7.4	1478	118	28	157	1.0	136	515	83	38.3	0.75	0.7	--	1102	410	274	4.0
30S/18E-02N01	03-12-54	7.7	602	52	16	60	1.0	152	73	39	43.0	0.18	0.6	--	396	187	35	1.9
	10-02-58	7.2	792	60	25	33	3.0	194	69	64	6.0	0.20	0.4	20.0	505	255	59	2.3
	07-30-59	7.2	685	58	22	58	2.0	158	110	45	31.0	0.20	0.1	30.0	500	235	77	1.0
	10-04-60	7.7	875	74	24	70	1.0	191	149	52	30.0	0.40	0.5	33.0	384	285	92	1.8
	04-19-61	7.7	810	69	21	71	1.0	184	30	48	45.0	0.19	0.3	35.0	691	259	75	2.9
	10-31-61	8.0	836	66	24	81	2.0	180	151	57	31.0	0.16	0.3	32.0	541	263	63	2.3
	10-22-62	7.9	720	61	20	60	1.0	162	15	39	36.0	0.20	0.4	40.0	430	234	72	1.7
	10-10-63	8.0	670	48	28	62	1.0	166	125	41	36.0	0.32	0.1	31.0	494	235	69	1.8
	10-07-64	7.8	765	62	20	63	1.0	166	117	36	10.0	0.24	0.4	38.0	440	237	71	1.8
	10-22-65	7.9	884	77	22	60	1.0	180	158	34	39.0	0.26	0.3		600	293	95	2.0
	11-04-67	8.2	866	77	19	83	2.0	175	150	62	40.0	0.20	0.4	--	570	270	95	2.2
	10-22-68	8.0	909	76	24	86	1.0	167	176	62	45.0	0.29	0.3	--	625	289	121	2.5
	11-18-70	7.8	1030	94	50	101	--	180	205	74	55.0	0.26	0.3	--	706	317	131	2.2
	11-09-72	7.9	513	43	15	38	1.5	136	85	32	36.3	0.7	0.3	--	356	169	31	1.9
	10-22-68	7.9	514	34	12	52	1.0	136	83	32	56.3	0.7	0.3	--	346	154	23	2.0

Notes:

EC: Electrical Conductivity
Ca: Calcium
Mg: Magnesium
Na: Sodium
Alk: Alkalinity
K: Potassium
SO_4: Sulfate
NO_3: Nitrate
B: Boron
F: Fluoride
SiO_2 Silica
Cl: Chloride
TDS: Total Dissolved Solids
SAR: Sodium Absorption Ratio

3.4.2 Groundwater Levels

There is no active groundwater level monitoring occurring near the site. However, based on historic groundwater well data obtained from the Regional Water Quality Control Board (RWQCB), DWR, and other local well data, groundwater levels in the area have fluctuated over the years between a minimum of 4.3 meters (14 feet) bgs to approximately 16 meters (54 feet) bgs. Historical water levels for the northern region of the basin in 1967 are shown on a figure provided in Kemnitzer (1967; Appendix B).

The depth to groundwater was measured in the proposed pumping well on February 14, 2008. On that date, the depth to water was 37.49 feet bgs. In 1965, the water level was approximately 30 feet bgs. Depth to groundwater fluctuates seasonally as a result of recharge and discharge (groundwater pumping, ET and outflow from the basin). Although these measurements represent only two widely separated data points, it is likely that the difference in water levels is a function of seasonal variation.

3.4.3 Proposed Pumping Well

The proposed pumping well, shown on Figure 3-3, has a DWR well ID of T29S/R18E-L03.

3.4.3.1 Groundwater Sampling Procedures

On February 14, 2008, URS personnel conducted purging and water quality sampling of the proposed pumping well at the CESF site. Prior to purging and sampling of the well, the depth to groundwater was measured to the nearest 0.01 foot using a Solinst electronic water-level indicator. The depth to groundwater was approximately 37.49 feet bgs. A Schafer 5-horsepower (hp) pump was installed in the well temporarily at a depth of approximately 120 feet bgs to facilitate purging and sampling. At the time of the water quality sampling and temporary pump installation, the turbine was not present on top of the well. The property owner had removed the turbine and the pump so that the pump could be serviced. A 15,000-Watt portable generator was used to provide electricity to power the pump. The well was pumped at rates between 95 and 108 gpm and purged of at least three casing volumes (approximately 19,000 gallons) prior to sampling. Parameters measured during purging included potential of hydrogen (pH), temperature, conductivity and oxidation-reduction potential (ORP) using an YSI flow through cell. Once the parameters stabilized to within 10 percent between readings, purging stopped after approximately 4 hours of pumping. Approximately 47.65 feet of drawdown was observed in the well during purging. The water level in the well was allowed to return to at least 80 percent of its original water column height. Ferrous iron was also monitored during purging. Ferrous iron was not present in the discharge at detectable concentrations (<0.2 mg/l). A purge log is provided in Appendix F.

Groundwater was collected using a bailer suspended using a nylon cord. The groundwater was decanted into laboratory-supplied containers with preservative as required for specific analyses. The groundwater samples were sealed, labeled, placed in an insulated cooler with ice and transported under chain-of-custody procedures to Calscience Environmental Laboratories, Inc. (Calscience), a state-certified laboratory in Garden Grove, California for analyses. Some analyses were contracted to other laboratories by Calscience. The bailer and sampling equipment was decontaminated prior to use by washing in a non-phosphate detergent solution followed by rinsing twice with distilled water.

3.4.3.2 Groundwater Analysis Methods

The groundwater sample was analyzed for parameters to evaluate general water quality, address CEC Data Request 50, and provide specific water quality information to the facility design engineers. The parameters analyzed (and the analytical methods) were as follows:

- Anions (sulfate, chloride, nitrate, orthophosphate and fluoride) by U.S. Environmental Protection Agency (EPA) Method 300.0.
- Dissolved and total metals (calcium, magnesium, sodium, potassium, silicon, chromium, copper, iron, manganese, arsenic, cadmium, nickel, lead, zinc, aluminum, mercury, antimony, barium, beryllium, selenium and thallium) by EPA Methods 6010B and 7470A.
- Turbidity by SM 2130B.
- Alkalinity (Total, Bicarbonate and Hydroxide) by SM 2320B.
- Specific conductance SM 2510B.
- Total Dissolved Solids (TDS) by SM 2540C.
- Total Suspended Solids (TSS) by SM 2540D.
- pH by SM 4500 H+B.
- Total Phosphorous by SM 4500 P B/E.
- Carbon dioxide by SM 4500 CO2D.
- Radionuclides by EPA Method 900.0, 903.0, 905.0, 906.0, 908.0 and RA-05.
- Volatile organic compounds (VOCs) by EPA Method 8260B Semivolatile organic compounds (SVOCs) by EPA Method 8270C.
- Asbestos by EPA Method 100.2.
- Cyanide by SM 4500-CN E.

3.4.3.3 Groundwater Analytical Results

Analytical results for the groundwater sample collected from the proposed pumping well to address CEC Data Request 50 are summarized in Table 3-4. Primary and secondary Maximum Contaminant Levels (MCLs) for drinking water in California are provided on the table for comparative purposes. Primary MCLs were developed to address human health risk associated with drinking water. Secondary MCLs were established primarily to address aesthetics, such as color, odor and taste. It is Carrizo's intent to use inferior quality water as a supply, since it will be treated to meet specifications for site use. A copy of the laboratory analytical reports and chain-of-custody form are provided in Appendix F.

Table 3-4
Groundwater Analytical Results - Proposed Pumping Well
(analytes reported in mg/l, unless noted otherwise)

Analyte	Concentration	Primary/ Secondary MCL
Title 22 Metals:		
Antimony	**0.0262**	0.006
Arsenic	<0.0100	0.05
Barium	0.019	1.0
Beryllium	<0.00100	0.004
Cadmium	<0.00500	0.005
Chromium	0.0181	0.05
Copper	<0.00500	1.0
Lead	<0.0100	0.015
Mercury	<0.000500	0.002
Nickel	<0.00500	0.1
Selenium	<0.0150	0.05
Thallium	**0.0278**	0.002
Zinc	0.0194	5.0
Base Cations:		
Calcium	107	NE
Magnesium	23.7	NE
Sodium	183	NE
Potassium	0.9	NE
Other Metals:		
Aluminum	<0.0500	1.0*
Iron	**0.733**	0.3*
Manganese	**0.0616**	0.05*
Silicon	19.8	NE
Silica	42.4	NE

Analyte	Concentration	Primary/ Secondary MCL
Anions:		
Fluoride	1.4	2.0
Chloride	66	NE
Nitrate (as N)	**13**	10
o-Phosphate (as P)	<0.10	NE
Total Alkalinity (as $CaCO_3$)	114	NE
Bicarbonate (as $CaCO_3$)	114	NE
Carbonate (as $CaCO_3$)	<1.0	NE
Hydroxide (as $CaCO_3$)	<1.0	NE
General Water Quality Parameters:		
EC (umhos/cm)	**1600**	900*
TDS	**1140**	500*
TSS	1.5	NE
pH (unitless)	6.88	NE
Total P	0.4	NE
Carbon Dioxide	6.3	NE
Other Priority Pollutants:		
VOCs (ug/l)	ND	---
SVOCs (ug/l)	ND	---
Total Cyanide	<0.050	NE
Asbestos	0.19	7
Radionuclides (pCi/L):		
Gross Alpha	9.36	15
Gross Beta	0.00	50
Strontium 90	1.03	8
Radium 226	0.237	5
Tritium	0.000	20000
Uranium	6.00	20
Radium 228	0.241	2

Notes:
NE: None Established.
ND: None detected; see lab report for detection limits for specific compounds.
MCL: Maximum Containment Level.
MCL is primary, unless indicated with an asterisk (*).
BOLD indicates concentration is above MCL.
The symbol “<” (less than) indicates the constituent was not detected above the analytical detection limit specified.

Both dissolved antimony and thallium concentrations detected in groundwater are present at concentrations above their respective primary MCLs for these metals. Nitrate (as Nitrogen) is present at a concentration that is above its primary MCL. Total manganese and iron are also present at concentrations that are above their respective secondary MCLs. Analytical results indicate that the TDS specific conductance and sulfate in the groundwater were also above their respective secondary MCLs for drinking water. Therefore, the groundwater from the Lower Aquifer is not suitable for use as drinking water without treatment.

None of the VOCs and SVOCs was detected in the groundwater sample analyzed; therefore, none of the specific compounds was present above its primary MCL. The radionuclides analyzed were not present in the groundwater sample at levels above their respective primary MCLs. Asbestos was also not present in the groundwater sample above its primary MCL.

In December 2005, groundwater samples from the proposed pumping well were analyzed for general water quality parameters by BC Laboratories, Inc. These data are included Table 3-5.

Table 3-5
Historical Groundwater Analytical Results - Proposed Pumping Well
(analytes reported in mg/l, unless noted otherwise)

Component	Average Concentration
Bicarbonate	150
Boron	0.77
Calcium	90
Carbonate	ND
Chloride	69
Hardness (total)	290
Hydroxide Alkalinity	ND
Magnesium	17
Nitrate as N	15
Nitrite as NO_2	65
pH, Field (unitless)	8.0
pH, Lab (unitless)	7.4
Potassium	ND
Sodium	150
Specific Conductance (umhos/cm)	1100
Sulfate	330
Total Dissolved Solids	790
Total Cations	12
Total Anions	12

3.4.4 Aquifer Characteristics

The proposed pumping well is constructed of a 16-inch diameter casing that is set to a depth of 603 feet bgs. At the time the well was drilled in 1965, depth to groundwater was 30 feet bgs and the well yield was approximately 500 gpm with 370 feet of drawdown after 8 hours. A well driller's report is provided in Appendix E.

No aquifer testing of the proposed pumping well was conducted since the well yield has been reported to be considerably greater than the water needed for construction and operation of the project. Additionally, a pump test was conducted on a Lower Aquifer well immediately adjacent to the site. The now dismantled ARCO solar site was located on the adjacent section to the east of the CESF (Section 27) from approximately the mid-1980s to the late 1990s. Research and testing was conducted prior to construction to determine whether the underlying Carrizo Plain Groundwater Basin could support the proposed water requirements for that project. A design long-term mean of 115 gpm was proposed (maximum seasonal water requirement of 190 gpm for 4 months from June to September and 24-hour peak demands of 250 gpm).

A groundwater exploration program was conducted in 1984 and three test borings were drilled (W-1 through -3). Borings W-1 and -2 were drilled to approximately 620 and 600 feet bgs, respectively. No significant sand or gravel zones were encountered at these locations, so no test wells were installed. Another exploratory boring was drilled approximately 120 feet north and 120 east of the southwest corner of Section 27 (test boring W-3) where sand and gravel was encountered at depths ranging from approximately 460 to 610 feet bgs. The boring was reamed and a 12-inch diameter well was installed. The Bechtel report indicated that the well was abandoned since the well screen had been broken during installation or development. A replacement boring was drilled about 36 feet to the north of W-3A and a well installed with a 10- and 8- inch diameter casing and 8-inch diameter screen. The screen was installed at depths ranging from 530 to 550 and 570 to 600 feet bgs. The screen consisted of 0.030-inch slots. A gravel filter pack was installed from 220 to 620 feet bgs.

Bechtel reported that it conducted a constant-rate pump test. A review of the data and analyses of the pumping test conducted at test well 3A (W-3A) indicated that the well was capable of yielding the design water requirements (115 gpm) and could meet both seasonal and peak demands. The static level of water in the well before pumping was 40 feet bgs and the pumping rate was set to 305 gpm initially. There was 333 feet of drawdown, resulting in a water level that was 373 feet below ground surface. Pumping rates over the following 3 days varied between 254 to 268 gpm, with an average pumping rate of 265 gpm. The depth to water recovered to 340 feet bgs and then again began dropping slowly. At the end of 3 days, the water level was 368 feet bgs. Based on the well's performance and adjusting the well's performance to a rate of the desired 115 gpm over 20 years (projected operational period of the ARCO Site), Bechtel indicated that "the aquifer is capable of providing the water requirement and the extraction would not interfere with existing users." Similarly, Bechtel noted that preliminary literature reviews followed by discussions with local farmers indicated that the groundwater resources at the proposed site should be sufficient to meet the water requirements. Bechtel concluded that the maximum long-term mean capacity of the well was estimated to be 170 gpm. A copy of this report is provided in Appendix E. Based on the results of the aquifer test, the transmissivity of the aquifer was estimated based on the Theis solution to the non-steady state flow equation. Conservative estimates of transmissivity estimated using both drawdown and recovery data ranged from 1,300 to 3,200 gallons per day per foot (gpd/ft). This range of values was considered in the groundwater model simulation performed that is described in Section 3.6.

3.5 GROUNDWATER BUDGET

Relative to other basins in California, there has been little historical study of groundwater use, monitoring of trends in groundwater elevations, and characterization of the hydrogeologic conditions in the Carrizo Plain basin. The resulting lack of data leads to more than the usual hydrogeologic uncertainty regarding a current water budget for the basin. Some planning documents indicate that the Carrizo Plain is currently in an overdraft situation. In contrast, the only hydrogeologic characterization of the basin suggests that there is a substantial net flow of water from the basin as discussed below (Kemnitzer 1967).

Kemnitzer (1967) estimated total net consumption of groundwater in the Carrizo basin in 1967 as approximately 3,898 afy, of which approximately 534 afy was from the 89 shallower wells (mostly less than 100 feet in depth) he identified that were for household and livestock use. This total net consumption was estimated to be about 2 percent of the gross and 5 percent of the net average annual recharge. Kemnitzer (1967) estimated the balance between water recharge and discharge for the Carrizo basin involves a gross annual amount of approximately 177,000 af. This figure is based on the average precipitation of 8 inches of rainfall annually falling upon 266,000 acres of watershed. Of this gross recharge, at least 118,000 af, or nearly 67 percent, is estimated lost through ET and other natural processes. The remaining 59,000 af, or 33 percent of the gross, is considered to be the net average annual groundwater recharge.

That part of the net average annual recharge of 59,000 af or 33 percent into the Carrizo groundwater body which is not being utilized is believed to pass out of the basin as underflow at its northern end into the adjacent Las Yeguas and the San Juan subsurface drainage areas. Kemnitzer (1967) concluded that this outflow could be captured economically before it has opportunity to leave the basin, without lowering appreciably the overall groundwater levels. He also concluded that recovery this net recharge would then be sufficient to irrigate approximately 32,000 acres of hay and grain, alfalfa, pasture, truck and miscellaneous crops as well as to supply a modest community development in the northern half of the plain.

Based on his analysis and a historical review of the available data, Kemnitzer (1967) concluded that:

> “In neither of these groundwater bodies [the upper and lower aquifers comprising the water bearing zones of the basin], have enough wells been drilled or has sufficient water been discharged from wells to lower the groundwaters from their original levels established by the natural balance between recharge and discharge.”

Recent discussions with local residents indicate that the current pumpage may be substantially less than in 1967, when Kemnitzer authored his assessment of the groundwater budget for the Carrizo Plain.

3.6 GROUNDWATER MODELING ANALYSIS

URS prepared a basin-wide model to simulate steady-state flow and estimate the movement of groundwater in the basin and to evaluate the potential effects that the proposed groundwater withdrawals for the proposed project may have on surrounding wells and the aquifers. A simple analytical solution to steady-state groundwater flow to estimate possible effects on surrounding wells was prepared and presented at the March 12, 2008 public workshop. The analysis was preliminary and it showed that pumping in the Lower Aquifer would result in changes in water levels in the wells penetrating this aquifer of generally 3 feet or less immediately adjacent to the site as a result of approximately 20 years of pumping. This model did not account for basin recharge or infiltration, and therefore the results were considered to conservatively overestimate the potential affects of pumping.

At the request of the CEC, a scoping-level model was developed to include infiltration, basin-wide groundwater budgets, and basin-wide hydrogeologic characteristics. This model can be used to explore the range of plausible hydrogeologic conditions in the site vicinity in a sensitivity analysis. Local grid refinement and a local “inset” model with a finer (more dense) grid were developed for the site vicinity to more accurately simulate drawdown in this region. As a result of more recent CEC data requests and discussion during the August 5, 2008 workshop, the potential infiltration resulting from the project (infiltration areas on-site has also been included in subsequent model runs described herein. The models were run for steady state Project and transient Construction Scenarios and, with the exception of calculations for on-site infiltration, is conservatively developed for dry periods when there is no surface water flow and no assumed surface water in Soda Lake. Simulations were performed using the USGS Software, MODFLOW 2000. The rationale for characterization of the groundwater system is described below.

3.6.1 Model Domain and Grid

The model domain is bounded laterally by the watershed divide for the Carrizo Plain and the top of the land surface elevation (Figure 3-4). The domain is discretized (divided) horizontally into square grid blocks 2,000 feet on each side (Figure 3-5). The local grid refinement has a discretization of 125 feet and the local inset model grid has a discretization of 100 feet on each side (Figure 3-5). Vertically the water bearing formations as described in Dibblee, Jr. (1962) and Kemnitzer (1967) are divided into six layers (Figure 3-6). These layers become thicker from west to east to mimic the stratigraphy of the basin. The water-bearing deposits of all but Layer 1 (Upper Aquifer) and Layer 3 (Lower Aquifer) terminate on the east at the San Andreas Fault. Layer 1 represents the Upper Aquifer that supplies domestic, livestock and irrigation water to residences on the plains. This layer extends to a depth of approximately 300 feet bgs on the site. Layer 3 on the site includes the depth interval from approximately 450 to 600 feet bgs that includes the screen interval of the proposed CESF pumping well (T29S, R18E-28L03). Layers 4 and 5 comprise deeper, high-conductivity (permeability) water-bearing formations. Layer 6 includes bedrock and low-conductivity (permeability) strata present at greater depth.

3.6.2 Boundary Conditions

Boundary conditions for the base model, as well as changes used in sensitivity analyses are discussed below.

3.6.2.1 No Flow and General Head Basin Boundaries

The watershed divide comprises a no-flow boundary, with the exception of the northern end of the basin, where general head boundaries (GHB) are applied (see Figure 3-5) to represent underflow from the basin at its northern end into the adjacent La Yeguas and the San Juan subsurface drainage areas as described in Kemnitzer (1967). In a sensitivity analysis, flow out these GHBs was eliminated to yield an alternative conceptual model of the basin from which there is no underflow leaving to the north as proposed by Kemnitzer (1967). The GHB conditions are applied using the MODFLOW GHB package. No-flow boundaries are also applied to the bottom of the model.

3.6.2.2 Recharge

Annual average recharge of 60,000 afy was applied to Layer 1 of the model. The recharge rate was computed as the difference between precipitation (177,000 af) and the estimated evapotranspiration (ET) (including that from Soda Lake) of 118,000 afy (Kemnitzer 1967). The estimated recharge varies spatially to represent greater precipitation rates in the northwest region of the basin and the ET effects of dry-land farming (Kemnitzer 1967). This rate of recharge falls within the range of the AMC I and AMC II estimates for existing recharge on the CESF project site (see Section 2.2.3.4). The Project Scenario includes a net increase in recharge in the project area of 86 afy (230 afy Project less 144 afy existing) to the Upper Aquifer resulting from the infiltration of surface water in the drainage swales on the site. This water would otherwise infiltrate or evaporate along the drainage channel that extends beyond the site to Soda Lake for no net gain to the basin. In the Project Scenario, an equal amount of recharge (86 afy) was removed from the model nodes that represent the drainage channel extending south of the site to Soda Lake. This recharge is conservatively assumed to offset recharge that would have occurred along the main channel en route to Soda Lake, *i.e.*, the proposed project does not result in a net increase in recharge. Recharge was applied using the MODFLOW recharge package.

3.6.2.3 Pumping

Pumping was assigned to each of the 86 wells identified in the well survey and that fall within the model domain. Pumping rates from domestic and irrigation wells were reevaluated based on discussions at the August 5, 2008 public workshop and CEC data requests. The pumping rates for the wells identified were as follows:

Domestic Wells: Domestic wells penetrating the Upper Aquifer were pumped at an average rate of 0.62 gpm or approximately 1 afy as requested by the CEC to reflect expected residential water use in the area. Many of the wells identified during the survey are located on subdivided 40-acre parcels that the local residents indicate are used primarily for residential use and penetrate the Upper Aquifer only.

Irrigation Wells: Although the actual rate of pumpage from irrigation wells is not known, local feedback indicates that the overall rate of pumpage from irrigation wells is less than when last estimated in the 1960s (Kemnitzer 1967). It was assumed that the irrigation wells are those that have been identified in the Lower Aquifer (Layer 3). For some wells, irrigation pumpage was calculated from known land use (see below). For the remaining wells, land use is uncertain and estimates from such an analysis would be correspondingly characterized by a great degree of uncertainty. Therefore, an approach was taken wherein two rates of pumpage were considered to conservatively bracket a range of probable irrigation pumpage within the basin.

For the base model, it was assumed that the irrigation wells identified are operated year round using a 35% duty cycle at their estimated well yield at the time of their construction. Based on information provided by Mr. John Ruskovich, some of the irrigation wells are only pumped for three months out of the year to support the cultivation of spring hay. Others are also likely to be used for only part of the year. Others may not be used at all. Furthermore, during periods of the year when wells are being used for irrigation, a 35% duty cycle likely overestimates the duration of operation. Therefore, year-round operation with a 35% duty cycle represents an upper bound estimate for irrigation pumpage that conservatively maximizes groundwater withdrawal and drawdown, and therefore, maximizes any potential impacts of the CESF project and the proposed OptiSolar project on groundwater in the surrounding area. A lower bound for irrigation pumpage was considered in sensitivity analyses. To bracket a lower bound, it was assumed that all irrigation wells were only used for three months out of the year with a 35% duty cycle. Note also that Mr. John Ruskovich informed URS that several of the irrigation wells are no longer used and the pumping rates for these wells were set to zero in all model runs. In addition, there are a number of specific wells where water use has been estimated based on land use.

Pumpage was calculated for two properties where specific land use is known. First, there is a Lower Aquifer well at the California Valley restaurant and hotel that is not used to support agriculture, located in T30S R18E Section 12. A recent discussion with the owner, Mr. Kenny Tab, indicates that the well has an estimated yield of 500 gpm and supplies water to his restaurant, hotel and provides irrigation for landscaping. The landscaping includes a 3,000-foot row of trees (assumed to occupy approximately 3 acres). Based on calculations, it is assumed that the water use from this well for irrigation and other uses is the equivalent of 26 residential homes or approximately 14 afy. There are also approximately 8 water wells that provide irrigation supply to approximately 160 acres of olive groves at La Panza Ranch, approximately 3 miles southwest of the site in T30S R18E Section 6. It was assumed that 2.5 feet/year are required for irrigation to sustain the olive groves (see data appearing in Table 1-3). Each well was designated a pumping rate that is one-eighth of the total estimated annual water demand for the groves.

Site (CESF) Pumping Well: It was assumed that the site well will pump at a rate of 144 afy for the Construction Scenario and 20.8 afy for the Project Scenario from the Lower Aquifer (Layer 3).

Hypothetical Topaz/OptiSolar Well: The combined effect of pumping from the CESF project and the proposed Topaz/OptiSolar project to the north was also evaluated as requested by the CEC. The Topaz/OptiSolar well was included because the nearest areas of that project lie within a 3-mile radius of the CESF site and there are private parcels with residential wells located between the two projects that may have the potential to be affected by groundwater pumping. Topaz Solar Farms LLC/OptiSolar, Inc. (OptiSolar) indicates in its Conditional Use Permit (CUP) Application submitted to San Luis Obispo County that groundwater will be supplied to the project from existing wells within the site footprint. The document provides no further detail on the location of the wells or the aquifer that will be pumped. To provide a conservative evaluation of the combined effect of the CESF and OptiSolar pumping wells on the surrounding area, it was assumed that: 1) the OptiSolar well is located near the CESF site in a location where there are residential wells between the two proposed sites and, 2) the well will be pumping at a rate of 26.7 afy. This is the rate of maximum anticipated water use at the OptiSolar site during three years of construction. After construction, the facility is expected to use approximately 3.5 afy. In addition, it was assumed that OptiSolar would be required to use water of lesser quality, and as such, water would be pumped from the Lower Aquifer (Layer 3).

Hypothetical SunPower California Valley Solar Ranch: A CUP Application was submitted to San Luis Obispo County in January 2009 for the proposed SunPower California Valley Solar Ranch. Expected daily water demand indicated in the application is estimated as 32,500 gpd (22.6 gpm or 36.4 afy) for construction and 10,400 gpd (7.2 gpm or 11.7 afy) for operations. This well was not included in the model simulations, since:

- The nearest point of the SunPower project is approximately 6 miles east of the CESF project boundary, which is too far away to have a combined impact on the site vicinity.
- The proposed groundwater withdrawals for SunPower and any other well that may be located in the site vicinity are essentially accounted for in the range of withdrawals considered for the basin in the model runs.
- Previous model runs that considered groundwater withdrawals for the residential wells of 12 afy did not result in any significant impact of the pumping site well on surrounding wells.

The overall pumpage in the model for the wells identified is 2,624 afy, which is 30% less than the estimate made in 1967 (Kemnitzer 1967). This reflects the change in water use practices related to agriculture that has been reported by a number of long-time residents of the plains. Well depths were assigned based on reported screen intervals, where available; otherwise wells were assumed to be screened in the Upper Aquifer (up to 300 feet bgs). The proposed pumping well at the site is assumed to withdrawal water from Layer 3 of the model during construction and operation of the facility. Conservatively it assumes pumping of 144 afy for three years during construction and 20.8 afy (18,500 gpd, or approximately 13 gpm) for site operations following construction. The model was also run for 144 afy for the first year of construction. In the No-project Scenario, no pumpage is assigned to this well. The base model includes combined CESF and OptiSolar projects where pumpage is also assigned to the OptiSolar well. Wells were simulated using the MODFLOW well package.

3.6.2.4 Model Parameters: Hydraulic Conductivity (K), Specific Storage (S_S) and Specific Yield (S_y)

Conceptual Model. Hydraulic conductivity (permeability) values are based on the measured data and the geologic interpretation. Flow in the Upper Aquifer (Layer 1) generally follows the topography and is directed towards Soda Lake. Historical groundwater levels in the Upper Aquifer appear in Kemnitzer (1967) provided in Appendix B. Kemnitzer (1967) suggests that there is substantial underflow in a northwest direction out of the basin. To accommodate this conceptual model, the deeper aquifers (Layers 4 and 5) must have higher horizontal hydraulic conductivities (K_h) than the Upper Aquifer and low enough vertical hydraulic conductivity (K_v) to allow for this substantial flow, as well as trends in hydraulic heads that oppose those of the Upper Aquifer north of Soda Lake. This conceptual model indicating high K_h in the deep aquifers is consistent with the presence of ancestral channels of a stream that flowed northward. In addition, a low K_v is consistent with the well logs that indicate substantial heterogeneity with a significant volume fraction of clay, and the need for multiple borings to find substantial high K sediments in the Upper and Lower Aquifers (Bechtel 1984). The K_h of the Upper Aquifer is expected to generally decrease near Soda Lake since it is underlain by lacustrine deposits consisting of clay and silt.

Specified *K* Values. The K_h varies spatially within each layer of the model. The K_h of the Upper and Lower Aquifers ranges from 1.0 to 2.5 feet/day. The higher end of this range is consistent with the results of the aquifer test on the adjacent ARCO well and is generally assigned to developed regions in the north basin including the site. The K_h for the pumping well was estimated based on the thickness of the sand lenses described on the drilling log, compared to those observed during drilling in the ARCO well boring. These model runs also consider the estimated hydraulic conductivities for the gravel pack, based on information provided on the boring log, which extends from a depth of 70 feet bgs to the total depth of the well. During pumping, it was assumed that there will be no well screen present in the Upper Aquifer in the proposed pumping well,

Lower values of K_h were assigned near Soda Lake and east of the San Andreas Fault. The K_h values for Layers 4 and 5 are as high as 5.0 feet/day. The K_h of Layer 6 (bedrock and the bottom of the model) was specified as 0.01 feet/day. The specified ratio for K_v/K_h in the base model was approximately 1/100. The smaller the K_v, the less pumpage from the Lower Aquifer affects the Upper Aquifer. The specified ratio for K_v/K_h was selected from the upper range of plausible values and then both adjusted even higher by a factor of 4 to 1/25 and lower by a factor of 10 to 1/1,000 in a sensitivity analysis to consider uncertainty in this parameter. Most of the specified K values were adjusted during calibration of the model.

Specified Storage Values. Aquifer storage parameters describe the ability to yield water from a decline in groundwater levels. The specific storage was specified as a constant 2.0 x $10^{-5}ft^{-1}$ for the system. Typical values of S_y range from 0.01 to 0.3, with the smaller values associated with semi-confined systems that yield less water and experience greater water level declines in response to pumping. It was assumed that much of the Upper Aquifer behaves as a semi-confined system. Values of specific yield of approximately 0.01 were therefore assigned to Layer 1 in the project vicinity.

3.6.2.5 Evapotranspiration (ET)

An estimated 118,000 afy of ET was accounted for in estimates of the recharge as described above. As noted by Kemnitzer (1967), groundwater heads (elevations) in many parts of the basin near Soda Lake are rarely more than 10 feet bgs. In addition, heads in other parts of the basin periodically rise to near land surface. Under such conditions, when groundwater levels are near land surface, ET from groundwater will occur naturally (Figure 3-4). This additional ET was simulated in the model using the MODFLOW ET package and an ET rate of 5.5 feet/yr with an extinction depth (the depth at which there is no ET) of 15 feet bgs.

3.6.2.6 San Andreas Fault

The San Andreas Fault is assumed to impede the flow of groundwater from east to west. The hydraulic effects of the San Andreas Fault are simulated with horizontal flow barriers (HFBs) using the

MODFLOW HFB package. The locations of HFBs corresponding to the San Andreas Fault are shown on Figure 3-5.

3.6.3 Results of Analysis

The model was run for Construction, Project and No-project Scenarios. A Combined Projects Scenario was also performed at the request of the CEC to include the proposed Topaz Solar Farm LLC/Optisolar, Inc. (OptiSolar) facility that is proposed immediately to the north of the CESF. The results of the analysis provide insight into the validity of the conceptual model of the basin, as well as an evaluation of the potential impacts of the project on groundwater flow in the basin and neighboring wells. Model results are provided below. Sensitivity analysis results are provided in Appendix G.

3.6.3.1 Conceptual Model and Calibration

A hand calibration was performed to match the general character of the observed heads in the Upper Aquifer (Layer 1) and the measured head in the Lower Aquifer (Layer 3) at the proposed pumping well. Calibration involved changing (hydraulic conductivity) *K* values and the distribution of recharge. The calibrated recharge rate in the vicinity of the CESF property, estimated independently of the infiltration analysis for the CESF property (Section 2.2.3.4), falls between the AMC I and AMC II estimates for existing recharge on the property. The base model includes substantial underflow from the basin, but less than that suggested by the sole historical hydrogeologic analysis (Kemnitzer, 1967) of the Carrizo Plain (see Section 3.6.5.4 and Appendix G for additional discussion of alternative conceptual models). The results discussed in the following section and appearing in Appendix G is sufficient to infer the potential project impacts for alternative conceptual models of the basin. Groundwater budgets for the final base model are shown in Table 3-6. Simulated groundwater levels for the Upper and Lower Aquifers for the basin are shown on Figures 3-7 and 3-8, respectively. Simulated groundwater levels for the Upper and Lower Aquifers for the site vicinity (inset model) are shown on Figures 3-9 and 3-10, respectively.

3.6.3.2 Project and No-project Scenarios

Both the Combined Projects and Project Scenarios include the proposed CESF pumping well (T29S/R18E-28L03). The No-project Scenario includes no pumping from this well. The proposed pumping well at the CESF is currently screened in the Upper and Lower Aquifers, from 75 feet bgs to approximately 600 ft bgs. When used in the proposed CESF, the upper portion of the screen will be sealed with a sleeve so that water can only enter the well casing through the screen interval that corresponds with the Lower Aquifer. In the No Project, Project and Combined Projects Scenarios, the CESF well was included in Layer 3. Additional No Project scenarios were run where the CESF well was included in Layers 1, 2 and 3 with no pumping to estimate borehole flow. Borehole flow, the transfer of water between aquifers through flow within the wellbore, was simulated in these scenarios using the multimodal well package of MODFLOW. A reduction in potential borehole flow associated with installation of the sleeve has the potential to mitigate drawdown in the Upper Aquifer.

In the Project Scenario, it was assumed that the CESF well is pumped at an average annual rate of 18,500 gpd, or 13 gpm. The overall pumpage in the model for the wells identified is 2,678 afy, which is 30% less than the estimate made in 1967 (Kemnitzer 1967). This reflects the change in water use practices related to agriculture that has been reported by a number of long-time residents of the plains.

Modeling results for the Project and No-project Scenarios are described below. The Project Scenario includes pumping from the on-site pumping well, Sensitivity analyses are presented in Section 3.6.5.4.

Budgets. The groundwater budgets from these Project and No-project Scenarios are shown in Tables 3-6 through 3-8. The increase in pumping at the project well is approximately 20.7 afy, or 0.78% of the estimated total pumping from the basin. This increase in pumping is compensated for locally by the estimated local increase of 86 afy of recharge from the CESF project; nevertheless, as discussed previously, the model does not include a net increase in recharge due to the project. The project results in a decrease of 22.1 afy in the total groundwater ET and an increase in the total underflow from the basin of 1.6 afy.

Table 3-6
Simulated Groundwater Budgets without Project

Budget Component	In (afy)	Out (afy)
Recharge	60,641	--
Underflow	- -	11,676
Groundwater ET	- -	46,317
Pumping from Wells	- -	2,648
TOTAL	60,641	60,641

Table 3-7
Change in Simulated Groundwater Budgets Due to Project

Budget Component	In (afy)	Out (afy)
Recharge	0	0
Underflow	0	1.6 (0.014%)
Groundwater ET	0	-22.1 (-0.048%)
Pumping from Wells	0	20.7 (0.783%)

Table 3-8
Simulated Groundwater Budgets with Project

Budget Component	In (afy)	Out (afy)
Recharge	60,641	- -
Underflow	- -	11,678
Groundwater ET	- -	46,295
Pumping from Wells	- -	2,668
TOTAL	60,641	60,641

Groundwater Elevations. Simulated groundwater elevations for the Upper (Layer 1) and Lower (Layer 3) Aquifers from the basin-scale model are shown on Figures 3-7 and 3-8, respectively. Groundwater levels simulated with the inset model for the Upper and Lower Aquifers in the site vicinity are shown on Figures 3-9 and 3-10, respectively. Note that because results show little combined effects due to the CESF and OptiSolar projects, these figures (Figures 3-7 through 3-10) are shown for the results of the Combined Projects Scenario. The differences in heads (drawdown) between the No-Project and Project Scenarios for the Upper and Lower Aquifers (Layers 1 and 3) at the project property boundary are shown on Figures 3-11 and 3-12, respectively. The approximate change in head in the Upper and Lower Aquifers at the property boundary are -1.5 and 0.2 feet, respectively. Changes in groundwater elevations on the property near the proposed pumping well in the Lower Aquifer will be greater than 0.2 feet. Note also that groundwater levels in the Upper Aquifer (Layer 1) actually rise due to the local increase in recharge calculated for the project considering local increase in infiltration. Results not shown show that an additional increase in water levels may result from the placement of a sleeve in the upper portion of the existing well screen (Layers 1 and 2 of the model). These results indicate that pumping the CESF well will not have a significant affect on neighboring wells and groundwater levels in the basin. Because the effect of pumping the CESF well will not result in a significant change in groundwater levels, the water supplied to it will not be drawn from great distances (for example, poor quality water from the Soda Lake area 10 miles away). Therefore, pumping of these wells will not have a significant affect on water quality in the area or basin. In addition, due to the relatively low rates of proposed pumpage for the projects, no significant impacts will result from other plausible alternative models and sensitivity.

3.6.3.3 Combined Projects Scenario

As requested by CEC, a model run considering the possible combined effects of both the project and the proposed OptiSolar project (Combined Projects Scenario) was completed. This scenario includes pumping from the CESF well considered in the Project Scenario and a hypothetical OptiSolar well that has been located on T29S/R18E Section 21 where residential wells lie between the two sites, as this would be the most conservative geometry. The hypothetical OptiSolar well was also assumed to be pumping from the Lower Aquifer. The results of modeling for the Combined Projects Scenario are summarized below.

Budgets. The groundwater budgets from these scenarios are shown in Tables 3-9 and 3-10. The total pumpage for the Combined Projects Scenario is 47.5 afy, or 1.8% of the estimated current total pumpage from the basin. The Combined Projects Scenario results in an decrease of 43.6 afy in the total groundwater ET and an decrease in the total underflow from the basin of 4.8 afy.

Table 3-9
Simulated Groundwater Budgets with Combined Projects

Budget Component	In (afy)	Out (afy)
Recharge	60,641	-
Underflow	- -	11,671
Groundwater ET	- -	46,275
Pumping from Wells	- -	2,695
TOTAL	60,641	60,641

Table 3-10
Change in Simulated Groundwater Budgets Due to Combined Projects

Budget Component	In (afy)	Out (afy)
Recharge	- -	- -
Underflow	- -	-3.9 (-0.033%)
Groundwater ET	- -	-43.6 (-0.094%)
Pumping from Wells	- -	47.5 (1.794%)

Note:
Budget does not account for potential decrease in ET and increased recharge to the Upper Aquifer resulting from construction of the OptiSolar project.

Groundwater Levels. The differences in heads (drawdown) between the No Project and Combined Project Scenarios for the Upper and Lower Aquifers (Layers 1 and 3) for the inset model are shown Figures 3-11 and 3-12. The approximate change in head in the Upper and Lower Aquifers is -1.2 and +0.2 feet, respectively. As noted previously, drawdown on the property near the proposed pumping well in the Lower Aquifer will be greater than 0.2 feet. Note also that groundwater levels in Layer 1 rise due to the local increase in recharge resulting from construction of the CESF project. It should be noted that the results do not take into account the potential reduction in ET that is likely to be associated with construction of the OptiSolar project that would also potentially enhance and increase recharge to the Upper Aquifer. These results indicate that pumping the Combined Projects wells will not have a significant affect on neighboring wells and groundwater levels in the basin. Because the effect of pumping the wells will not result in a significant change in groundwater levels, the water supplied to it will not be drawn from great distances (for example, poor quality water from the Soda Lake area 10 miles away). Therefore, pumping of the wells will not have a significant effect on water quality in the area or basin. In addition, due to the relatively low rates of proposed pumpage for the projects, no significant impacts will result from other plausible alternative models and sensitivity.

3.6.3.4 Construction Scenario

The Construction Scenario includes pumping from the proposed CESF well at three projected average annual rates for Years 1 through 3 during the construction phase of the project. The highest average annual use is expected during Year 1 (128,500 gpd; 89 gpm). The water use during the subsequent years of construction decreases considerably. During Year 2 the projected water use for construction is 64,300 gpd (45 gpm) and during Year 3, water use is projected to be 33,900 gpd (24 gpm). In addition to on-site groundwater pumping, the model simulations also assumed that the Optisolar well was also being pumped at the rate indicated in its CUP Application. The construction scenario model runs were conducted to simulate transient flow conditions. The results of modeling for the Construction Scenario are summarized below.

Groundwater Levels. The differences in heads (drawdown) between the No Project and Construction Scenarios for the Upper and Lower Aquifers (Layers 1 and 3 for the model) are shown on Figures 3-13 and 3-14 following pumping at the highest rates that is project to occur in Year 1 (144 afy, 89 gpm). The approximate change in head in the Upper and Lower Aquifers on the property boundary is 0.9 and +2.1 feet, respectively. Drawdown of 0.9 feet in the Upper Aquifer (where nearby local residents obtain their groundwater) during construction conditions is not considered a significant impact considering the analysis includes conservative aquifer parameter and response assumptions and that this is a temporary drawdown that will decrease as the project uses less water in the transition from construction to operation as shown for the Upper Aquifer following Years 2 and 3 of construction (Figures 4-14 and 4-15) and the Combined Projects Scenario previously presented on Figure 3-11.

As noted previously, drawdown on the property near the proposed pumping well in the Lower Aquifer will be greater than 3.0 feet. It should be noted that the results do not take into account the potential reduction in ET that is likely to be associated with construction of the OptiSolar project that would also potentially enhance and increase recharge to the Upper Aquifer. Results also do not include the changes in borehole flow that will occur when the upper section of the well screen is sleeved and that are also likely to reduce drawdown. Results show that the water supplied to the well will not be drawn from great distances (for example, poor quality water from the Soda Lake area 10 miles away). Therefore, it is not anticipated that pumping of the wells will have a significant effect on water quality in the area or basin.

These results indicate that pumping during construction at the specified rate will not have a significant effect on neighboring wells and groundwater levels in the basin. However, results for the Construction Scenario are sensitive to changes in hydrogeologic conditions; results for other plausible alternative models and sensitivity analyses discussed below suggest that there is some drawdown (less than approximately 3 feet) in the Lower Aquifer beyond the property boundary that can result from pumping during construction under specific hydrogeologic conditions.

3.6.3.5 Sensitivity Analysis

Sensitivity analyses including lower pumpage, higher vertical conductivity, and an alternative conceptual model were conducted to evaluate effects of changes in particular parameters and boundary conditions on groundwater drawdown resulting from the combined pumping of the CESF and hypothetical OptiSolar wells. Maps showing the results of the sensitivity analysis are provided in Appendix G as Figures G-1 through G-8. Note that the maximum drawdown in the Construction Scenario occurs at the end of the first year of pumping (Year 1), after which drawdown decreases due to the corresponding decrease in the pumping that will occur during Years 2 and 3. Estimated drawdown in the upper Aquifer in the site vicinity related to the decreased pumping during Years 2 and 3 are shown on Figures G-1 and G-2, respectivelly.

Lower Overall Pumpage. As previously indicated, there were lower and upperbound pumping rates estimated for the basin. The lower pumping rate for the irrigation wells in the basin had little effect on the drawdown for the Construction Scenario compared to the upperbound pumpage used in the base model as shown for the Upper and Lower Aquifers on Figures G-3 and -4, respectively.

Vertical Hydraulic Conductivity (*K_v*). The specified ratio for K_v/K_h in the base model was 1/100. By increasing or decreasing the K_v, drawdown in the Upper Aquifer, groundwater levels either increase or decrease, respectively, in response to pumpage in the Lower Aquifer. An increase in K_v can result in more drawdown in the Upper Aquifer because this results in an increase in vertical connection allowing water to move from the Upper to the Lower Aquifer in response to pumping. Similarly, a decrease in K_v will focus drawdown to the Lower Aquifer and decrease drawdown in the Upper Aquifer. Therefore, scenarios with the specified ratio for K_v/K_h adjusted higher and lower by a factor of 4 to 1/25 and 1/1,000, respectively, were run in a sensitivity analysis for the Combined Projects and the Construction Scenarios. It is noteworthy that the scenario with an increase in overall K_v includes two additional conservative assumptions: (1) no borehole flow (see below), and (2) an increase in the vertical conductivity due to the gravel pack of the well assuming a hydraulic conductivity of 2,000 feet/day (Driscoll 1989).

Increasing or decreasing K_v (the ability for water to move vertically) had little effect on changes in groundwater levels in Layers 1 and 3 between the Combined Projects and No-Project Scenarios for the site vicinity (results not shown). For the Construction Scenario at Year 1 and the decrease in K_v, drawdown in the Upper and Lower Aquifers at the boundary of the proposed CESF property was negligible (results not shown) and 7.0 feet, respectively (Figures G-5 and -6 respectively). For the Construction Scenario at Year 1 and an increase in K_v, estimated drawdown in the Upper Aquifer at the boundary of the proposed CESF property was approximately 2.0 feet (Figure G-7). In addition, drawdown in the Lower Aquifer at the property boundary (Figure G-8) is virtually identical to that in the Upper Aquifer due to the high K_v. Note that, as discussed above, this scenario includes additional assumptions including no borehole flow and an accounting for an increase in the vertical conductivity due to the gravel pack of the CESF well.

Borehole Flow. As previously indicated, the No Project no project scenarios were also run to estimate the potential borehole flow under current conditions. The magnitude of borehole flow is sensitive to K_v as well as the conceptual model of the basin. Specifying a lower value for K_v will tend to focus vertical flow between layers to the wellbore, increasing wellbore flow. Wellbore flow was estimated to range from negligibe (high K_v) to more than 65 afy (approximately 40 gpm for the low vertical K) from Layer 1 to Layer 3. Wellbore flow in the base model was substantial at 34 afy (21 gpm) from Layer 1 to Layer 3. These results suggest the potential for a substantial reduction in wellbore flow that can significantly offset drawdown or increase the water level rise in the Upper Aquifer due to the project once the screen in the Upper Aquifer is sleeved.

Alternative Conceptual Model. Starting from the calibrated model, the conceptual hydrogeologic model of the basin proposed by Kemnitzer (1967) was tested through a series of analyses that adjusted a range of plausible alternative model parameters. These analyses suggest that the conceptual model of Kemnitzer (1967) overestimates flow out of the basin. Instead, excess water that does not flow out of the basin to the north is lost through groundwater ET (Tables 3-6 through 3-8). In fact, it appears that groundwater ET is not an explicit component of the water budget presented in Kemnitzer (1967). The calibrated model includes this groundwater ET and is consistent with groundwater levels near the land surface from which groundwater ET may become significant (*e.g.*, historical depths to groundwater observed onsite were as shallow as 14 bgs, see Section 3.4.2). As noted previously, groundwater levels in many parts of the basin near Soda Lake are rarely more than 10 feet bgs (Kemnitzer 1967). Under such conditions, when groundwater levels are near land surface, ET from groundwater will occur naturally. The base model includes substantial underflow (flow out of the basin). Thus, it is noteworthy that an alternative hydrogeologic conceptual model for the Carrizo Plain is one in which there is minimal underflow from the basin.

SECTION 4 CONCLUSIONS

Based on the information described herein, URS concludes the following:

- The CESF will use considerably less water than irrigated agricultural uses that have occurred historically on the plains.

- The CESF will use considerably less water than wet-cooled solar power and conventional power generating facilities.

- Historical information suggests that previous agricultural activities on the property pumped the existing well and other wells at considerably higher pumping rates compared to that proposed for the CESF Project. There were no indications that previous water use on the property affected nearby wells. Therefore, the proposed pumping that is considerably less than the historical pumping rate (Project scenario) will not significantly affect water quality, water levels or well flow rates (yield) on adjacent properties.

- The facility will be constructed to allow infiltration of surface water that falls directly on the site. It is estimated that the average annual infiltration post-construction will be approximately 230 afy. This is 1.5 times the projected water use during Year 1 of construction, and 10 times the annual water use estimated during facility operations.

- The facility will use inferior quality groundwater for its water supply. The results of groundwater sampling from the proposed pumping well indicate that several parameters are above their respective drinking water standards.

- The increase in pumping from the proposed project is likely to be offset by decreases in groundwater ET and underflow out of the basin. Model-simulated changes in groundwater ET and underflow out of the basin as a result of this proposed pumping were 0.048% (24 afy) and 0.014% (3.4 afy), respectively.

- Plausible alternative models of the basin will lead to results comparable to those presented herein, *i.e.,* the proposed pumping would likely result in commensurate decreases in either underflow, ET or a combination of both, with similar levels of drawdown.

- The results for the Project Scenario indicate negligible drawdown in the Lower Aquifer (Layer 3) at the property boundary, less than 3.0 feet of drawdown in the Lower Aquifer on site, and an actual water level rise in the Upper Aquifer (Layer 1), since some localized recharge is estimated as a result of the project.

- The results for the Project Scenario confirm historical accounts that pumping from the site well at the proposed pumpage rates will not have a significant effect on shallow neighboring wells and groundwater levels in the basin. Because the effect of pumping the CESF well will not result in a significant change in groundwater levels, the water supplied to it will not be drawn from great distances (for example, poor quality water from the Soda Lake area 10 miles away). Therefore, pumping of the CESF well will not have a significant effect on water quality in the area or basin.

- The results for the Combined Projects Scenario indicate that the combined effect of the pumping wells from both projects will not have a significant impact on neighboring shallow wells and water quality in the surrounding area. This also confirms historical accounts and observations that there have been no effects on neighboring shallow wells related to pumping of the proposed production well.
- Results for the Construction Scenarios indicate that drawdown in the Upper Aquifer (where nearby local residents obtain their groundwater) at the end of Year 1 (144 afy, 89 gpm) ranges from negligible (low K_v scenario) to less than 2.0 feet (high K_v scenario) at the property boundary and from negligible to less than 1.0 foot at the nearest offsite wells in the Upper Aquifer. This range of drawdown is not considered significant, particularly given that the upper end of the range is associated with analyses that include conservative assumptions regarding aquifer conditions and response. The maximum drawdown estimated for the end of Year 1 is a temporary condition. During subsequent years of construction, the pumping rate will decrease and the estimated drawdown is predicted to be even less than that estimated for Year 1.

SECTION 5 UNCERTAINTY AND LIMITATIONS

Geology and hydrogeology are inexact sciences, and data and interpretations commonly contain some degree of uncertainty. The movement of groundwater is a complex phenomenon. Our findings and opinions are based on limited published information related to the groundwater conditions in the Carrizo Plain and information gathered from a variety of public sources. URS cannot verify the accuracy of well information provided by individuals during our well survey. Unless we have knowledge to the contrary, information obtained from interviews or provided by property owners has been assumed to be correct and complete. URS does not assume any liability for information that has been misrepresented. Services have been performed by URS in a manner consistent with that level of care and skill ordinarily exercised by members of the same profession currently practicing in the same locality under similar conditions. No expressed or implied representation or warranty is included or intended in our reports, except that our services were performed, within the limits prescribed by our client, with the customary thoroughness and competence of our profession.

SECTION 6 REFERENCES

Bechtel Civil & Minerals, Inc. 1984a. Interoffice Memorandum transmitting the results of a pumping test, dated June 15, 1984.

Bechtel Civil & Minerals, Inc. 1984b. Transmittal of Test Assignment No. 1 from Mr. H.A. Balakrishna Rao to Mr. Lyle Lewis of Harding Lawson Associates, dated March 6, 1984.

California Department of Water Resources (DWR). 2004. “Carrizo Plain Groundwater Basin, California’s Groundwater,” DWR Bulletin 118.

California Department of Water Resources. 2004. California's Groundwater Bulletin 118, Hydrological Region Central Coast, Carrizo Plain Groundwater Basin. Last viewed on 6 July 2007 at http://www.groundwater.water.ca.gov/bulletin118/prev_b118_rpts/index.cfm.

Cooper, J.. W. 1990. A Geophysical study of the Hydrogeology of the Carrizo Plain Area, San Luis Obispo County, California, M.S. Thesis, San Jose State University. May.

Dibblee, Jr., T. W. 1962. Displacements on the San Andreas Rift Zone and Related Structures in Carrizo Plain and San Andreas Fault, San Joaquin Geological Society, Bakersfield, California.

Dibblee, Jr., T.W., Graham, S.E., Mahony, T.M., Blissenbach, J.L., Mariant, J.J., and Wentworth, C.M. 1999. “Regional Geologic Map of San Andreas and Related Faults in Carrizo Plain, Temblor, Caliente, and La Panza Ranges and Vicinity, California: A Digital Database,” USGS Open File Report 99.

Federal Emergency Management Agency, Flood Insurance Rate Maps for San Luis Obispo County. 1982. Community Panel Numbers 0603040550B and 06030400575B.

Jennings, Charles W. 1994. Fault Activity Map of California and Adjacent Areas, with Locations and Ages of Recent Volcanic Eruptions, California Division of Mines and Geology, California Geologic Data Map Series, Map No. 6.

Kemnitzer, William J. 1967, Groundwater in the Carrizo Plain, Economic Geologist, Menlo Park, California.

Ruskovich, John. 2008. Personal Communications Regarding Water Use on the Carrizo Plain. August.

San Luis Obispo County Division of Public Works, Department of Water Resources. 2001. Master Water Plan Update. Last viewed on 24 August 2007 at http://www.slocountywater.org/. Prepared by Edaw, Inc.

San Luis Obispo County Public Works, Volunteer Precipitation Gauge Station, Monthly Precipitation Report. Station Name: Cavanaugh Ranch #78 (Inactive); Station Location - Lat 35o21'30", Long 120o02'30", Water Years 1938/39 to 1981/82. Last viewed online at http://www.slocountywater .org/Water%20Resources/Data/Inactive%20Volunteer%20Precipitation%20Sites/index.htm.

San Luis Obispo County, Planning and Building, Title 19 Building and Construction Ordinance, last viewed on 24 August 2007 at http://www.slocounty.ca.gov/planning/General_Plan__Ordinances_and_Elements/Ordinances.htm.

San Luis Obispo County, Planning and Building, Title 22 Land Use Ordinance, Last viewed on 24 August 2007 at http://www.slocounty.ca.gov/planning/General_Plan__Ordinances_and_Elements/Title_22_-_Land_Use_Ordinance.htm.

San Luis Obispo County, Shandon-Carrizo Area Plan, Last viewed on 24 August 2007 at http://www.slocounty.ca.gov/Assets/PL/Area+Plans/Shandon-Carrizo+Inland+Area+Plan.pdf.

Tab, Kenneth, (California Serengeti Corporation), Well Data for the California Valley Vicinity, provided via Email on March 24, 2008; personal communication, September 15, 2008.

Topaz Solar Farms LLC. 2008. Conditional Use Permit Application, Topaz Solar Farm. July.

Triton Environmental Group, Inc. 2002. Groundwater Resources Evaluation, California Springs Lodge & Resort, California Valley. July 3.

United States Department of Agriculture (USDA). 2003. “Soil Survey of San Luis Obispo County, California, Carrizo Plain Area.”

United States Geologic Survey (USGS), various years. USGS Topographic Quadrangle Maps (California Valley 1966, La Panza NE 1973, Simmler 1982, Las Yeguas Ranch 1973).

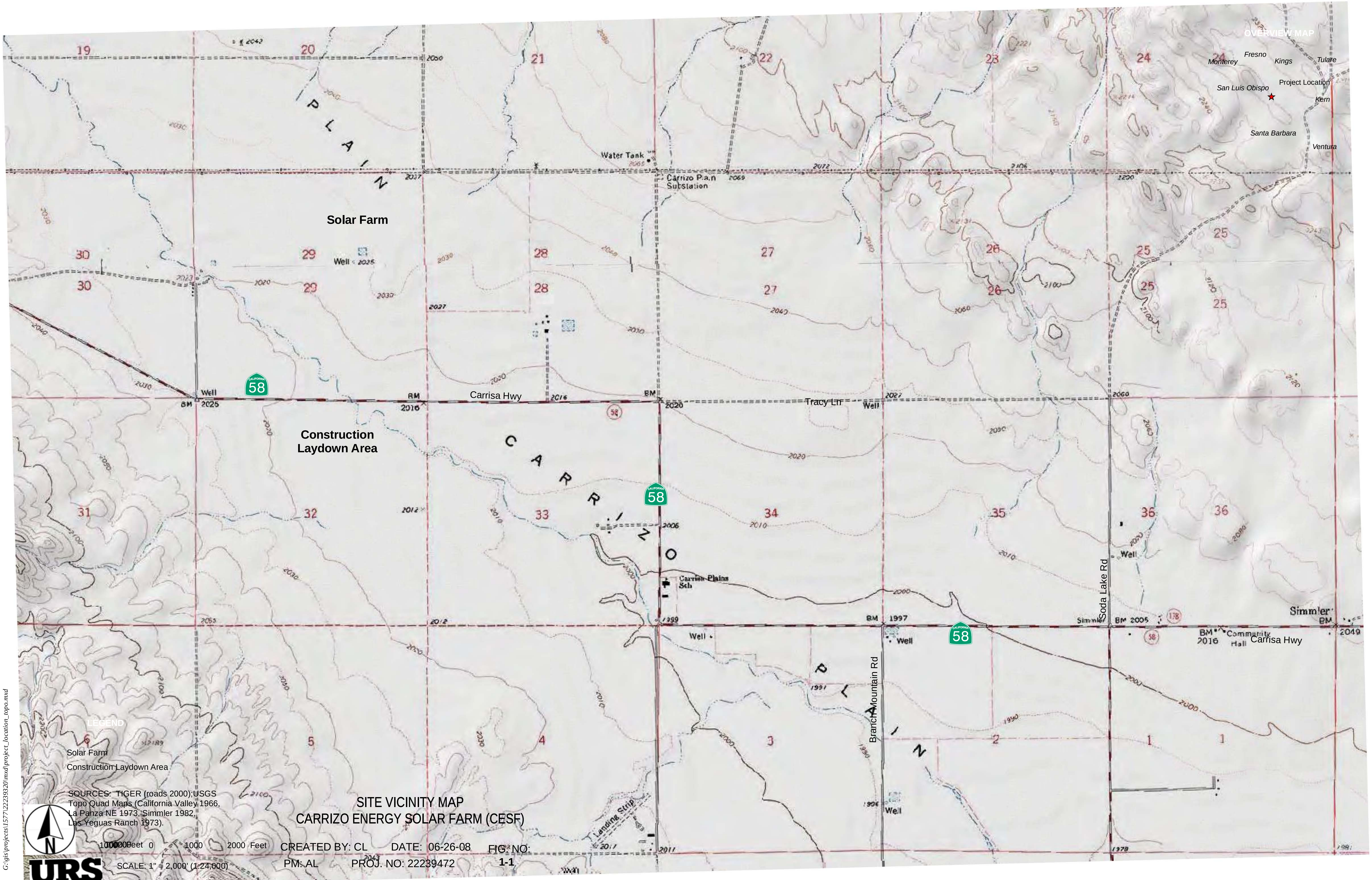
URS Corporation Americas. 2008. Applicant Responses to CEC Workshop Held on March 12, 2008, Application for Certification (07-AFC-8) Carrizo Energy Solar Farm, Carrizo Energy, LLC, April 16.

URS Corporation Americas. 2008. Applicant Responses to CEC Workshop Held on April 12, 2008, Application for Certification (07-AFC-8) Carrizo Energy Solar Farm, Carrizo Energy, LLC, May 15.

URS Corporation Americas. 2008. Applicant Responses to Docketed Letters, Data Requests from the CEC and Comments from Robin Bell (Part 2), Application for Certification (07-AFC-8) Carrizo Energy Solar Farm, Carrizo Energy, LLC, March 18.

URS Corporation Americas. 2008. Applicant Responses to John Ruskovich’s Comments, Application for Certification (07-AFC-8) Carrizo Energy Solar Farm, Carrizo Energy, LLC, March 18.

URS Corporation Americas. 2008. Responses to CEC Data Requests (#1-78) Application for Certification (07-AFC-8) Carrizo Energy Solar Farm, Carrizo Energy, LLC, February 26.



SOURCES: TIGER (roads 2000); USGS Topo Quad Maps (California Valley 1966, La Panza NE 1973, Simmler 1982, Las Yeguas Ranch 1973).

1000 Feet 0 1000 2000 Feet

SCALE: 1" = 2,000' (1:24,000)

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SITE VICINITY MAP
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 06-26-08 FIG. NO: 1-1
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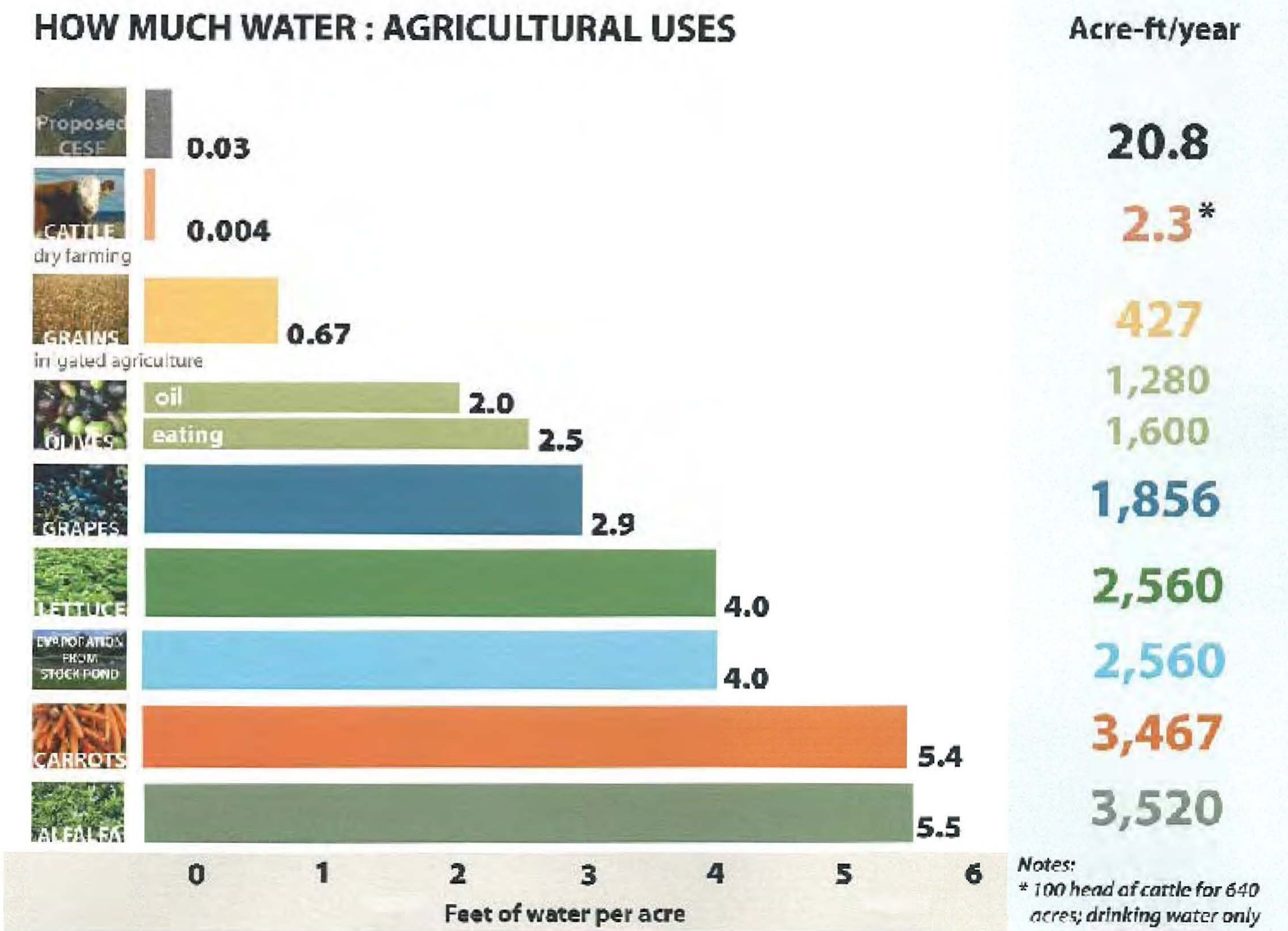

SOURCES:

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NO SCALE

GRAPHIC COMPARISON OF AGRICULTURAL WATER USES TO CESF
CARRIZO ENERGY SOLAR FARM (CESF)

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PM: AL PROJ. NO: 22239472

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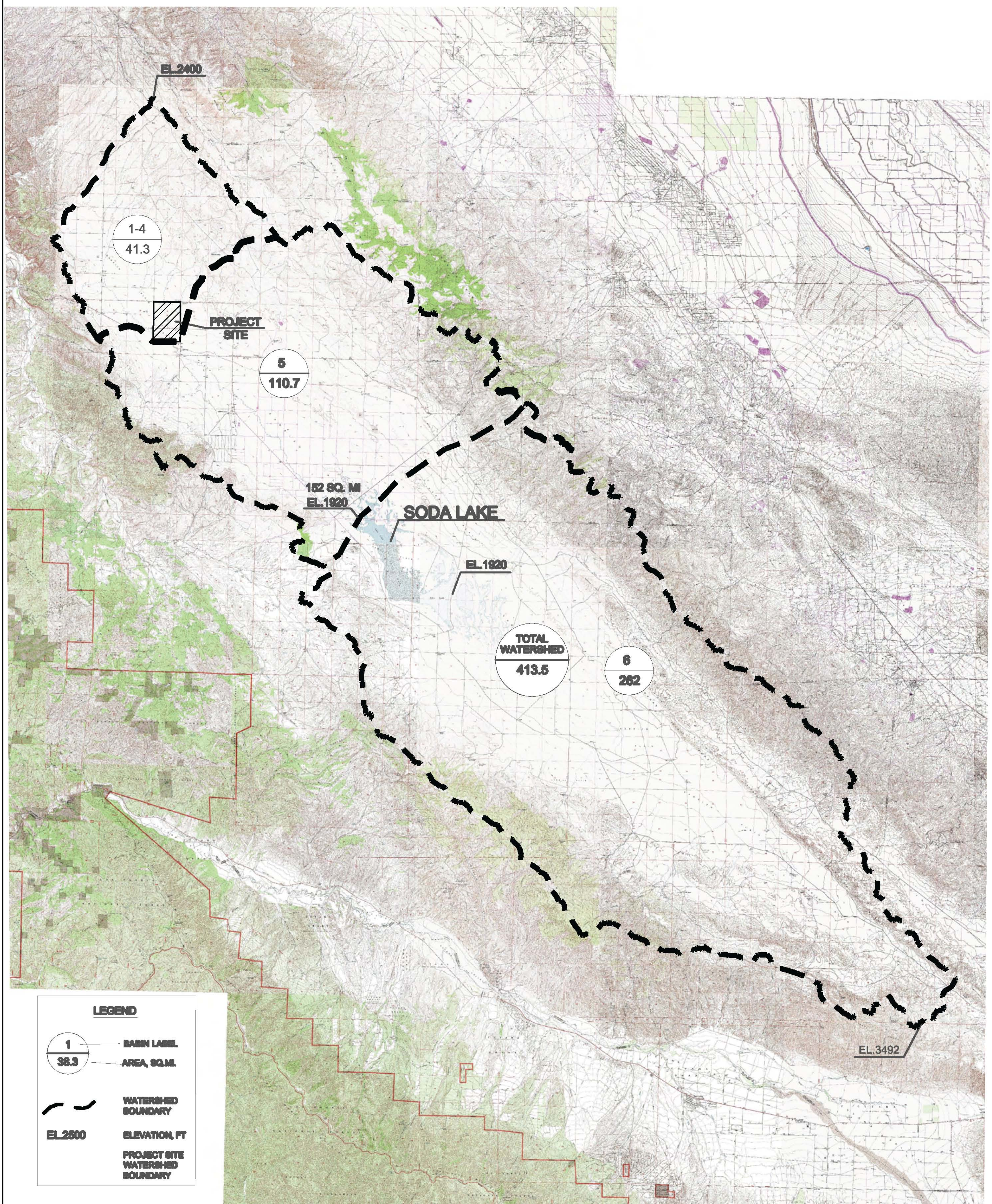

CARRIZO BASIN WATERSHED MAP
CARRIZO ENERGY SOLAR FARM (CESF)

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3000 0 3000 6000 Feet SCALE: 1"= 6000'	CHECKED BY: MM	DATE: 09-15-2008	FIGURE 2-1
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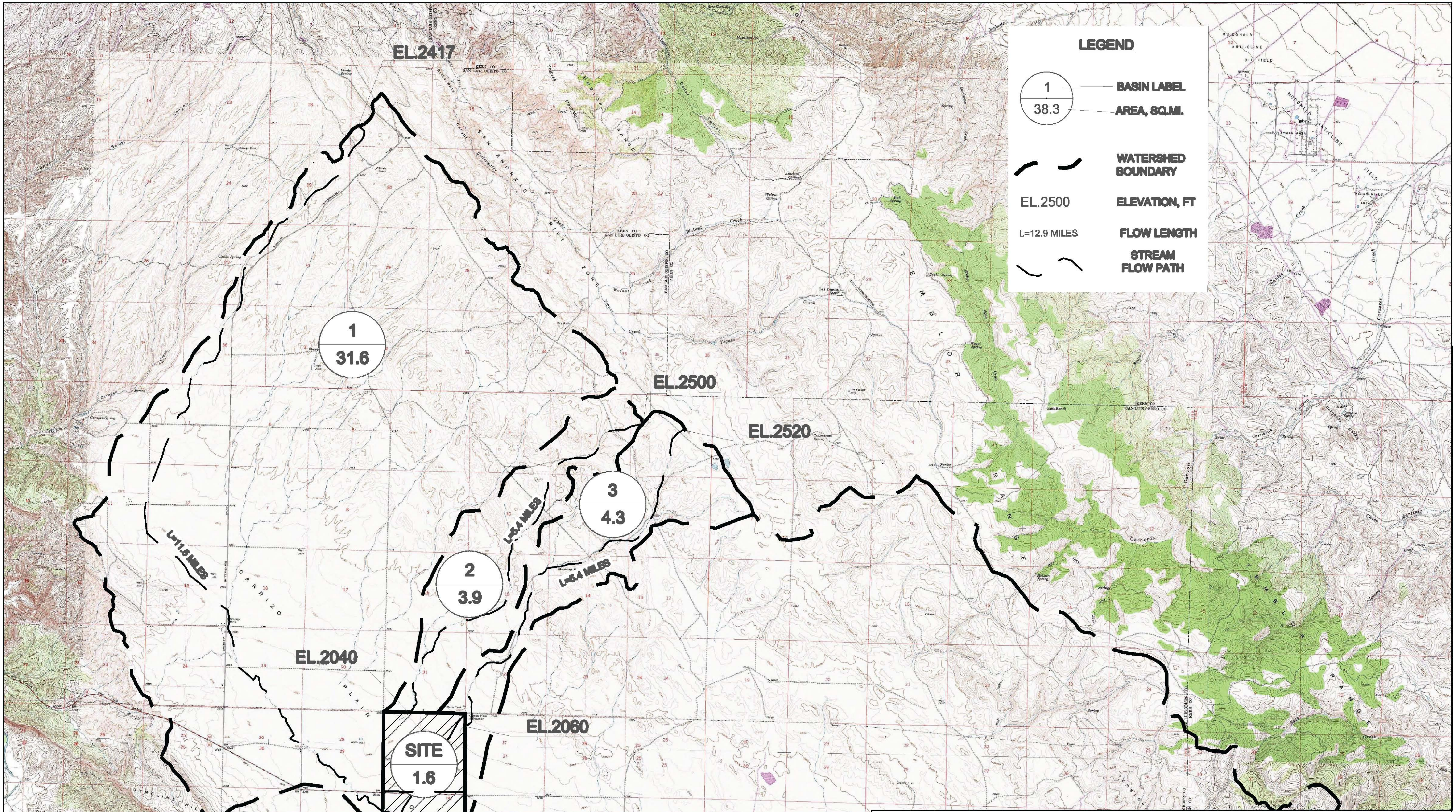

OFF-SITE WATERSHED MAP
CARRIZO ENERGY SOLAR FARM (CESF)

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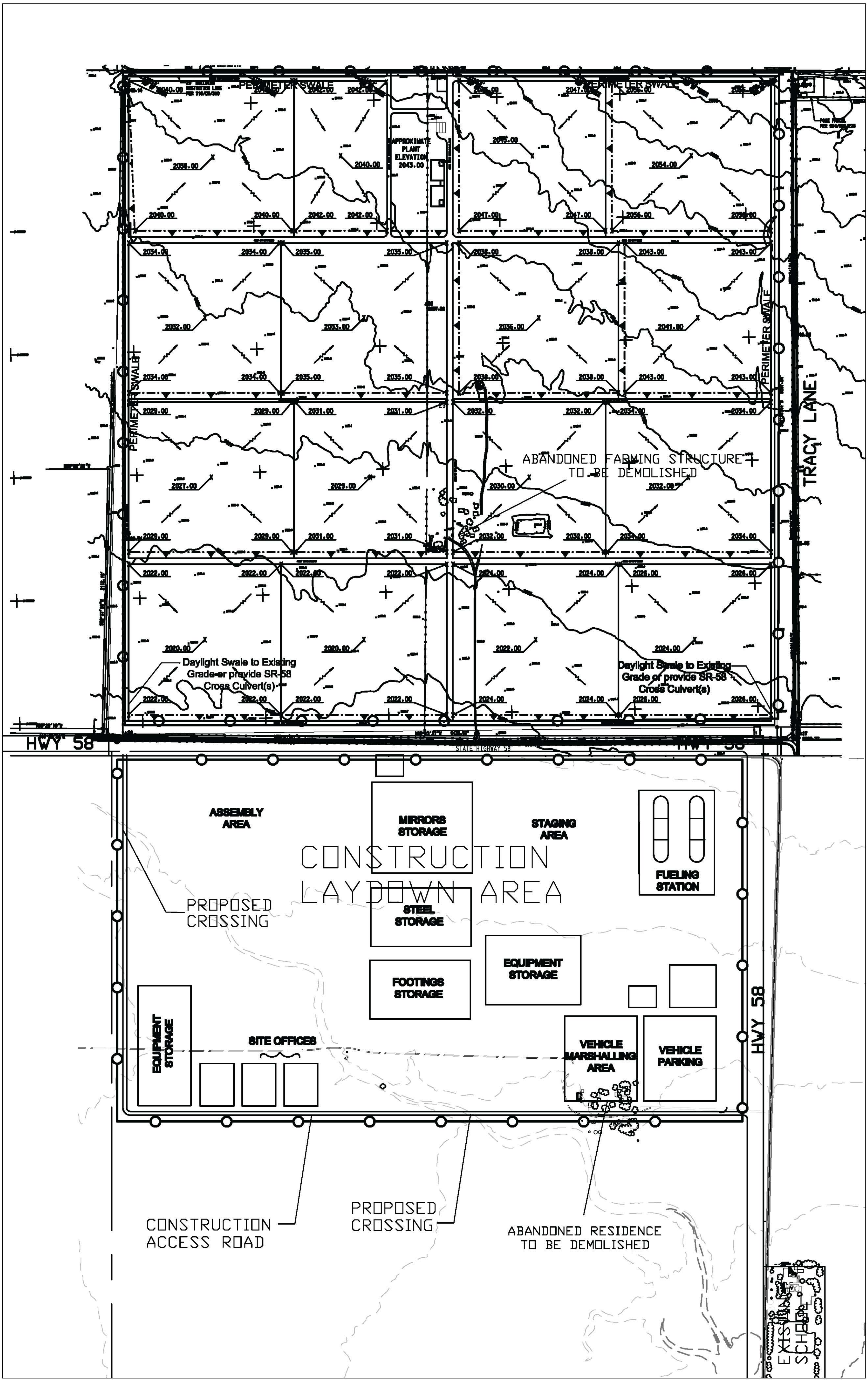

SOIL DISTURBANCE AREA

NOTES:

1. CONSTRUCTION AREA LAYOUT SUBJECT TO REVISION BASED UPON SITE AND CONSTRUCTION CONDITIONS.
2. INFILTRATION BMPS TO BE EMPLOYED IN SOLAR FIELD DETENTION/INFILTRATION AREAS.
3. CONSTRUCTION LAYDOWN AREA TO BE PERMANENTLY STABILIZED AFTER CONSTRUCTION COMPLETE.
4. PERIMETER SWALES TO DAYLIGHT TO EXISTING GRADE OR SR-58 CROSS CULVERTS TO BE INSTALLED TO PROVIDE POSITIVE DRAINAGE.

CESF PROJECT SITE
DRAINAGE, EROSION AND SEDIMENT CONTROL PLAN
SITE DELINEATION MAP

URS

400 0 400 800 Feet
SCALE: 1"= 800'

CHECKED BY: MM	DATE: 02-09-2009	FIGURE **2-3**
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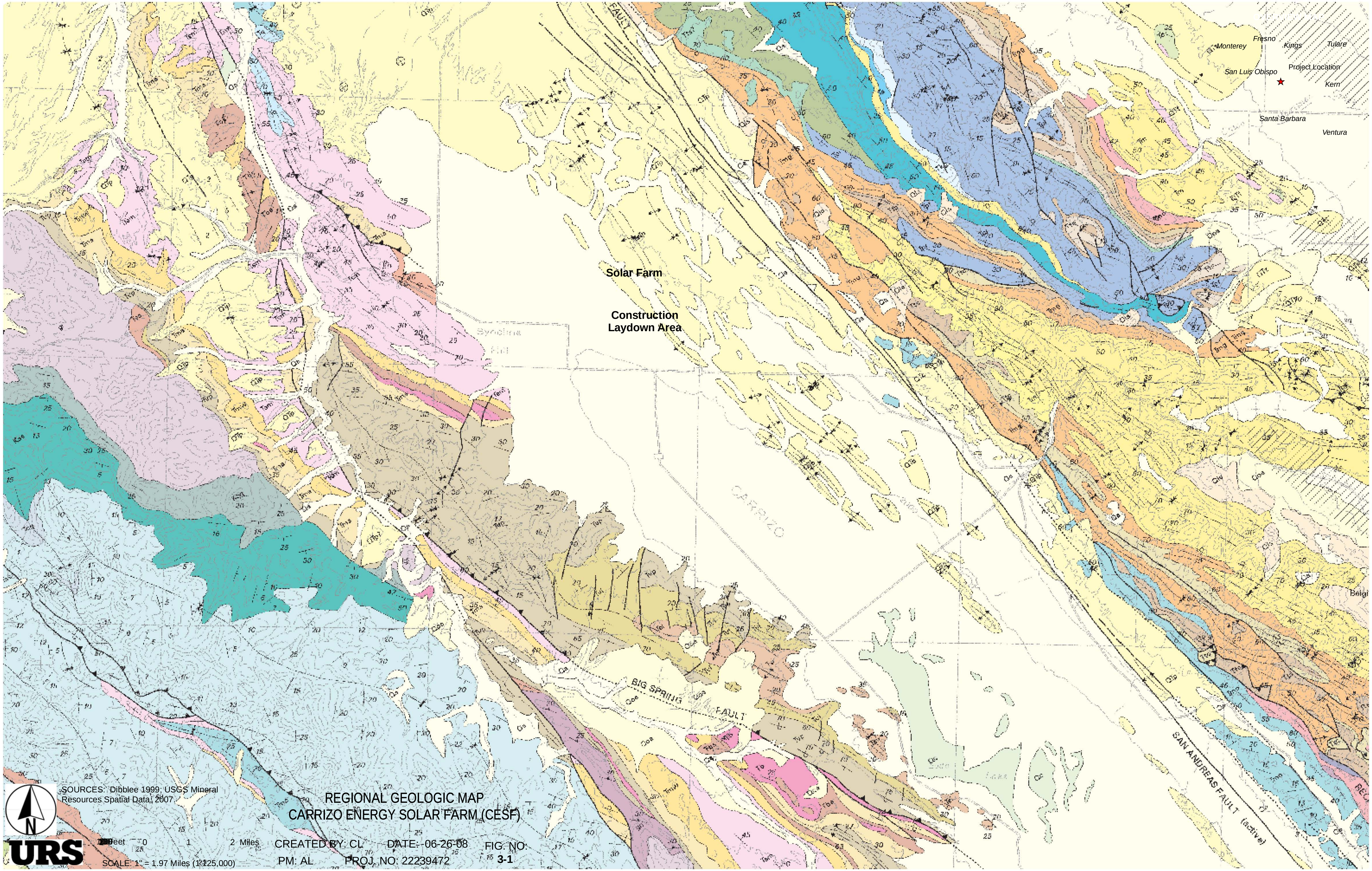

SOURCES: Dibblee 1999; USGS Mineral Resources Spatial Data, 2007.

SCALE: 1" = 1.97 Miles (1:125,000)

REGIONAL GEOLOGIC MAP
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 06-26-08 FIG. NO:

PM: AL PROJ. NO: 22239472 **3-1**

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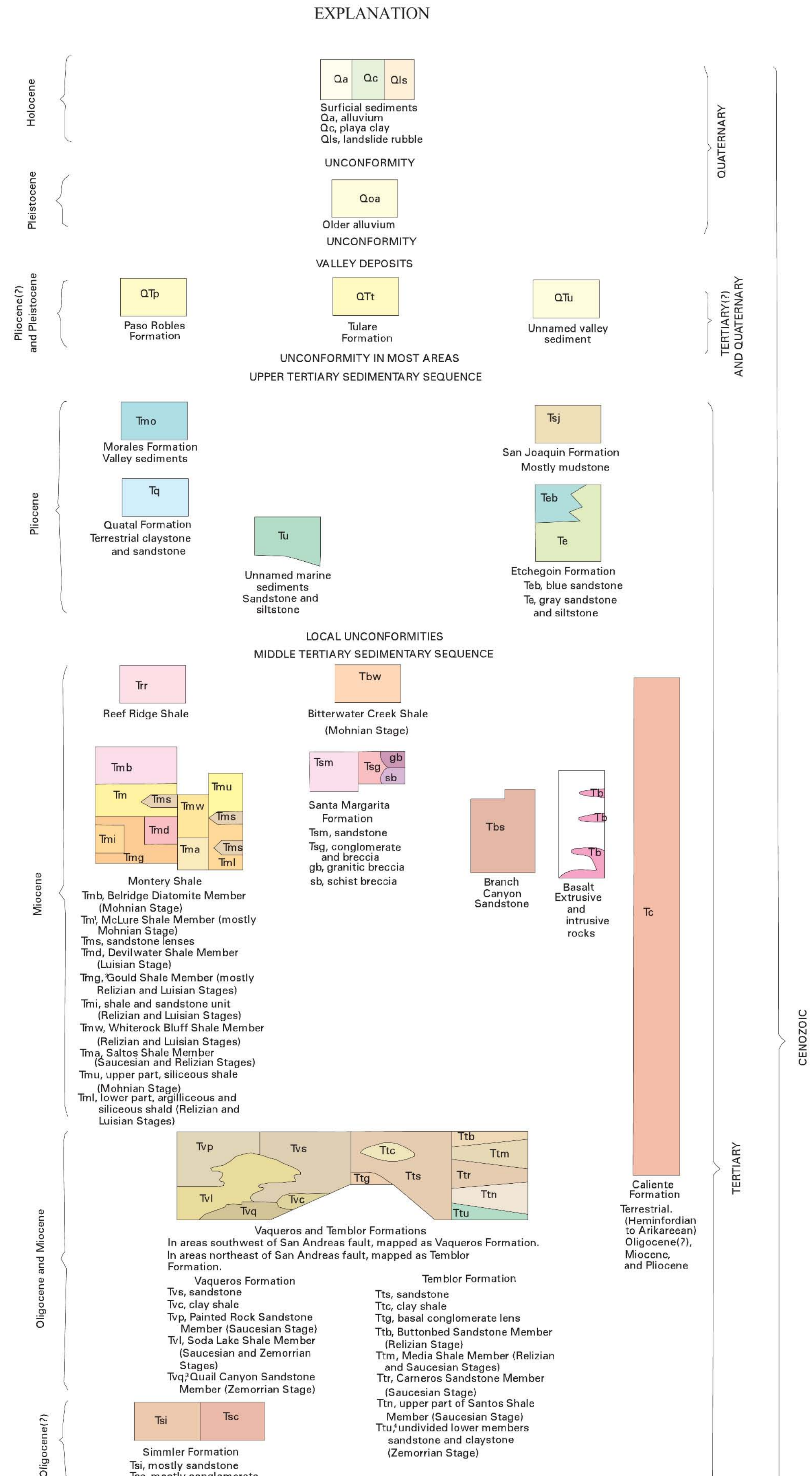

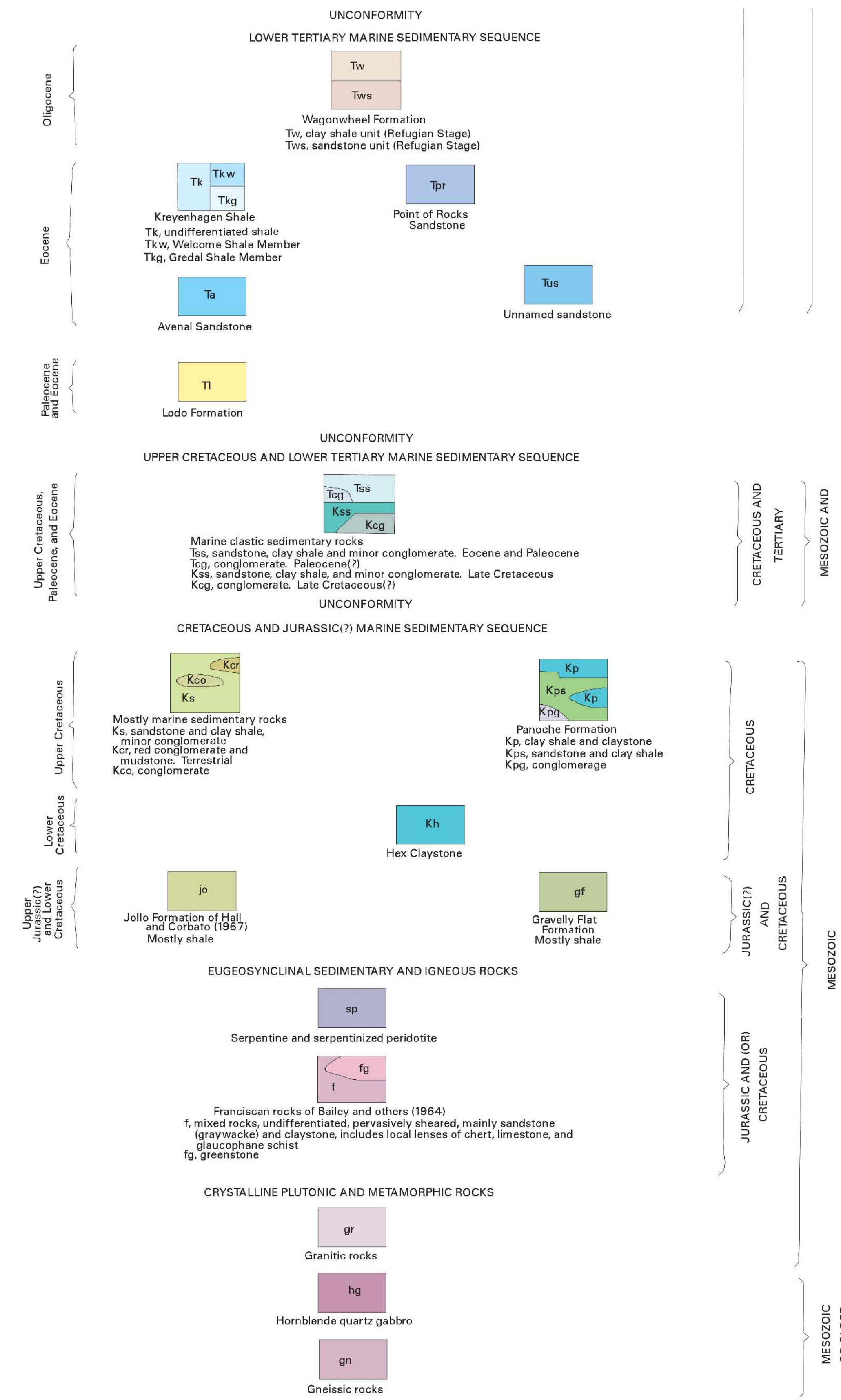

SOURCES: Dibblee 1999.

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Feet

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REGIONAL GEOLOGIC MAP LEGEND
CARRIZO ENERGY SOLAR FARM (CESF)

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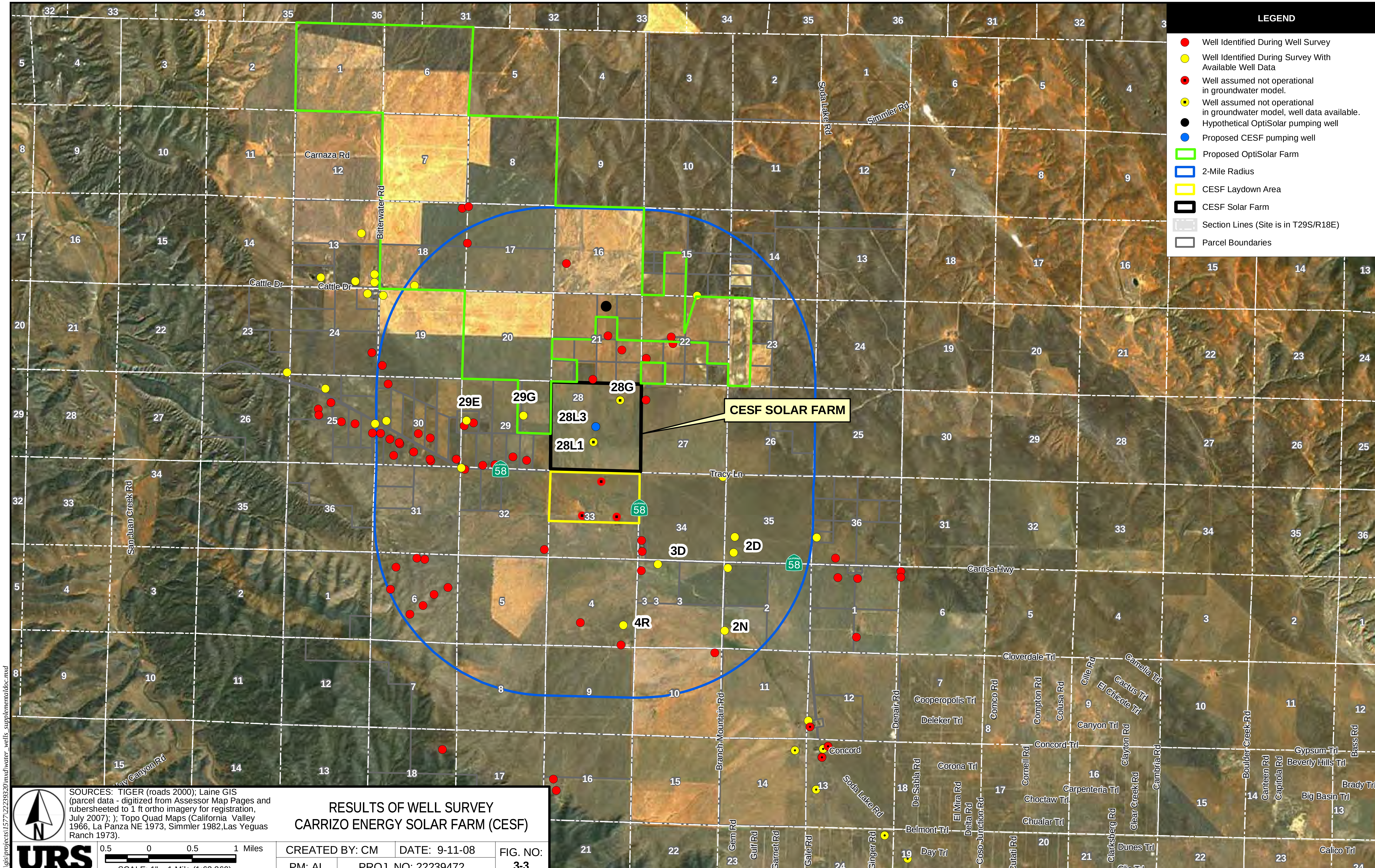
FIG. NO: 3-2



SOURCES: TIGER (roads 2000); Laine GIS (parcel data - digitized from Assessor Map Pages and rubbersheeted to 1 ft ortho imagery for registration, July 2007);); Topo Quad Maps (California Valley 1966, La Panza NE 1973, Simmler 1982,Las Yeguas Ranch 1973).

SCALE: 1" = 1 Mile (1:63,360)

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RESULTS OF WELL SURVEY
CARRIZO ENERGY SOLAR FARM (CESF)

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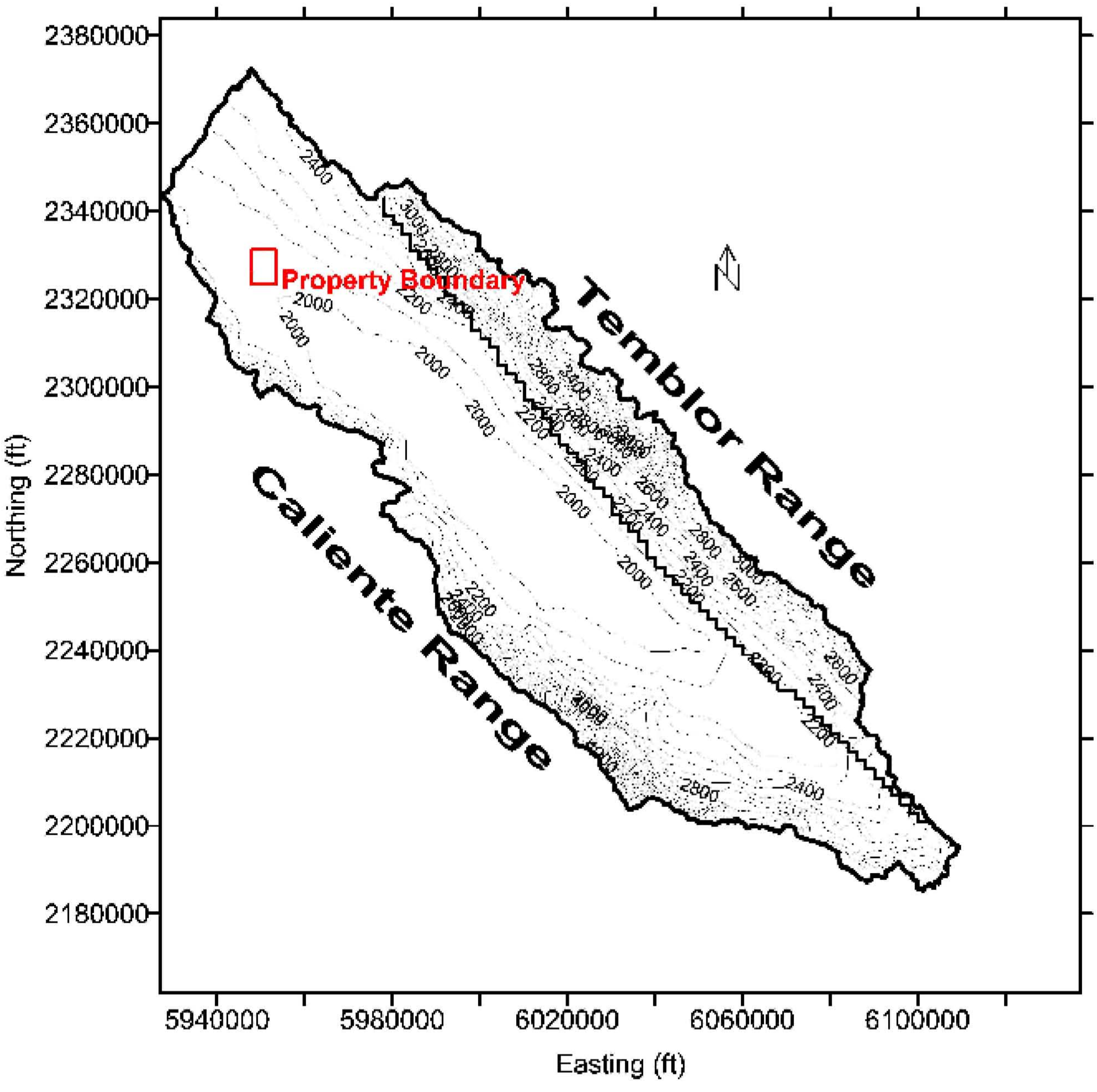


SOURCES:

100 0 100200 Feet

NO SCALE

URS

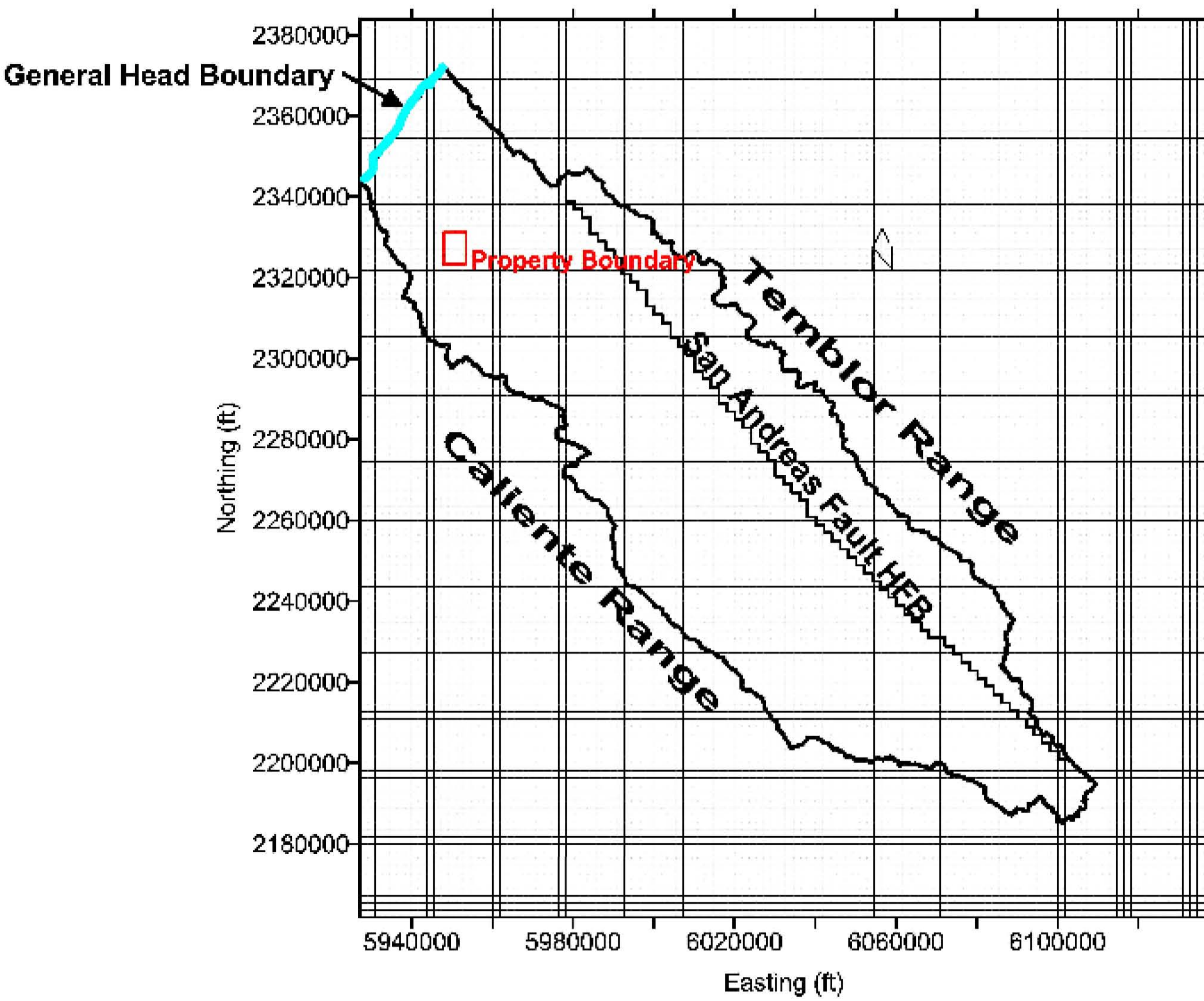
CARRIZO BASIN MODEL BOUNDARIES
AND TOPOGRAPHY (FEET, MSL)
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 06-26-08

PM: AL PROJ. NO: 22239472

FIG. NO: 3-4

Path: G:\gis\projects\1577\22239320\mxd\supplemental_filling\hydro_fig3-4.mxd, 06/26/08, camille_lill



SOURCES:

100 0 100 200 Feet

NO SCALE

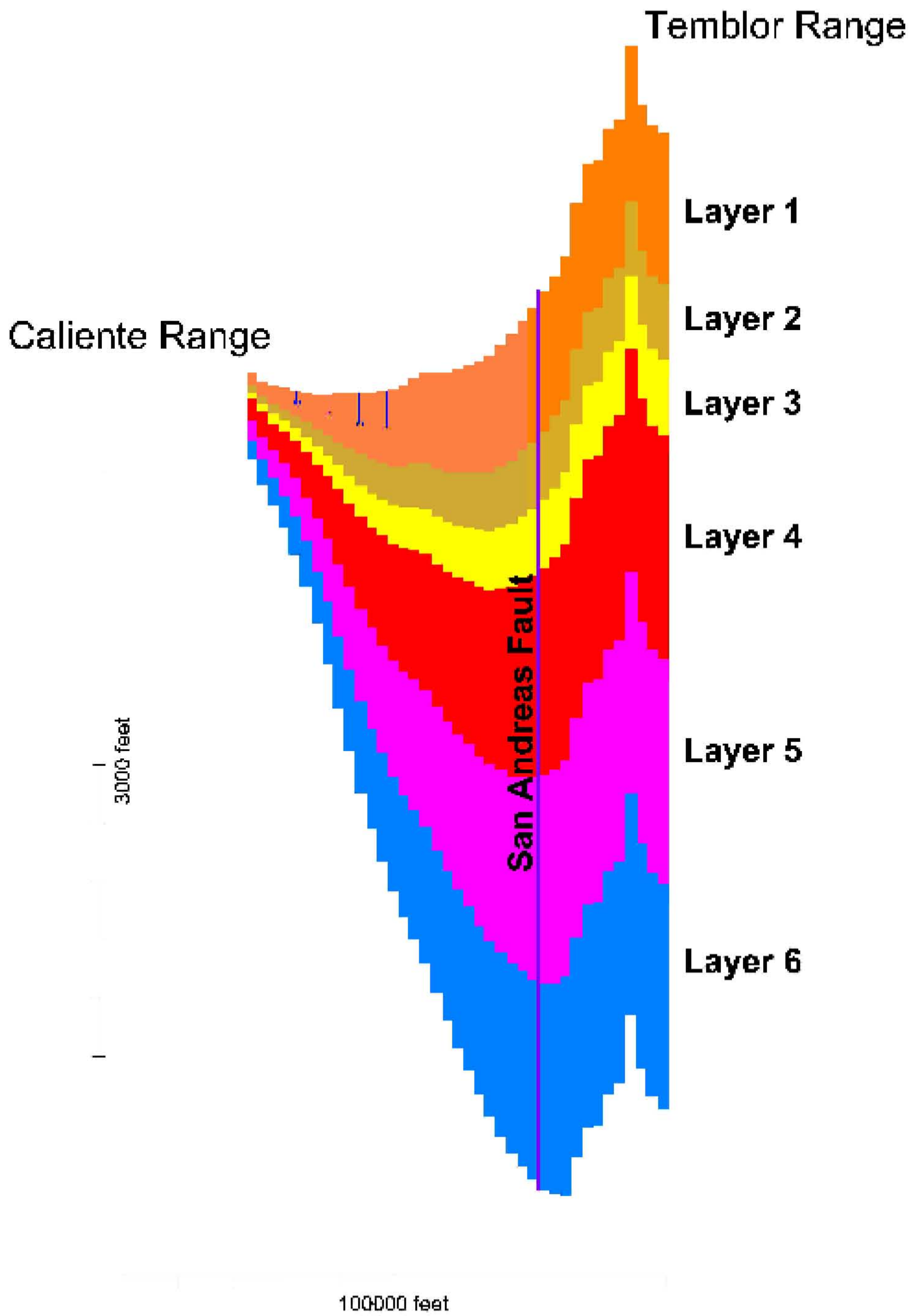
URS

GROUNDWATER MODEL GRID
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 06-26-08

PM: AL PROJ. NO: 22239472

FIG. NO:
3-5



SOURCES:

100 0 100 200 Feet

NO SCALE

GROUNDWATER MODEL GRID
CROSS SECTION
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 06-26-08

PM: AL PROJ. NO: 22239472

FIG. NO: **3-6**

Path: G:\gis\projects\1577\22239518\mxd\hydro_fig3-6.mxd, 06/26/08, camille_lill

With Project(s) (ft AMSL)
Without Project(s) (ft AMSL)
Property Boundary
San Andreas Fault
Area of Detail

Temblor Range

Caliente Range

Northing (ft)

2380000
2360000
2340000
2320000
2300000
2280000
2260000
2240000
2220000
2200000
2180000

5940000 5980000 6020000 6060000 6100000

Easting (ft)

N

URS

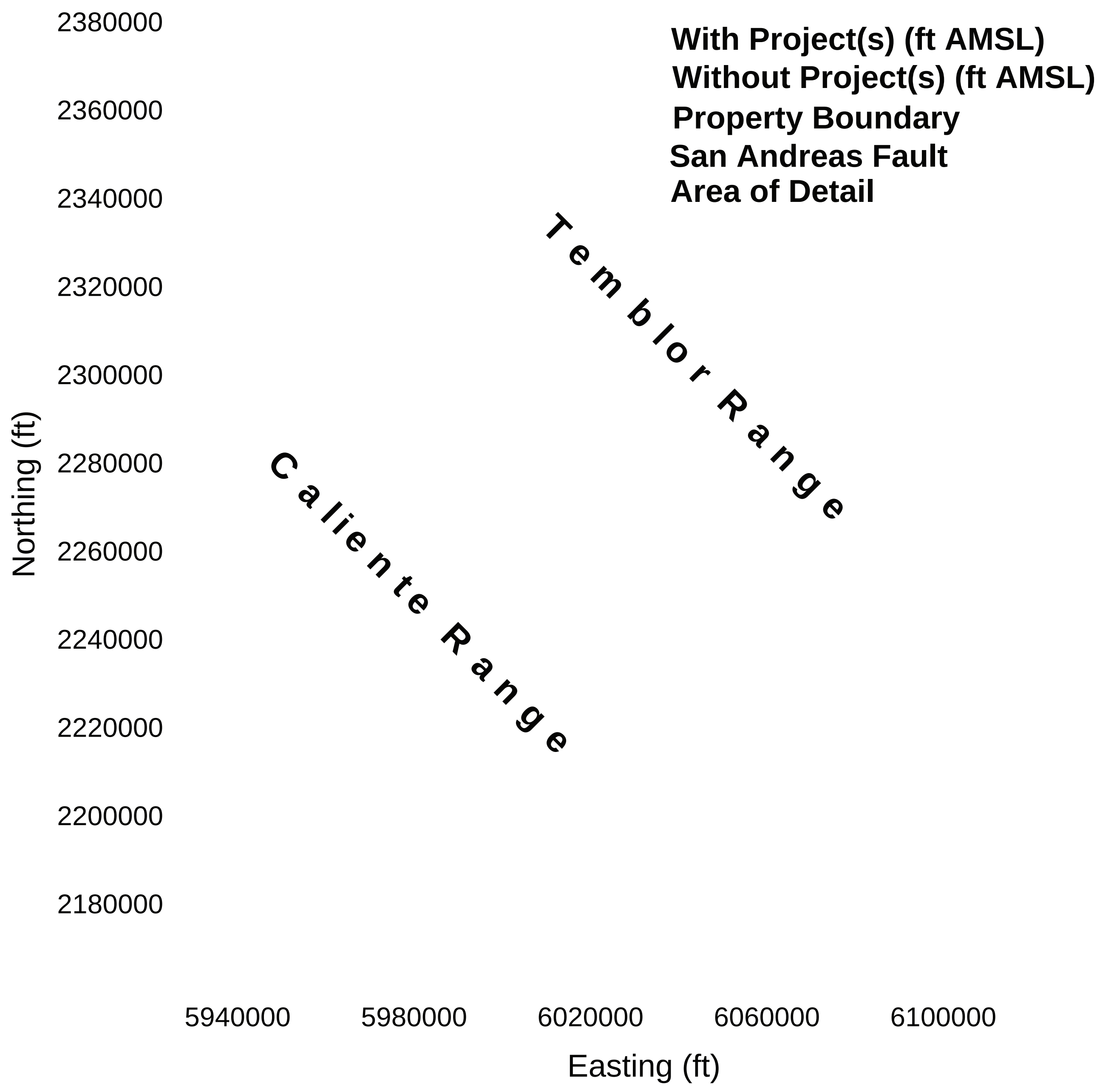
0 2.5 5 Miles

SCALE CORRECT WHEN PRINTED AT 8.5X11

BASIN-SCALE MODEL RESULTS: PROJECT/NO-PROJECT
GROUNDWATER ELEVATIONS - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 02-05-09
PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-7



0 2.5 5 Miles

SCALE CORRECT WHEN PRINTED AT 8.5X11

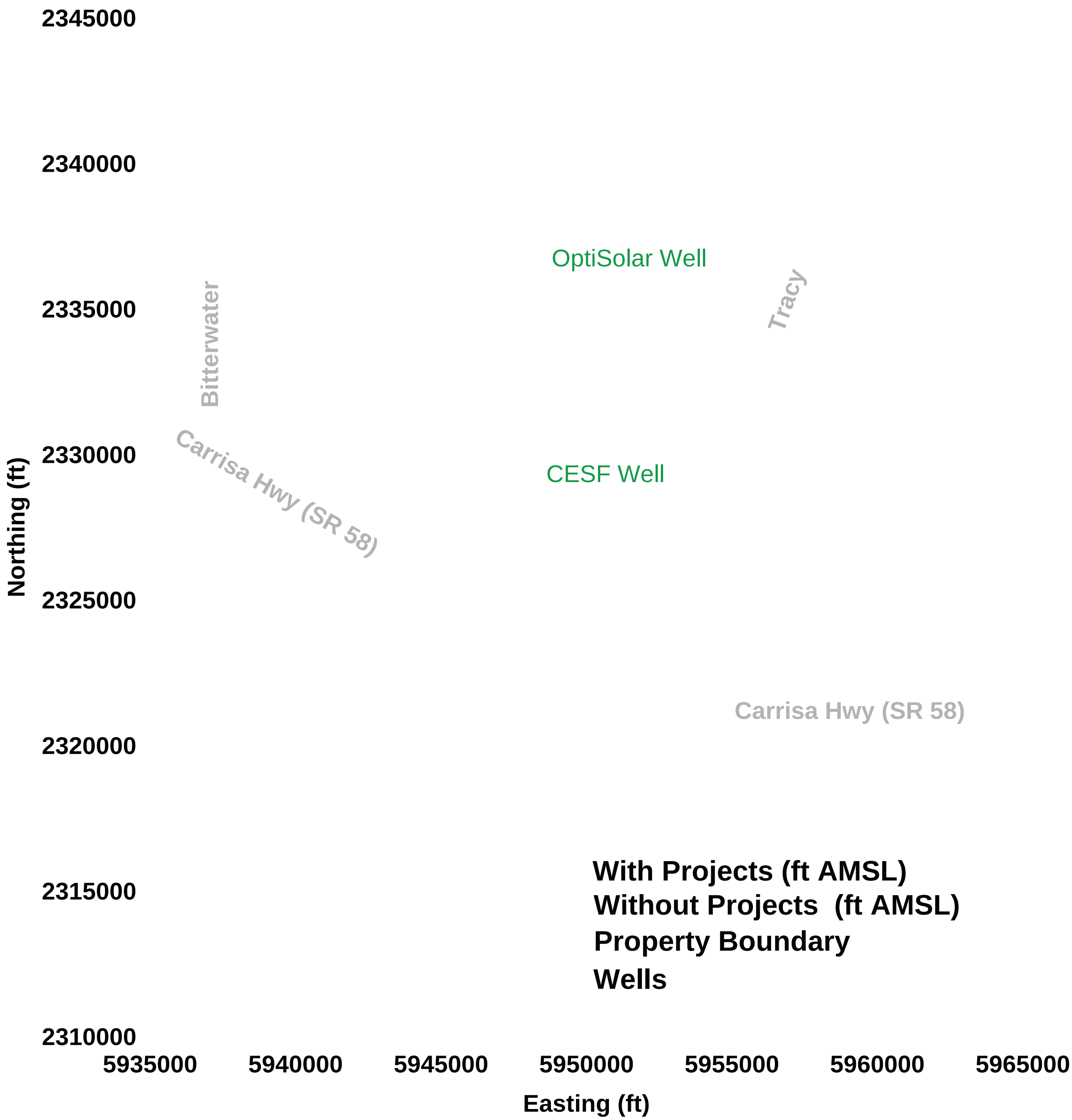
URS

BASIN-SCALE MODEL RESULTS: PROJECT/NO-PROJECT
GROUNDWATER ELEVATIONS - LAYER 3
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 02-05-09

PM: AL PROJ. NO: 27658060.01800

FIG. NO: **3-8**



0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

SITE VICINITY MODEL RESULTS: PROJECT/NO-PROJECT
GROUNDWATER ELEVATIONS - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 02-05-09
PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-9

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

With Projects (ft AMSL)
Without Projects (ft AMSL)
Property Boundary
Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

SITE VICINITY MODEL RESULTS: PROJECT/NO-PROJECT
GROUNDWATER ELEVATIONS - LAYER 3
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 02-05-09

PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-10

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

Negative drawdown indicates water level rise.

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

N

URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

SITE VICINITY MODEL RESULTS: COMBINED/NO-PROJECT
DRAWDOWN - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 02-05-09

PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-11

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

N

URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

SITE VICINITY MODEL RESULTS: COMBINED/NO-PROJECT
DRAWDOWN - LAYER 3
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: CL DATE: 02-05-09

PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-12

2345000
2340000
OptiSolar Well
Tracy
2335000
Bitterwater
2330000
Carrisa Hwy (SR 58)
CESF Well
Northing (ft)
2325000
Carrisa Hwy (SR 58)
2320000
Drawdown (ft)
Property Boundary
Wells
2315000
2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

Note: After Year 1; pumping rate of 144afy (89gpm)

SITE VICINITY MODEL RESULTS
CONSTRUCTION (YEAR 1) - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

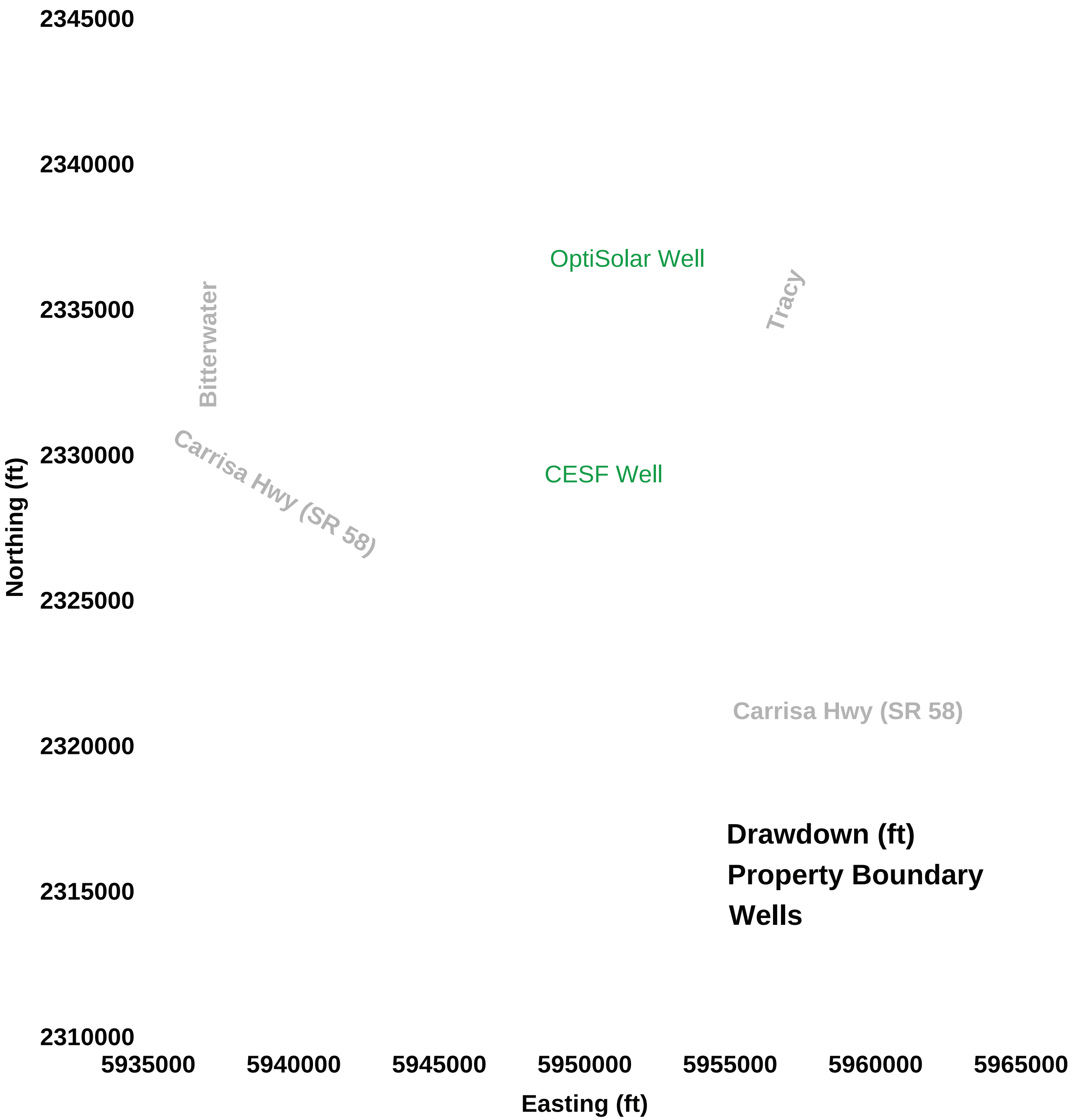
N
URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: CL DATE: 02-05-09
PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-13



Note: After Year 1; pumping rate of 144afy (89gpm)

SITE VICINITY MODEL RESULTS
CONSTRUCTION (YEAR 1) - LAYER 3
CARRIZO ENERGY SOLAR FARM (CESF)

URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: CL DATE: 02-05-09

PM: AL PROJ. NO: 27658060.01800

FIG. NO:
3-14

APPENDIX A Construction Water Use and Sanitary Water Use Summary

POWER ENGINEERS

Ausra Carrizo Construction Water Estimate

Water Truck Delivery Capacity			
Quantity	2	EA	Average 2 water trucks during construction period
Annual Working Days	260	DAYS	52 - 5 day weeks
Annual Operation	2,080	HR	8 - hour days
Capacity	3,600	GAL	Typical capacity (bigger trucks available)
Discharge Rate	330	GPM	5 MPH and 24 FT swath
Discharge Time	11	MIN	
Recharge Time (travel and refill)	30	MIN	Elevated tank gravity quick fill system
Cycle Time	41	MIN	
Truck Cycles	12	CYC/DAY	Maximum, probably less
Available Annual Water Truck Delivery	**67.41**	**AFY**	

Construction Water Usage Estimates			
Dust Suppression			
Dust Suppression Water Usage	0.03	GAL/SF	Estimate (32 SF/GAL)
Disturbed Area Water Coverage	1,359	GAL/AC	
Active Roadway Water Coverage	3,960	GAL/MI	24 FT wide road
Maximum Unstabilized Disturbed Area	20	AC	equivalent to a 5 Line Block
Maximum Active Roadway	2.0	MI	Estimate of active roadway
Disturbed Area Application Interval	2	APP/DAY	Estimate based upon climate
Active Roadway Application Interval	4	APP/DAY	Estimate based upon climate
A) Annual Water Usage	**68.66**	**AFY**	
Grading Compaction			
Fill Volume	1,200,000	CY	Grading completed within first year
Soil Dry Density	100	LB/CF	Assumption per preliminary geotech report
Moisture Conditioning	5%		Assumed added moisture for optimum compaction
Water Losses	20%		Assumed losses to waste and evaporation
B) Total Water Usage	**71.56**	**AF**	
Concrete Hydration			
Concrete Quantity	75,000	CY	30,000 CY Power Block and 45,000 CY Solar Field
Moisture Requirement	48	GAL/CY	
C) Total Water Usage	**11.05**	**AF**	
Potable Drinking Water			**Assume provided by off-site bottled water**
Labor Force (avg)	290	PEOPLE	
Worker Consumption	1	GAL/DAY	16 - 8 OZ glasses
D) Annual Water Usage	**0.23**	**AFY**	
E) Sanitary System			**Assume provided by off-site portable chemical toilets**

Estimated Annual Construction Water Usage			
YEAR 1 (month 1-12)	**143.87**	AFY	Dust suppression, grading compaction and partial concrete hydration (A + B + 0.33C)
	375.64	GPM	Average on-site well rate during working hours.
YEAR 2 (month 13-24)	**72.31**	AFY	Dust Suppression and partial concrete hydration (A + 0.33C)
	188.80	GPM	Average on-site well rate during working hours.
YEAR 3 (month 25-35)	**37.98**	AFY	Partial dust suppression and partial concrete hydration (0.50A + 0.33 C)
	99.16	GPM	Average on-site well rate during working hours.

Notes:

1) Four water trucks required through month 12, two through month 24, and one through month 35.
2) Soil will be more permantly stabilized using an alternative to water as earthwork is completed in each area.
3) Water for consumption and sanitary services during construction will be sourced from off-site.

Sanitary System Capacity Analysis

The following sanitary system capacity is based upon the below operational staff levels, which correlates with the AFC:

Total Personnel: 75 including:
Administration: 5 total (one-shift)
Operations: 10 total (two-shifts, 5 per shift)
Power Block Maintenance: 10 total (two-shifts, 5 per shift)
Solar Field Maintenance: 50 total (one-shift)

Table K-3 in the California Plumbing Code is the appropriate table for determining septic tank size and sanitary waste flows. Table K-3 has a value of 35 gpd per employee which is associated with Factories with showers. This is the closest category in the table that compares to an industrial power plant setting.

25 employees per day x 35 gpd = 875 gallons; plus
50 employees at 17.5 gpd = 875 gallons

Note that it is assumed that 50 employees work out in the solar field where there will be portable toilets and therefore half of the 35 gpd was used because we assume the employees will use the plant facilities in the morning and during the lunch hour.

Total wastewater flows then are 875 x 2 = 1750 gallons per day.

From table K-3 for flows over 1,500 gpd use the following formula:
Flow x 0.75 + 1125, 1750(0.75) + 1125 = 2437.5 gallons,
Select 2500 gallon septic tank.

Summary
The SLO county private septic system requirements will need to be considered in the detailed design of the sanitary facilities, but these requirements are focused on residential installations, and these calculations referred to the CPC for the tank capacity estimate per the above. The leach field design is partially based upon the soil percolation rate, which was not provided in the preliminary Geotechnical report. So, the detailed design of the leach field area will need to wait for input from the final Geotechnical report. As noted above, it is assumed the mirror washing personnel will have access to mobile chemical toilets in the solar field, so their number have only a partial impact on the site permanent sanitary facilities.

Average sanitary water usage would be based upon the above estimate of 1750 gpd. This equates to a sanitary flow rate averaging 1.22 gpm over a 24-hour period.

It is also assumed potable water for consumption will be bottled water from off-site.

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Stanford U.
(415) 321-1656
321-2300, x-4444

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Ground water in the Carrizo Plain
W. Kemnitzer, Economic Geologist, Menlo Park, 1967

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GROUND WATER IN THE CARRIZO PLAIN, CALIFORNIA

by

William J. Kemnitzer[1]

ABSTRACT

The objectives of this investigation have been (1) to ascertain the degree of development of ground water in the Carrizo Plain; and (2) to determine to what extent these waters might support maximum agricultural, livestock, and community development within the area.

The Carrizo is a treeless but grassy flat to rolling plain lying at an average elevation of some 2,200 feet above sea level between two moderately high coastal ranges in southeastern San Luis Obispo County, California. It is 120 miles in a straight line northwest of the city of Los Angeles. The floor of the plain has an area of around 324 square miles, or 207,000 acres, nearly all arable and about half irrigable. It is sparsely settled, mostly by a few old-time ranch families who, since the 1880's, have dry-farmed grain and grazed cattle and sheep during the natural grass-growing season.

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[1] Economic Geologist, Menlo Park, California.

In making this investigation, Government and private sources were consulted. Four field trips of several days' duration each were made into the area. Data obtained from these sources were correlated with geological investigations made intermittently over a period of several years. It was found that no comprehensive investigations or coordinated plans for water development in the Carrizo have been made, despite the fact that there exists an abundance of ground water and a large area of irrigable land.

The surface of the Carrizo Plain is a basined topographic feature comprising a hydrologic unit about 56 miles long and 8 miles wide within the limits of its watershed. This topographic basin superimposes and is in concurrence with a larger crescent-shaped structural geologic basin which is about 75 miles long and 12 miles wide at its center.

The Carrizo topographic basin is shaped in non-marine formations of post-Pliocene age. They consist mostly of loosely to well-consolidated sands, gravels, silts, and clays which overlay unconformably older folded and faulted marine and continental strata. The younger non-marine beds lay in a wedge-shaped body more than 3,000 feet thick in places fronting the San Andreas fault. This body wedges out westward across the plain onto uplifted older rocks of the Caliente Range and San Juan Hills. It is within these younger non-marine formations that most of the fresh ground water of the Carrizo Plain is found.

The Carrizo Plain is dependent on precipitation mostly in the form of rainfall for its water supply. Its watershed, including the floor of the plain, comprises 418 square miles, or 286,000 acres. An average of a little more than 8 inches of rain falls annually upon this watershed. Because the Carrizo basin is closed on all sides to surface water outflow, precipitation which does not find its way underground during the short season of intermittent rains, accumulates in Soda Lake in the center of the basin. Usually, however, these surface waters evaporate before the end of the long summer, leaving the lake bed dry during most of the year. Notwithstanding, water tables have remained high beneath most of the plain because ground water development to date has been on a small scale in relation to the annual natural recharge.

At present (1967), less than 1,000 acres, all in the northwestern quarter of the plain, or less than 1 percent of the approximate total of 100,000 acres of irrigable land are irrigated mostly for alfalfa and pasture crops. Ground water for this irrigation is pumped from 9 wells. These wells range in depth from 200 to 700 feet and have output capacities rated at from 200 to 1,100 gallons per minute.

Net consumption of ground water at present is estimated at the rate of 3,364 acre-feet annually. In addition, some 534 acre-feet annually are being pumped from 89 shallower wells (mostly less than 100 feet in depth) for household and livestock use. Thus, the total net consumption of ground water in the Carrizo at present is at the rate of around 3,898 acre-feet a year which is about 2 percent of the gross, and 5 percent of the net average annual recharge. In general, the ground waters outside the Soda Lake area and the deeper waters throughout the basin are from good to fair quality, but even the best of them are moderately hard.

The balance between water recharge and discharge for the Carrizo basin involves a gross annual amount of some 177,000 acre-feet. This figure is based on the average precipitation of 8 inches (0.667 foot) of rainfall annually falling upon 266,000 acres of watershed. Of this gross recharge, at least 118,000 acre-feet, or nearly 67 percent, is estimated lost through evapo-transpiration and other natural processes. The remaining 55,000 acre-feet, or 31 percent of the gross, is considered to be the net average annual ground water recharge. (See SPECIAL NOTE, p. 5a.)

That part of the net average annual recharge of 59,000 acre-feet into the Carrizo ground water body which is not being utilized, is believed to pass out of the basin as underflow at its northern end into the adjacent La Yeguas and the San Juan subsurface drainage areas. It is believed that this overflow could be captured economically before it has opportunity to leave the basin, without lowering appreciably the over-all ground water level. Recovery of this net recharge would then be sufficient to irrigate approximately 32,000 acres of hay and grain, alfalfa, pasture, truck and miscellaneous crops as well as to supply a modest community development, mostly in the northern half of the plain. Depths of wells to capture this underflow would fall within the range of from 500 to 1,500 feet.

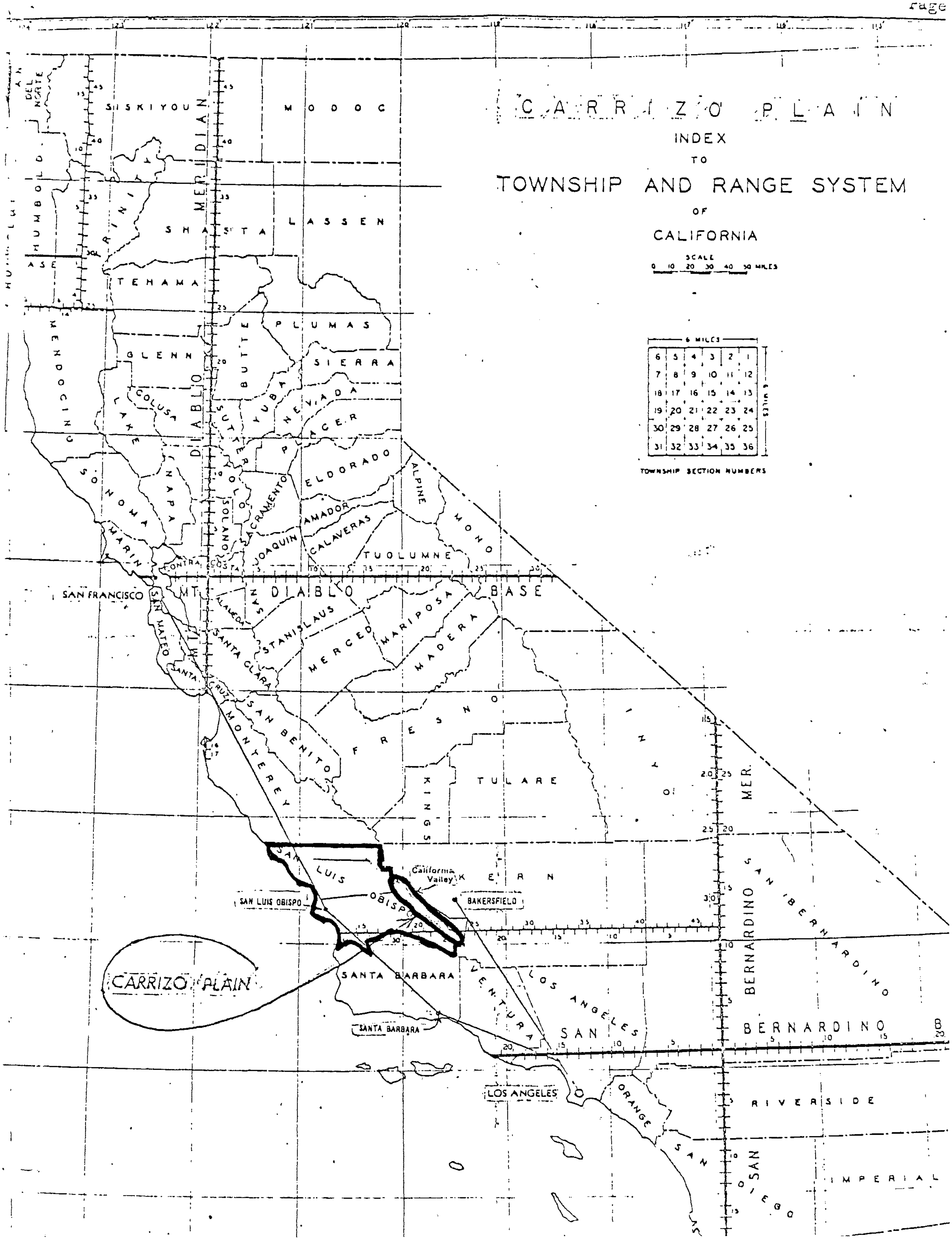
In addition to the net average annual recharge of meteoric[2/] waters available for use, certain quantities of connate[3/] waters might be drawn upon during periods of deficient recharge in order to meet requirements established on the basis of annual average recharge. Of course, the ultimate extent to which ground waters of the Carrizo might be utilized profitably will depend upon the economic results of balancing the cost of pumping water from deep wells with the revenue expected from the products of irrigation or other usage. It is here that feasibility studies involving the details of costs and revenues must be made before undertaking any extensive program of ground water development.

2/ Meteoric water is that which previously existed as atmospheric moisture or surface water, and that entered from the surface into the voids of the lithosphere. (Meinzer)

3/ Connate water is that which was deposited simultaneously with the deposition of solid sediments, and which has not since deposition existed as surface water or atmospheric moisture. (Meinzer)

SPECIAL NOTE

A first estimate of 80,634 acre-feet net average annual recharge available for use was determined by deducting from gross recharge, the vegetal discharge through native unplanted vegetation. A revised estimate of 55,232 acre-feet net average annual recharge available for use is derived by deducting from gross recharge, the vegetal discharge through planted dry-farmed vegetation. The difference is 25,402 acre-feet, based on 38,084 acres of planted vegetation (mostly dry-farmed grains) utilizing an average of 0.667 feet of seasonal rainfall. Obviously, the net average annual recharge available for use will vary according to the acreage of planted dry-farmed vegetation. (See Table 4, p. 40).


CARRIZO PLAIN
INDEX
TO
TOWNSHIP AND RANGE SYSTEM
OF
CALIFORNIA
SCALE
0 10 20 30 40 50 MILES
6 MILES
6 5 4 3 2 1
7 8 9 10 11 12
18 17 16 15 14 13
19 20 21 22 23 24
30 29 28 27 26 25
31 32 33 34 35 36
TOWNSHIP SECTION NUMBERS
DEL NORTE
SISKIYOU
MODOC
HUMBOLDT
TRINITY
SHASTA
LASSEN
TEHAMA
PLUMAS
MENDOCINO
GLENN
BUTTE
SIERRA
COLUSA
LAKE
YUBA
NEVADA
SUTTER
PLACER
SONOMA
NAPA
YOLO
ELDORADO
ALPINE
SOLANO
SACRAMENTO
AMADOR
MONO
MARIN
JOAQUIN
CALAVERAS
TUOLUMNE
CONTRA COSTA
MT. DIABLO MERIDIAN
MT. DIABLO BASE
SAN FRANCISCO
SAN MATEO
ALAMEDA
STANISLAUS
MARIPOSA
MADERA
SANTA CLARA
MERCED
SANTA CRUZ
SAN BENITO
FRESNO
INYO
MONTEREY
TULARE
KINGS
SAN LUIS OBISPO
California Valley
KERN
BAKERSFIELD
SAN BERNARDINO
SAN BERNARDINO MER.
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO BASE
CARRIZO PLAIN
SANTA BARBARA
LOS ANGELES
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL

INTRODUCTION

LOCATION AND SIZE OF THE AREA

The Carrizo[4/] Plain is a semi-arid area of flat, sloping, and rolling hills land in the southeastern part of San Luis Obispo County, California. The alluvial floor of this topographic basin is approximately 54 miles long and 6 miles wide. It comprises 324 square miles, or 207,000 acres of arable land, about half of which is irrigable. It is elongated in a northwest-southeast direction between two coastal ranges, the Temblor on the east and the Caliente-San Juan Range on the west.[5/] Elevation of the basin floor averages about 2,200 feet above sea level. That of the Temblor Range 3,000 feet and that of the Caliente about 4,000 feet, while the San Juan section of this latter range is considerably lower at about 2,500 feet.

A number of roads lead into the Carrizo Plain but probably the most travelled connect with California State

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[4/] The word "Carrizo" is the Spanish name for common reed grass. The early Spanish explorers who crossed the plain in the 16th century, applied this name to the area from the abundance of reed grass growing on the fringes of the lacusttrine areas in the central part of the plain.

[5/] Actually the Temblor Range is on the northeast and the Caliente-San Juan is on the southwest but common practice is to refer to the east and the west sides of the plain or basin.

route 58 which crosses the northern part of the plain between Bakersfield on inland route U.S. 99, and Santa Margarita (9 miles north of San Luis Obispo) on coast route U.S. 101. In crossing the Carrizo Plain, State 58 intersects Soda Lake Road. About 2 miles south on this road is the settlement of California Valley, headquarters of a new community development in the plain. Here there are an inn and other conveniences for visitors and residents. About 1 mile south of this place is a small landing field for private airplanes. There is no commercial air service into the area or other means of public transportation.

From San Francisco, the shortest route into the Carrizo is southward on U.S. 101 to Santa Margarita, thence 36 miles eastward on State 58 to California Valley, a total distance of 269 miles. From Los Angeles via Santa Margarita the total distance is 254 miles, but the shortest route from Los Angeles into the Carrizo is inland over U.S. 99 via the Maricopa turnoff (95 miles north of Los Angeles and 21 miles south of Bakersfield) over State 166 to Maricopa 23 miles, thence on State 33 northwestward 21 miles to State 58, thence westward on 58 over the Temblor Range 26 miles to California Valley, a total distance of 166 miles. A summary of road distances and average driving times is given in Table 1.

The location of the Carrizo Plain is shown in Figure 1. Other features are shown on 1:250,000-scale quadrangles of the U.S. Geological Survey[6] covering Southern California, and on the San Luis Obispo County township, range and section map of the California Division of Forestry, both in separate envelopes accompanying and made a part of this report. Figure 2 shows main roads to the Carrizo Plain.

TABLE 1.- Summary of road distances and average driving times to the Carrizo Plain (California Valley) from San Francisco and Los Angeles

To Carrizo Plain (California Valley) from	Road distance (Miles)	Driving time (Hrs:min)	Remarks
SAN FRANCISCO:			
via Santa Margarita.........	269	5:35	Paved; all weather
via Paso Robles & Cholame...	265	5:25	Last 38 miles unpaved
LOS ANGELES:			
via Santa Margarita.........	254	5:10	Paved; all weather
via Maricopa & Soda Lake Rd.	172	4:30	Last 45 miles unpaved
via Maricopa & Taft.........	166	4:15	Paved; all weather

CARRIZO PLAIN AS A HYDROLOGIC UNIT

The Carrizo Plain comprises one of six hydrologic units into which the County of San Luis Obispo has been divided.[7]

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[6] Other more detailed maps on other scales covering all or a part of the Carrizo Plain may be obtained from the Geological Survey, United States Department of the Interior, Menlo Park, California.

[7] According to State Water Resources Board. San Luis Obispo County Investigation. Bull. No. 18, vol. 1, p. 27. Sacramento, Calif., May 1958.

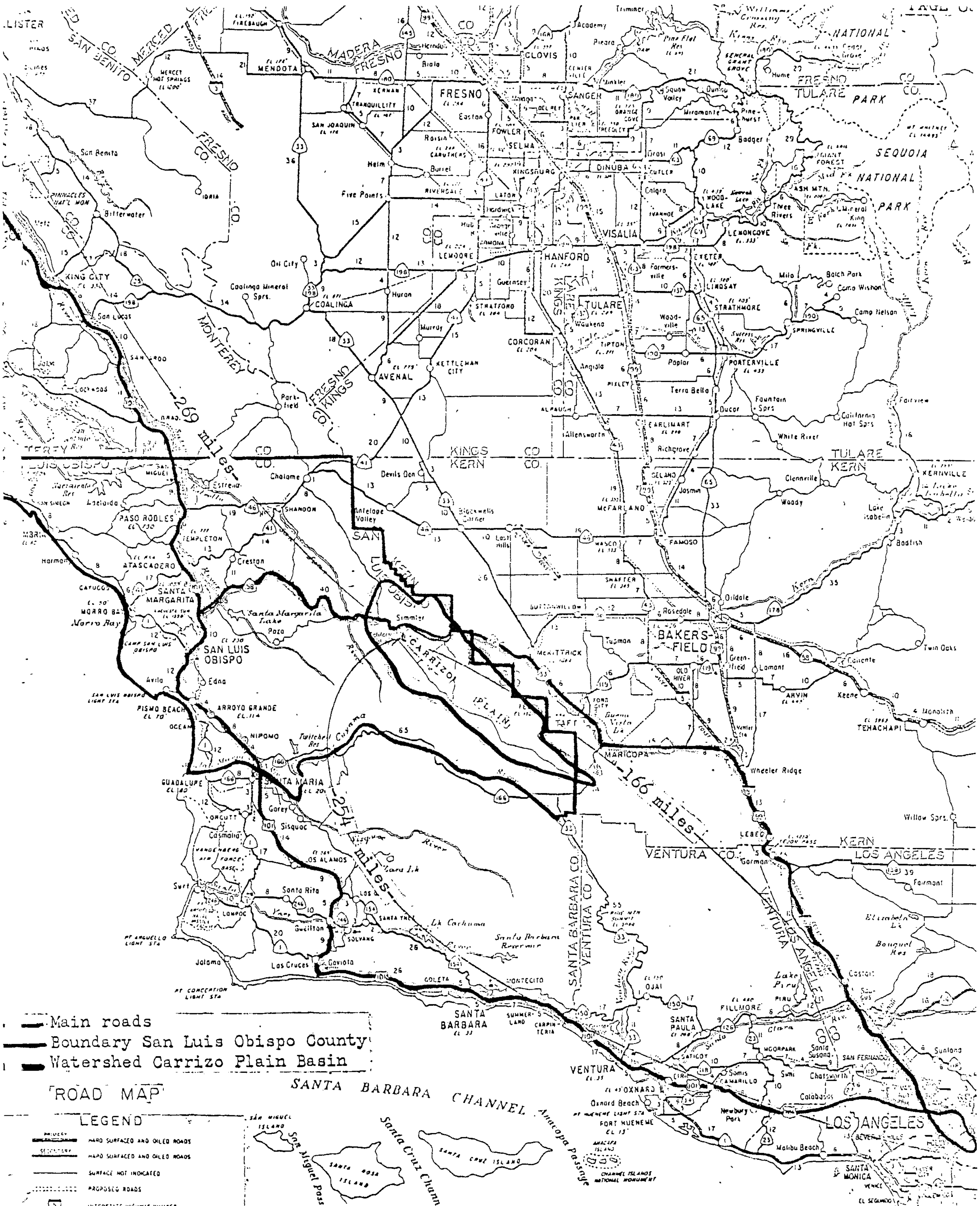

FIGURE 2.- Road map of a portion of California showing main roads to the Carrizo Plain area

The boundaries of these units have been defined after giving consideration to those factors of water supply and utilization, topography, and geology, which affect hydrologic analyses. The boundary of the Carrizo unit lies almost entirely within the County but in places along its eastern boundary, the topographic limits of the basin overlap into adjoining Kern County. This unit comprises approximately 286,000 acres within the limits of its watershed, or somewhat more than 11 percent of the total for the County. A comparison of the sizes of the six hydrologic units of San Luis Obispo County is shown in Table 2.

TABLE 2.- Hydrologic units of San Luis Obispo County, California, arranged in order of largest areas

Name of unit	Area (acres)				
	County			Total	
	San Luis Obispo	Monterey	Kern	Acres	Percent
Upper Salinas unit........	989,000	408,000	1,000	1,398,000	54.5
Coastal units[1/]	492,000	12,000	0	504,000	19.6
CARRIZO PLAIN UNIT........	271,000	0	15,000	[a/]286,000	11.2
Cuyama unit...............	268,000	0	0	268,000	10.4
Santa Maria unit..........	55,000	0	0	55,000	2.2
San Joaquin unit..........	54,000	0	0	54,000	2.1
Totals...............	2,129,000	420,000	1,000	2,565,000	100.0

[1/] Consists of subunits: Cambria 195,000 acres; San Luis Obispo 177,000 acres; and Arroyo Grande 132,000 acres.

[a/] Area of watershed measured from drainage divides surrounding the plain and including the floor of the topographic basin us approximately 416 square miles, or 266,000 acres according to author's measurements. Area of the post-Pliocene water-bearing mantle is approximately 350 square miles, or 224,000 acres.

DEVELOPMENT OF GROUND WATER

The development of ground water in the Carrizo Plain hydrologic unit has been slow and small. The early settlers who came into the area before the turn of the century made little effort to develop water, mainly because both surface and subsurface evidences of any large supply of fresh water were lacking. They managed to obtain enough potable water to meet requirements for household and livestock by drilling shallow wells (generally less than 100 feet in depth) in the more favorable spots near seepages and springs. They became satisfied with dry-farming and the seasonal grazing of livestock, made a comfortable living from these occupations, and generally held on to their large land holdings.

Under these conditions, and the fact that the Carrizo lay off the main road and rail transportation routes, the Carrizo has remained sparsely settled. Even at present there are only two small settlements in the plain. One is Simmler, a now practically deserted old ranch community in the north central part of the plain; and the other, California Valley, a new community real estate development several miles west and south of Simmler.

Despite the lack of extensive water development, the fertility of much of the soil has long been recognized, provided sufficient water could be placed on it. However, it was not until the close of World War II when water-well equipment again became available that any significant attempt was made to develop water for irrigation.[8] Probably the first wells for this purpose were two deeper wells drilled on the King Ranch in the northwestern part of the plain in 1945.[9]

These two wells proved irrigation to be feasible, but in the 20-year period between 1946 and 1967, only 9 additional irrigation wells were drilled, all in the same general area. Of the total of11 irrigation wells drilled to date, 2 have been abandoned (for mechanical reasons), leaving 9 wells at present pumping water for irrigation, mostly for alfalfa and forage crops to supplement range feed available only during the short natural grass-growing season. The total area irrigated comprises around 725 acres but from three to four cuttings of some forage crops are obtained per year.

In addition to shallow water wells drilled for domestic and livestock requirements by the original settlers and the few deeper ones for irrigation, a number of mostly shallow

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[8] Very little data on irrigation are available prior to 1920, the first year in which such data were included in the Federal Census reports. Later, investigations were made by the California State Water Resources Board, but outside of the report on water in San Luis Obispo County in 1958, little data have been collected with reference to water in the Carrizo Plain.

[9] One well was drilled in section 28, T29S-R18E to a depth of 325 feet; the other in section 2, T30S-R18E to a depth of 300 feet. Output of each of these wells was rated at from 500 to 600 gallons per minute.

wells have been drilled in the area of the recent California Valley development. This community effort, however, has not added materially to water development in the Carrizo Plain. The purchase of a 2-1/2-acre plot usually carries with it the necessity of the owner to develop his own water supply. Unfortunately, most of the subdivision acreage lays on the western slopes of the plain where the main water-bearing formations are either absent or thin. As a result many of the 20-odd shallow wells drilled in this locality have not yielded satisfactory amounts of water.

As a consequence of this unsatisfactory water development, efforts are being made to develop a community supply from deeper wells drilled down-slope on the edge of the Soda Lake flat, where the water-bearing formations are thicker. Three wells have been drilled in this locality.[10] The upper water-bearing formations in two of the wells located nearest the Soda Lake bed yielded water of poor and unsatisfactory quality. However, deeper sands yielded water of better quality. As yet the final results of this effort are not known. Just how and at what cost water from

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[10] These wells are "Chilcote" in section 12, T30S-R18E drilled to a depth of 550 feet; and the two "Cal Valley" wells located within 135 feet of each other in section 34, T30S-R19E; the one completed at a depth of 995 feet, and the other drilled to a depth of about 1,865 feet but not known at what depth completed.

these wells is to be distributed to the community plots on higher elevations is also not known.

PURPOSE AND SCOPE OF THE INVESTIGATION

The purpose of this investigation is essentially to ascertain to what extent ground water in the Carrizo Plain may be developed to sustain maximum development of agriculture and livestock activities and related community development, thereby improving the local economy and increasing property values. It includes estimates of natural discharge, pumpage and yield of ground water, data on water levels, well records, and water quality available to the author up to January 1, 1967.

This preliminary investigation does not attempt to determine the economics of ground-water development in relation to crop, livestock, domestic, community and other requirements. It was perforce limited by time and expense to a general survey to ascertain whether the potential water resources and extent of irrigable lands were sufficient to warrant a comprehensive and detailed feasibility study of water development in the Carrizo to determine its economic potentialities as a geographic unit of importance. Such an investigation is in line with government policies for land development, particularly as adapted to the improvement and growth of good beef stock which the Carrizo Plain and adjacent areas afford.

RELATED INVESTIGATIONS AND REPORTS

Little has been published on the water resources of the Carrizo Plain. The three works listed below probably cover the subject as thoroughly as any. The author has drawn freely upon them for basic data and information but the interpretations made from them together with data collected as a result of his own efforts, are his own.

Upson, J.E. and G.F. Worts, Jr. Ground Water in the Cuyama Valley, California. Geological Survey Water Supply Paper 1110-B, in Contributions to Hydrology, 1948-1951. U.S. Department of the Interior, Washington, D.C., 1951.

Division of Resources Planning, California Department of Water Resources. San Luis Obispo County Investigation, Bull. 18, Vols. I and II. Sacramento, Calif., May 1958.

Hackel, Otto; Chairman and others. Guidebook - Geology of Carrizo Plains and San Andreas Fault. San Joaquin Geological Society. Bakersfield, Calif., 1962.

ACKNOWLEDGMENTS

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Flood Control and Water Conservation District, San Luis Obispo, California.

The author is grateful to the many oil companies which, with few exceptions, when requrested supplied electric logs, core descriptions and other data relating to their geological work in the area.

PHYSICAL FEATURES OF THE AREA

GEOMORPHOLOGY[11]

Probably the most notable physical aspects of the Carrizo Plain are: (1) the large expanse of treeless but grassy flat lands in the center of the basin sloping upward to the bare rolling hills along its periphery; (2) the elongation of the basin in a northwest-southeast direction between two prominent coastal ranges, the Temblor on the east and the Caliente-San Juan on the west; (3) the notable depression in the center of the basin, occupied by the intermittent Soda Lake; (4) the well-defined straight-line escarpment of the San Andreas fault along the eastern side of the plain; and (5) the curved Caliente-San Juan uplift and fault complex marking the western limits of the basin and abutting at each end against the San Andreas fault scarp to mold the crescent-shaped Carrizo basin.

The topography of the surface terrain is largely the result of processes of deposition and erosion pertaining to

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[11] Geomorphology is that branch of physical geography which deals with the general configuration of the surface, the distribution of the land, water, etc., and the history of geologic changes through the interpretation of topographic forms.

the mantle of post-Pliocene soils, sands, gravels, silts, and clays which blankets unconformably the structural basin of older folded and faulted strata which in turn overlay a granitic basement on the west and deeper-seated metamorphic basement complex on the east.

Whereas the eroded pre-Pliocene folded and faulted strata are formed into a subsurface structural basin tilted slightly to the east and the north, the post-Pliocene cover forms a topographic surface basin with elevations considerably higher on the east and the north than on the west and south. The pre-Pliocene sedimentary beds overlay and in places overlap the basement granitic mass on the Caliente Range and San Juan Hills on the west while they terminate abruptly against the San Andreas fault on the east.

Topographically, the surface of the basin is highest at its narrow southern end. The surface elevation here reaches 2,900 feet above sea level. In the center of the basin at Soda Lake, the elevation drops to 1,900 feet. To the north the elevation rises, but to less than 2,100 feet.

The southern half of the Carrizo is an area which slopes upward from its center, gently eastward into the low Panorama Hills fronting the Temblor Range and more steeply westward into the Caliente Range. The floor of this half of the basin averages about 4 miles wide. The land is largely unfenced. Most of it is used for cattle grazing, but some of it is dry-farmed. Within an area of more than 100 square miles, there are no settlements other than a few ranch houses. Most of the roads are gravel or dirt. Some of them are impassable in wet weather.

The northern half of the basin is wider than the southern half. It averages about 7 miles in width. It contains more flat and gently sloping land, but in the northeast are low rolling hills. All of the land in the lower north half is arable. There are more ranch houses in the north than the south and the only two settlements in the Carrizo are here. Also, the only land irrigated is in this part of the plain, and practically all of the remainder is dry-farmed. The roads are mostly black-topped.

Aside from the plain itself, probably the most prominent physical features of the area are the two coastal ranges which confine the plain. The Temblor Range on the east rises to more than 1,000 feet above the plain. Elevations along its highest ridge average more than 3,000 feet above sea level. The Caliente Range on the southwest rises higher, but its northward extension into the San Juan Hills is much lower, averaging less than 2,500 feet along its highest ridge. The highest point in the Temblor is McKittrick Summit, 4,332 feet above sea level; in the Caliente is Caliente Mountain, 5,106 feet; and in the San Juan Hills, Freeborn Mountain, 3,311 feet. These ranges are usually covered with an abundance of native grasses, but other vegetation is scant. There are scattered oak and pine trees on the higher elevations, and frequently patches of brush, especially on the southwestern slopes which receive the full force of the seasonal rains.

Along the northwestern rim of the Carrizo topographic basin, the divide between the Carrizo and the San Juan drainage area is in places barely more than 50 feet above the ground level of the adjoining San Juan. Nevertheless, this low divide has been high enough to prevent any surface waters of the Carrizo from flowing out of the basin even during the heaviest rains. The rains falling upon the Carrizo watershed have formed a reservoir of ground waters which rise above the surface in the depressed Soda Lake area during most of the rainy season and remain very close to the surface at other times.

CLIMATE

The climate of the Carrizo area has some of the features of a desert basin notwithstanding that it is a plain within the Coastal Ranges. This anomoly is because the uplifted plain is on the inland side of the Coastal Ranges near the southern end of the San Joaquin Valley and is flanked by moderately high mountains.

Rainfall over the plain and its watershed, although variable, has averaged over the years, a little more than 8 inches annually. Nearly all of the precipitation is in the form of rain which falls mostly during the months of December through February. However, isolated thunder showers sometimes occur during the summer. Snow rarely falls on the basin floor but does rather frequently during the winter on the summits of the adjoining mountains.

During the winter, temperatures below freezing are common. During the summer months daytime temperatures are mostly high. Frequently they are in the 90°'s and occasionally go above 100° F. Nights are usually cool even in the summertime. The long dry summers provide an adequate growing season for most crops but the relatively high altitude of the plain results in a shorter growing season which limits the types of some crops. The time between frosts averages around 200 days.

The air of the Carrizo is unpolluted. Most of the time it is remarkably clear and exhilerating. During the winter, in the lower parts of the plain there may be occasional ground fog. However, these low, patchy fogs are usually "burned off" before mid-day.

Records of rainfall, temperature, and other meteorological data for the Carrizo are scanty. Within the Carrizo Plain and watershed, there are only two precipitation stations. The records go back some thirty years but they are not complete. However, they do reveal the main features of seasonal variations, rainfall distribution and intensity. A sample of these records is shown in Table 3. Lines of equal mean seasonal precipitation are shown in Figure 4.

TABLE 3.- Records of rainfall from precipitation stations in the Carrizo Plain, San Luis Obispo County, California

Precipitation station	Elevation (ft.)	Period of record[1/] From	To	Seasonal year Mean (inches)	Maximum Year	Maximum Inches	Minimum Year	Minimum Inches
Simmler Highway Maintenance[2/]...	2,047	1938	1954	8.1	1941	18.1	1951	4.4
Soda Lake[3/].......	1,975	1926	1954	8.7	1941	18.5	1934	5.4

1/ Data for more recent years not procured.

2/ Source: State Division of Highways, San Luis Obispo.

3/ Source: U.S. Bureau of Reclamation and San Luis Obispo Farm Advisor.

SOILS

The soils of the Carrizo vary in their physical and chemical properties in accordance with differences in parent materials, the method of formation or deposition, the age and degree of development since their deposition. The soils may be divided into three broad groups: (1) residual soils; (2) older valley fills; and (3) Recent alluvial soils.

Residual soils include those which have been developed in place on consolidated bedrock of sedimentary, igneous, and metamorphic origin. These soils are found only on the steeper slopes of the drainage area surroun ing the basin where the drainage is good; and they are usually shallow and of medium texture. Rock outcrops are frequently found.

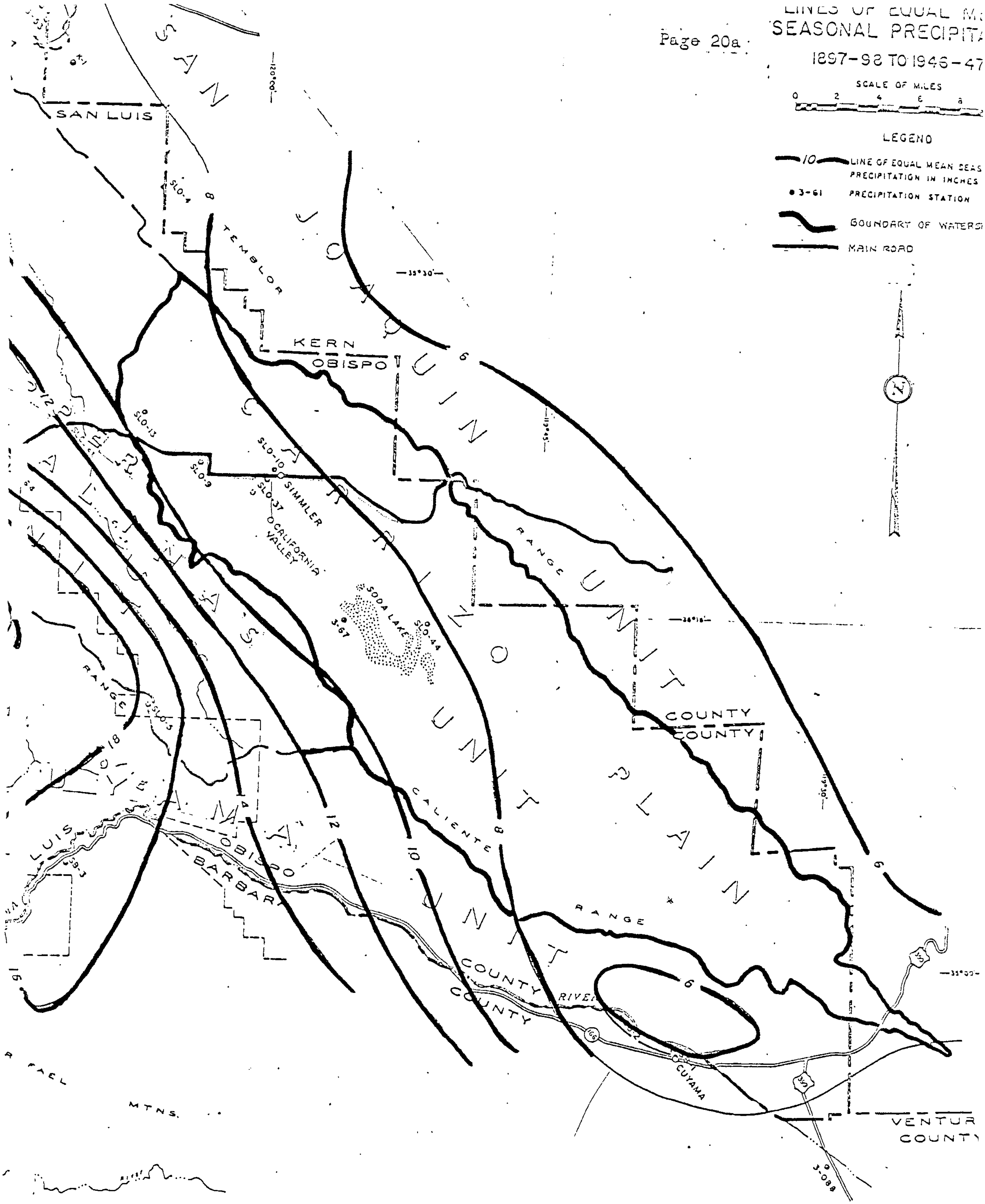

FIGURE 4.- Rainfall map of the Carrizo Plain area, California, showing lines of equal mean seasonal precipitation, period 1897-98 to 1946-47

Only a small percentage of these soils occur around the rims of the Carrizo and mostly in the southern half.

Older valley fill which comprises most of the northeastern part of the Carrizo and extends in scattered areas along both sides of the San Andreas escarpment elsewhere but is generally absent in the central part of the Plain. Since their deposition, the soils of this group have been elevated and later eroded to varying degrees. As a result, a rolling topography characterizes the areas in which these soils occur. These soils cover most of the northeastern area. Textures vary from light to medium at the surface to heavy in depth. Surface drainage is generally good but subsurface drainage is often retarded by heavier subsoils. Moisture holding capacities are fair to good in the upper zones but poor in the lower zones. In years of deficient rainfall, failures of shallow-rooted, dry-farmed crops occur. In general, however, good harvests of climatic-suited crops may be grown in the older valley fills.[12/]

Recent Alluvium occupies the greater part of the Carrizo Plain arable area. It is estimated that the soils in this category, outside the Soda Lake area, cover approximately 135,000 acres, or about 38 percent of the total arable land. Soil depths vary considerably--from a few feet on the periphery of the basin to several hundred feet

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[12/] Large acreages of wheat are produced in these soils. The wheat produced is a high gluten Baart wheat which brings premium prices from the flour milling industry.

in the center of the Soda Lake bed. Textures vary from light to medium outside the Soda Lake area. In this area, they are for the most part heavy impervious clays that are heavily impregnated with mineral salts. Away from the Soda Lake borders, stratified silts, sands, and gravels are often found beneath the surface, and drainage is usually good except in periods of inundation. In general, with the proper application of water and careful use of fertilizers where required, the alluvial soils of the Carrizo have a high commercial value.

GEOLOGIC FEATURES OF THE AREA

STRATIGRAPHY

Within the confines of the structural basin lying between the Temblor uplift on the eastern side of the San Andreas fault and the Caliente-San Juan uplift on the west, is a stratigraphic section of post-Jurassic rocks. Most of these are unaltered sedimentary formations but there are some metamorphic basement rocks and interstratified Miocene volcanics.

The stratigraphy (as well as the structure) is shown in the cross sections made of the basin by Dibblee.[13] Probably the most representative of these are the ones across the central part of the basin. They show a section of sedimentary deposits ranging in thickness from a few feet overlaying a granitic basement complex on the west to more than 15,000 feet on the downthrown eastern side of the structural basin fronting the San Andreas rift.

Broadly, the stratigraphic sequence in the Carrizo basin is as follows. A Mezozoic basement complex of granitic rocks,

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[13] Dibblee, Jr., T.W. "Displacements on the San Andreas Rift Zone and Related Structures in Carrizo Plain and Vicinity." Guidebook - Geology of Carrizo Plain and San Andreas Fault. San Joaquin Geological Society, Bakersfield, Calif., 1962.

exposed at the surface in places in the Caliente-San Juan uplift is overlain unconformably in varying thicknesses by Cretaceous conglomerates and sandstones, followed to a limited extent by Paleocene sandstones and shales. Overlaying the Cretaceous unconformably is the widespread Simmler formation of non-marine sandstones and siltstones of Oligo-Miocene age. The Simmler is overlaid by marine Vaqueros (lower Miocene) which is divided into the Soda Lake shale and the Painted Rock sandstone. Overlaying the Painted Rock are a wide variety of silicious shales, basalts, sandstones, and shales--some marine and some nonmarine--of the Monterey series (middle and upper Miocene). Above the Monterey is the widespread and often thick Santa Margarita sandstone of the upper Miocene.

On top of the Santa Margarita sandstone is the Rancho Pico shale followed by the Quatal clay, both lower Pliocene. These compact impervious beds where present, prevent ground waters in the overlaying Morales (upper Pliocene) and the Paso Robles (lower Pleistocene) sands, gravels, and silts from percolating downward into the older marine strata. A comparatively thin mantle, from a few to several hundred feet thick, of Recent Alluvium covers much of the Paso Robles, especially through the center of the basin and in the Soda Lake depression. However, in the northeast, the Paso Robles is exposed over most of the surface.

The most notable and important features of the stratigraphy of the Carrizo from the standpoint of ground water accumulation is the position of the fresh water-bearing Pleistocene Paso Robles overlaying in marked unconformity, the Tertiary and older beds; and the impervious nature of the lower Paso Robles which prevents percolation of ground waters downward. These younger water-bearing formations are superimposed upon the older strata in a wedge-shaped mass more than 3,000 feet thick fronting the San Andreas rift, thinning out westward on the eastern flank of the Caliente-San Juan uplift.

East of the San Andreas fault, the stratigraphy follows the same general age pattern as that west of the fault but the formations are not specifically correlative with those on the Carrizo side. An exception is the Paso Robles formation and a few of the post-Pliocene beds, thin patches of which occur on both sides of the San Andreas, notably in the southeast. East of the San Andreas, the basement complex of Mezo-Cretaceous age, consists of diorites, intrusive serpentine, and metamorphic rocks of the Franciscan series. The granite basement complex of the Caliente-San Juan does not appear east of the San Andreas fault.

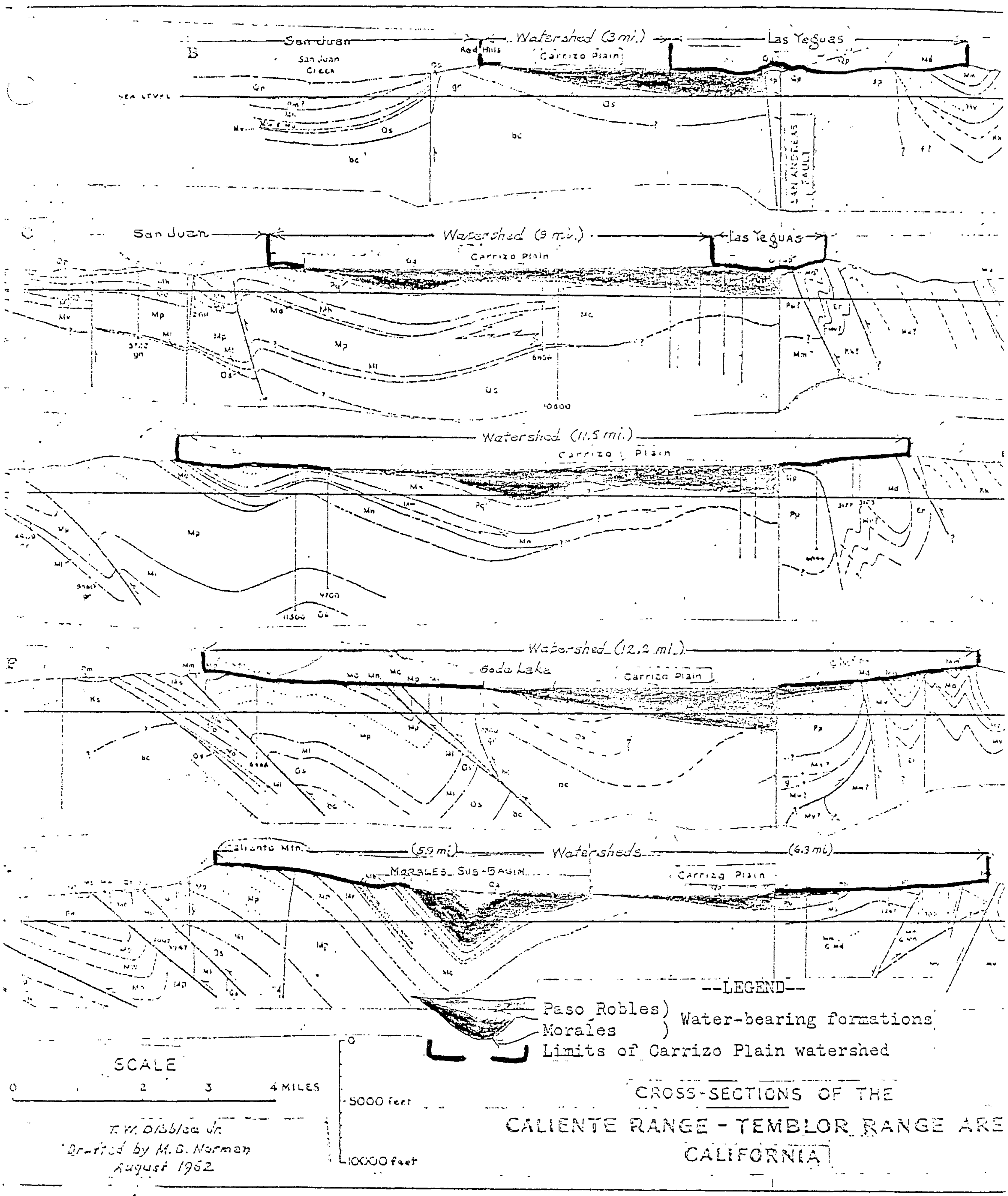


FIGURE 7.- Geologic cross-sections of the Carrizo Plain area, California, showing ground-water-bearing formations (yellow) and watershed (blue) in relation to older non-water-bearing formations and geologic structure. (Geology by Dibblee;

STRUCTURE

The geologic structure embodying the Carrizo Plain is essentially an elongated synclinorium some 75 miles long and 12 miles wide at its center, in strata of post-Jurassic age, compressed between two uplifted basement masses. This structural basin is tilted downward on the east against the San Andreas fault, and northward against the Red Hills-San Juan fault system.

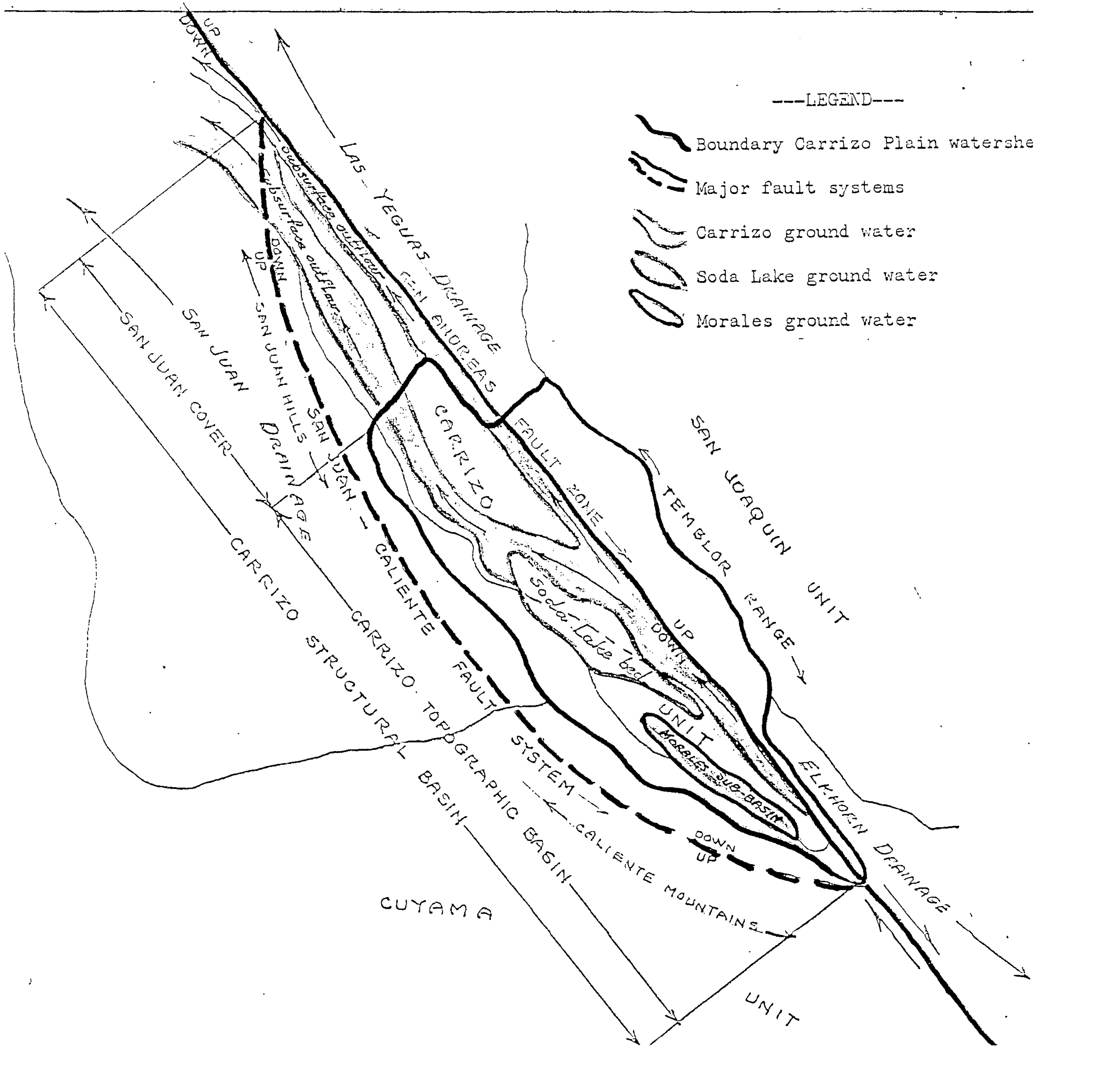
Besides marking the eastern limit of the basin, the San Andreas fault is the dividing line between the dissimilar strata on either side of the fault. Apparently, a lateral movement took place along the San Andreas rift which shifted for many miles what was originally a contiguous sequence of formations.

Subsequent to this extensive lateral movement, or possibly contemporaneous therewith, the formations on the western side of the San Andreas fault in the Carrizo area were downthrown several thousand feet. Also, probably at the same time, both the western (Caliente-San Juan) side and the eastern (Temblor) side of the basin were uplifted while compressive forces folded, faulted, and in places overthrust the pre-Pliocene sedimentary section from east to west.

In all of these orogenic movements, the San Andreas rift remained virtually in a straight northwest-southeast trending line while on the western side of the basin a complex of folding and faulting formed into an arc which encompassed a 75-mile segment of the San Andreas fault, thus forming the crescent-shaped structural basin of the Carrizo.

Following these major structural movements in the pre-Pliocene rocks, various processes of erosion and deposition took place which covered a large area with post-Pliocene boulders, gravels, sands, silts, and clays of terrestrial origin. In the Carrizo structural basin these younger non-marine beds were laid down unconformably over tilted, unevenly eroded and folded and faulted pre-Pliocene strata. Through subsequent movements along old lines of stress, these younger non-marine beds were gently folded and faulted while processes of secondary erosion and re-deposition account for the wedge-shaped superimposition of these younger continental formations unconformably upon the older marine strata.

The Carrizo Plain is unique in that it involves two basins: (1) a topographic basin superimposed unconformably upon (2) a structural basin. This situation is fortunate from the standpoint of ground water in that it affects favorably the movement and accumulation of such waters. The closed topographic basin prevents any fluvial flow from the surface basin. The top of the underlying structural basin, covered for the most part by impervious clays at the bottom of the Paso Robles and tilted eastward and northward, channels ground water underflow in those directions whenever subsurface water reservoirs are filled. Wells properly located could prevent much if not all of this subsurface outflow.



OCCURRENCE OF GROUND WATER

PRINCIPAL FORMATIONS THAT YIELD WATER TO WELLS

The Ground Water Body

The geologic formations of the Carrizo Plain may be divided into non-fresh water bearing and fresh water bearing groups. The non-fresh water bearing group includes the pre-Cretaceous granitic rocks, sedimentary rocks of the Jurassic through the lower-Pliocene, and volcanics of Miocene age.[14/] The fresh water bearing group includes most of those sands and gravels in the post-Pliocene section. The more important of these younger fresh water bearing formations are the Quaternary alluvium (Qa), the Pleistocene Paso Robles (Qp) and the upper Pliocene Morales (Pm) formations.

Broadly, there are two extensive ground water bodies in the Carrizo basin: (1) the Soda Lake; and (2) the Carrizo. The Soda Lake ground water body is confined to a

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[14/] Of course, any formation of pre-Pliocene age may yield some fresh water locally at or near surface exposure but in depth waters in these older formations yield either brackish or salty waters. They are not considered fresh-water bearing on any large scale.

comparatively shallow platter-shaped area about 12 miles long and 2 miles wide beneath the lake bed. This body lays below several hundred feet of muds and clays, and contains water highly contaminated with mineral salts. The Soda Lake ground waters are either in the lower part of the Quaternary Alluvium or upper section of the Paso Robles.

The Carrizo ground water body lies below the Soda Lake in the middle and lower parts of the Paso Robles. This confined body of ground water is overlain by materials sufficiently impervious to sever hydraulic connection with over-lying water, and moves under pressure caused by the difference in head between intake and discharge areas of the confined water body. The Carrizo ground water body spreads beneath most of the middle and eastern parts of the entire basin where the Paso Robles formation is extant. The waters of this body, unlike those of the Soda Lake range from good to fair over-all quality. (See Figure 9, p. 37a)

Quaternary Alluvium (Qa)

Recent Alluvium of the Quaternary period (Qa) covers most of the surface of the Carrizo Plain. It is estimated that this alluvium is spread in varying thicknesses up to several hundred feet over approximately 142,000 acres, or 63 percent of the basin floor. The thickest alluvium centers in the Soda Lake depression in the central part of the surface basin.

In general, the alluvial beds rest with angular unconformity on older continental deposits and locally on still older formations. There are few Quaternary Terrace deposits within the area of the Carrizo Plain. There is little or no evidence that streams or other fluvial conditions necessary for the formation of terrace deposits, ever existed after the original structural depression was formed.

Most of the alluvial beds in the Carrizo appear massive, but some are evenly stratified or slightly cross-bedded. As revealed in well logs, the alluvial deposits are highly variable in composition and thickness. In general, however, they are unconsolidated or loosely consolidated sands, gravels, and silts with a few beds of compacted clays. An exception is the Soda Lake area where they are mostly thick compacted heavily mineralized muds and clays.

The alluvium absorbs water readily in most parts of the basin, particularly where it is not already saturated; that is, where the water table is well below the surface. In the center of the basin around Soda Lake, although the more permeable upper parts of the alluvium underlying the thick layer of muds and clays may be heavily mineralized, there exist impermeable beds which prevent percolation of these contaminated waters downward into the underlying reservoir of better quality waters. In the central part of the basin, especially in the Soda Lake area, it is believed that the alluvium does not readily transmit water downward, but elsewhere precipitation absorbed by the alluvium may find its way into the underlying Paso Robles formation.

The Alluvium is not the principal water-bearing formation of the Carrizo, except possibly in the east central part of the basin where it is in direct contact with the runoff from the Temblor watershed. So far only in the western part adjacent to the narrow Caliente watershed has any water been developed from it and this not to any considerable estent. In most other parts, the top of the saturated zone is either deep in the alluvium or below its base. In some localities, even this Recent Alluvium is saturated but not very permeable. It is, therefore, necessary to drill deeper into the underlying continental deposits to obtain any appreciable amount of water. Little or nothing is directly known about the water-bearing characteristic of the undrilled alluvium over most of the basin.

Pleistocene Paso Robles (Qp)

This formation of Quaternary Pleistocene age consists of poorly sorted mostly loosely consolidated gravels, sands, and silts. It is exposed over the surface of a large section of the plain especially in the rolling hills of the northeast. Elsewhere it is covered by a mantle of alluvium. The Paso Robles is widely distributed beneath the floor of the Carrizo Plain.

The Paso Robles "wedge", more than 3000 feet thick fronting the San Andreas rift, thins out across the basin onto the Caliente-San Juan uplift. In general, well logs indicate that the Paso Robles is more permeable on the western side of the basin where it is thinnest than on the eastern side where it is thickest. However, most of the formation appears to be permeable or faulted enough to transmit and store ground water in considerable quantities.

Contours on the base of the Paso Robles show that this floor slopes in general from west to east and from south to north; is thickest in the depressed areas of the underlying older strata and thinnest over the uplifted sections of the older beds. Once the depressions in the Paso Robles are filled with ground waters, the recharge waters flow down dip eastward and northward along channels in the top of older strata at the unconformity between the base of the Paso Robles and the immediately underlying older strata.

The Paso Robles is by far the most important formation for the migration and storage of ground waters in the Carrizo basin. Though few deep wells have been completed for water in this formation, those that have, have yielded substantial amounts of fresh water of fair quality.

Pliocene Morales (Pm)

This formation, of upper-Pliocene age, is the lowest of the fresh water bearing formations in the Carrizo Plain. It crops out on the surface over relatively small areas in the northwest beyond the limits of the Carrizo surface basin but within the limits of the structural basin; and in the extreme southeast. It underlays the Paso Robles unconformably but overlays the Miocene strata conformably. Although it has not been mapped as being present beneath the entire surface of the Carrizo Plain, its presence in exploratory wells drilled for oil within the confines of the Carrizo would indicate that the Morales is more widespread than depicted by areal geology.

The Morales, like the Paso Robles, is made up mainly of sands, gravels, and silts, but generally these beds are more stratified and compact in the Morales than those in the Paso Robles. The thickness of the Morales ranges from a few feet to more than 3000 feet. Structurally, the Morales extends the length of the basin in a syncline off the eastern flank of the San Juan uplift in the northwest. It is not recognizable southward until it appears in a somewhat tightly folded syncline at the southern end of the basin off the eastern flank of the Caliente uplift.

As a water-bearing sand, the Morales may hold considerable water, but its waters are believed to be somewhat brackish due to percolation of salt waters into the formation from underlying marine beds. Notwithstanding, some of the waters in the Morales may be locally suitable for livestock and selected irrigation. However, depth to any considerable amount of water in the Morales may be prohibitive to economic recovery, and unless the volume discharge would be large, the wells would not be economical. In general, the Morales is not to be considered a major source of fresh water development in the Carrizo.

NON-WATER BEARING FORMATIONS

Formations that do not carry appreciable amounts of water or that carry water which cannot be economically recovered by means of wells consist essentially of the pre-Pliocene marine and older continental deposits. Although some of these older formations contain permeable beds, they are not generally in favorable positions or of sufficient areal extent to absorb much precipitation.

Some of the older formations may store small quantities of fresh water in cracks and joints but they do not transmit much of it. They are, therefore, not important sources for any considerable amounts of free fresh water. Even in a few localities where they are known to be substantially water-bearing, they underlay land which, for the most part, is topographically unsuited for agriculture. Only the most favorable locations in valley bottoms have been tapped by a few water wells for limited domestic and stock use. These waters are of no practical value as sources for extensive irrigation. The real value of these older beds is their structural function to transmit water to the alluvial plain.

URE 9.- Longitudinal section showing relative positions of main ground water zones in the Carrizo Plain Basin, Calif.

WATER SUPPLY AND DEMAND

BALANCE BETWEEN WATER RECHARGE AND DISCHARGE

Water supply and demand are generally expressed in hydrologic terms as water recharge and water discharge. Recharge is that water which replaces water discharged from a hydrologic unit.[15] Discharge is that water which is taken or escapes from a hydrologic unit. A hydrologic unit is a topographic basin into which water is fed by natural precipitation within the confines of a watershed limited by the topographic divides surrounding the basin.

The Carrizo Plain is entirely dependent upon precipitation for its water supply. No waters are brought in from the outside. The discharge of waters from the Carrizo results from natural processes and from pumping water from wells.

In any undeveloped ground water basin, the long-term natural recharge must equal the long-term discharge. Because the Carrizo Plain so far is a practically undeveloped closed ground water basin, it is not difficult to arrive at meaningful figures for its water recharge and discharge.

15/ More specifically, recharge may consist of waters originating naturally in the form of precipitation and flowing into the basin either by surface or subsurface channels; or by being imported into the basin from outside units via pipe lines, aqueducts or other means.

The area of the Carrizo topographic basin up to the crest of its watershed is approximately 416 square miles, or 266,000 acres. Over a long period of years, precipitation of rain over this area has averaged a little more than 8 inches annually. By multiplying the 226,000 acres of watershed by 0.667 foot (8 inches) of precipitation, the gross volume of water falling upon the area averages around 177,000 acre-feet per year.

Of course, not all of this estimated recharge of 177,000 acre-feet of water annually results in stored ground water. From this gross figure must be deducted that amount of water which is discharged from the original source by natural processes plus that which is consumed by pumping from wells.

The amount of ground water which is discharged by natural processes is estimated roughly to be around 118,000 acre-feet annually, or 67 percent of the gross. The amount of water discharged at present by pumping from wells is estimated at the rate of something less than 4,000 acre-feet a year, leaving approximately 55,000 acre-feet to be recovered before it might escape as ground water overflow at the northern end of the structural basin into the Las Yeguas and the San Juan drainage areas. The figures of estimated recharge and discharge are given in the following Table 4.

TABLE 4.- Balance sheet of estimated ground water recharge and discharge for the Carrizo Plain hydrologic unit, San Luis Obispo County, California

Item	Discharge basis: Natural vegetal	Dry-farmed vegetal
	(Acre-feet)	
NATURAL BALANCE		
RECHARGE:		
Gross annual average recharge (266,240 ac. x 0.667 ft.)1/	177,582	177,582
DISCHARGE:		
Evapo-transpiration:		
From Soda Lake natural surface catchment (8,960 ac. x 5 ft.)2/	44,800	44,800
From soil and vegetation3/	46,474	71,871
From springs and seepages (1% of 177,582 ac.-ft.)4/	1,776	1,776
Subtotal	93,050	118,447
Outflow:		
Surface fluvial	0	0
Subsurface5/	84,532	59,135
Subtotal	84,532	59,135
Total natural discharge	177,582	177,582
USE BALANCE		
NET AVERAGE ANNUAL RECHARGE:		
Subsurface outflow5/	84,532	59,130
USE DISCHARGE:		
Pumped from wells:		
For irrigation (725 ac. x 5.8 ft.)6/	4,205	4,205
Less return to ground water reservoir (20% of 4,205 ac.-ft.)7/	841	841
Net used for irrigation	3,364	3,364
For household, livestock, and community (89 wells av. 6 ft.)8/	534	534
Total pumpage net discharge	3,898	3,898
UNUSED BALANCE AVAILABLE FOR USE	80,634	55,232

1/ Basis: 266,240 ac. total area of Carrizo watershed times average annual precipitation of 8 inches (0.667 ft.) per year.

2/ Basis: water area of lake 8,960 ac. times average depth of 5 ft. at height of rainy season all of which water is evaporated during summer.

3/ Based on observations by U.S.G.S. for Cuyama Valley that natural discharge is nearly two-thirds of total discharge (pumpage plus natural discharge). Thus, 66.7 per cent of 177,582 equals 118,447 minus (44,800 plus 1,776) equals 71,871 ac. ft. estimated evaporated from soil and transpiration through vegetation.

4/ Rough estimate based on natural flow from springs and other seepages in general.

5/ Based on natural subsurface reservoirs being filled to capacity whence subsurface recharge waters will move northward along underflow conduits and overflow into the Las Yeguas and San Juan subsurface drainage areas.

6/ Basis of alfalfa and other forage crops averaging from three to four cuttings per year utilizing an average of 5.8 ft. of net applied water per acre.

7/ Based on observations by U.S.G.S. for Cuyama Valley and discounting for Carrizo conditions.

8/ Based on rough estimate for 89 wells averaging 6 ac. ft. discharge each annually.

WATER RECHARGE

Source, Movement, and Accumulation

Most of the precipitation which falls upon the surface of the Carrizo watershed, seeps into the porous alluvial cover of the basin, and percolates downward into the subsurface reservoir rocks. In times of heavy rainfall or cloudbursts, the surface flow of water may be in the form of swift-flowing rivulets or flash floods of intense but short duration. In these times, considerable water may flow into the Soda Lake depression where it forms a shallow lake sometimes covering as much as 10,000 acres but rapidly diminishing in size, and usually becoming a dry lake bed before the end of the summer.

Eventually, nearly all recharge waters find their way either over the surface or through subsurface channels into various parts of the post-Pliocene water bearing formations. However, during migration, some of the waters may be trapped in underground catchments dammed by faulting or impervious barriers, and rise to the surface in the form of springs or moisture areas.

At times of saturation, ground water discharges naturally by upward leakage into the Soda Lake depression. When this lake is filled to a certain level, the ground waters will tend to move toward the lower sections of the ground water body mainly eastward thence northward along the San Andreas fault; or northward along other structural channels to the northern end of the basin. It is when the ground water body is filled to capacity, that recharge waters will overflow the subsurface north rim of the structural basin and thus maintain the natural balance between recharge and discharge.

Quality of Waters

The quality of waters of the Carrizo Plain is naturally variable. Their quality depends largely on the path of flow and the locality of accumulation of recharge waters. For example, the ground waters of the northern and southern parts of the basin are of considerably better quality than those which migrate into the Soda Lake area. Here the continuing cycle of evaporation-recharge-evaporation over long periods of geologic time has resulted in a high concentration of dissolved minerals in the upper ground-water body above the impervious clay beds near the bottom of the lacustrine Quaternary Alluvium which here is several hundred feet thick. In the deeper ground water bodies beneath this impervious clay barrier in the Soda Lake area are waters of better quality, but the surface and upper ground waters of this area are of poor quality.

In general, the meteoric waters of the Carrizo basin deteriorate in quality as they migrate from the watershed around the periphery of the basin into the Soda Lake area. Those waters which do not reach this area, however, are of from good to fair quality. This change in ground water quality is shown in the analyses of waters from selected wells listed in the following Table 5.

TABLE 5.- Chemical and mineral analyses of ground waters from selected wells in the Carrizo Plain, California

(In parts per million unless otherwise designated)

Township-Range.......	T29S-R17E	T29S-R18E	T30S-R18E	T29S-R19E	T30S-R18E
Section-well number..	13-R1	28-L1	12-N1	31-F1	34-N1
Identification.......	Cooper	E.R. King	Chilcote	Thompson Spr	Soda Lake
Date sampled.........	10-22-65	10-22-65	2 - 9-66	9 - 1-54	12-16-63
Temperature..........					
pH[1/]	7.9	7.8	7.9	7.9	8.1
Conductance[2/]........	832	847	587	1,236	27,500
Ca..................	40	73	37	67	152
Mg..................	13	22	17	28	584
Na..................	125	86	70	166	9,400
K...................	0.9	1.0	1.2	1.2	1.0
CO_3..................	0	0	0	0	0
HCO_3.................	162	227	214	192	353
SO_4..................	120	144	65	271	7,096
Cl..................	80	51	33	103	1,085
NO_3..................	71	41		68	0
F...................	0.90	0.31	0.50	0.60	0.20
As..................	0.04	-	-	0.04	-
Boron...............	0.50	0.23	0.26	0.67	3.12
SiO_2.................	42	36	26	29	1.0
Total solids/sum.....	545	546	404	838	28,740
Hardness/NC..........	154	271	161	283	2,780
Effective salinity...	7.24	-	-	23.32	-
Depth (ft)...........	200	300	550	-	[a/]995
Distance to water (ft)	47	41	-	-	10
Output capacity (gpm).	100	500	500	-	-

1/ Hydrogen ion concentration.

2/ EC x 10^6 @ 25° C (Conductance) carries the unit micro mho/cm, and is an indicator of total dissolved solids. For most waters, the total dissolved solids content in parts per million can be approximated by multiplying the conductance by 0.7.

a/ Completed depth; total depth 1,028 feet.

Irrigation.

Criteria commonly used to judge the suitability of water for irrigation are (1) conductance (EC x 10^6 @ 25° C) as an indicator of dissolved solids; (2) chloride concentration; (3) sodium percent; and (4) boron concentration. Tentative standards for the classification of irrigation waters, taking into account these four factors or constituents, are listed in Table 6.

TABLE 6.- Tentative standards for irrigation waters.1/

Factor	Irrigation waters: Class I Excellent to good	Class II Good to injurious	Class III Injurious to unsatisf'ty
Conductance.......	Less than 1,000	1,000-3,000	More than 3,000
Chloride, epm.....	Less than 5	5-10	More than 10
Sodium, percent...	Less than 60	60-75	More than 75
Boron, ppm........	Less than 0.5	0.5-2.0	More than 2.0

1/ Doreen, L.D. Excerpt from paper by. Division of Irrigation, University of California, Davis, Calif., 1958

With the exception of the Soda Lake area, ground waters of the Carrizo Plain fall mostly within Class II, partly in Class I, and rarely in Class III.

Conductance. Conductance is an indicator of total dissolved solids. The presence of excessive amounts of dissolved solids in irrigation water will result in reduced crop yields. Conductance of most of the ground waters in the Carrizo Plain outside of the Soda Lake area is less than 1,000, placing them in the excellent to good category.

Chlorides. Chlorides are not considered essential to plant growth. They may be harmful in high concentrations as they cause subnormal growing rates and the burning of plant leaves. Outside the Soda Lake area, ground waters developed in the Carrizo show a range of from 30 to 100 ppm and probably average less than 60 ppm, placing them in the excellent to good category. Their epm value in general is less than 5.

Sodium. Water containing high percent sodium[16/] can have an adverse affect on the physical structure of the soil by dispersing the soil colloids and making the soil "tight", thus retarding the movement of water through the soil. This, in turn, retards the percolation of water and makes the soil difficult to work. However, because most of the soils of the Carrizo are open, deep percolation of water is easily accomplished. Sodium percent in most of the shallower Carrizo waters is rather high. They probably average 75 percent, placing them in the injurious to unsatisfactory

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[16/] Percent sodium (Na) as shown in water analysis is the proportion of the sodium cation (negative ion) to the sum of all cations. It is computed by dividing sodium content measured in equivalents per million (epm) by the sum of the calcium, magnesium, and sodium contents also measured in equivalents per million, all multiplied by 100.

category. However, the effective salinity (in epm) of most waters falls within the 7-15 range, placing most of them in the satisfactory category.

Boron. Boron in small amounts (less than 0.1 ppm) is required for the growth of most plants. However, plants usually will not tolerate more than 0.5 to 2 ppm boron depending on the crop concerned. Outside the Soda Lake area, the boron content of Carrizo ground waters rarely exceeds 0.5 ppm but is always present in smaller quantities sufficient for required growth.

Household, Livestock, and Community.

Total hardness is an important factor in determining the suitability of water for household and community use. Compounds of calcium and magnesium are the principal causes of hardness although other substances such as iron, magnesium, aluminum, barium, silica, strontium, and free hydrogen contribute to the total hardness.

Hardness is generally expressed as parts per million of calcium carbonate. Waters containing 100 ppm or less of hardness (as $CaCO_3$) are considered soft; those containing 101 to 200 ppm, moderately hard; and those in excess of 201, ppm, very hard. In general, the ground waters of the Carrizo are moderately hard to very hard, falling within the range 150 ppm to 300 ppm. It is believed that sufficient waters of not over 200 ppm hardness can be developed at selected localities for any moderately-sized community use. Of course, hard waters with proper treatment, can be reduced to acceptable limits.

As for drinking water, most of the waters outside those in the upper ground water bodies in the Soda Lake area, are potable. However, the potability of waters in the Carrizo varies widely, and appropriate analyses for such use should be made of every water developed within the basin.

Industrial and Other

The standards for domestic and municipal use apply in general to industrial use. Depending on the economics of the matter, waters can be treated to provide softening, demineralizing, and other treatment as required. However, it is not likely that the Carrizo within the predictable future will be industrially developed.

Impairment of Water Recharge

The intermittent streams which flow down from the higher portions of the Carrizo watershed and are not absorbed by the loose soils and find their way underground, gather mostly in the Soda Lake depression in the center of the basin. Ultimately, concentration of their mineral constiuents forms the saline and alkaline dry bed of solid residues. Fortunately most of the waters flowing into Soda Lake are retained and evaporated there. Due to the highly impermeable mud and clay bottom of the lake bed little of these contaminated waters percolate downward into the lesser-contaminated waters beneath the highly mineralized upper (Soda Lake) ground-water body.

Of course, locally, some contamination takes place in other parts of the basin. Increased mineralization has been noted in some localities where the ground water is exposed to faulted and fractured gouge zones containing water soluble materials. However, outside the San Andreas fault zone and along a few other major lines of faulting, impurities from these conditions do not play an important part in ground-water contamination in the Carrizo basin. Although the quality of ground waters may vary considerably from one locality to another depending on local conditions, outside of the Soda Lake area, impairment of ground waters in the Carrizo basin is believed not to be such as to preclude adaptability of most of the waters to the uses desired.

In localities where residential subdivision requires that each unit develop its own domestic water from wells, and at the same locality dispose of its own sewage by underground septic means, there is, of course, a condition for contamination which should be recognized.

Irrigation of agricultural crops requires application of water in excess of the consumptive requirement for water in order to prevent undue build-up of salts in the root zones. This excess water may contain from two to as many as ten times the salt concentrations found in the original water supply. In areas where irrigation return water can percolate to the ground water, it may constitute a source of degradation to the water supply. However, proper disposal of irrigation runoff can largely solve this problem.

WATER DISCHARGE

Natural Processes[17/]

The discharge of ground water by natural processes in the Carrizo Plain takes place mainly in three ways: (1) through evapo-transpiration (evaporation at the surface from zones of saturation, and transpiration by vegetation); (2) through springs and seepages (discharge of water in the liquid state without the agency of man); and (3) through underflow conduits. A fourth way, through surface water outflow, does not apply to the Carrizo basin.

17/ Most definitions used in the paragraphs following are those of Meinzer. Meinzer, O. E. Outline of Ground-water Hydrology with Definitions. U.S. Dept. of the Interior, Geological Survey: Water-supply Paper 494: U.S. House of Representatives, 67th Congress, 2nd Session, Doc. No. 209. Government Printing Office, Washington, D.C., 1923.

Ground-water discharge may be divided into hydraulic discharge and evaporation discharge. Hydraulic discharge of ground water is discharge of water in the liquid state directly from the zone of saturation upon the land into a body of surface water. Hydraulic discharge may be divided into (a) discharge through springs and seepages; and (b) discharge through wells and other man-made devises.[18/] Evaporation discharge of ground water is discharge into the atmosphere, in a gaseous state, of water derived from the zone of saturation.

Evapo-transpiration

Evaporation discharge of ground water may be divided into (a) vegetal discharge and (b) soil discharge. Vegetal discharge of ground water is discharge through the physiological functioning of plants. The water may be taken into the roots of plants directly from the zone of saturation or from the capillary fringe, which in turn is supplied from the zone of saturation. It is discharged from the plants by a process of transpiration.[19/] Soil discharge of ground water is discharge through evaporation directly from the soil or rocks. Discharge of this kind can only take place where the water table is close to the surface.

[18/] This latter category of discharge, subsection (b), is not a natural process. It is, therefore, considered below under "Pumping from Wells."

[19/] Transpiration. In bot., the exhalation of watery vapor from the surface of aerial parts of plants.

The above evaporation discharges apply to ground water only. In the Carrizo Plain Basin, discharges must also include evaporation of surface waters, nearly all of which accumulate in the Soda Lake bed and are prevented from any extensive downward percolation by the presence of a thick and largely impermeable mud and clay bottom. Thus most of the surface water here is totally evaporated before the end of the long dry summer season. It is estimated that an average of nearly 45,000 acre-feet, or more than 25 percent of the total water falling upon the Carrizo watershed annually, evaporates from this lake.

Natural vegetation in the Carrizo Plain is scant, but planted vegetation of dry-farmed grains is substantial. The losses through natural vegetal transpiration are comparatively small but those through planted non-irrigated vegetal transpiration are large. Soil discharge of subsurface water is large due mainly to the arid conditions prevailing in the Carrizo during most of the year. Together, vegetal and soil discharge is estimated to range from 46,000 acre-feet to 72,000 acre-feet per year, depending on the extent of non-irrigated crops.

<u>Springs and Seepages</u>

There are few springs of importance in the Carrizo Plain but there are areas of substantial seepages of perched waters along some fault lines, especially during times of heavy rainfall. Even so, hydraulic discharge from these natural vents combined is not believed to be large in comparison to the whole. It is estimated at less than 2,000 acre-feet per year.

Underflow Conduits

Underflow is the movement of ground water in an underflow conduit. An underflow conduit consists of a permeable deposit which underlies a surface streamway but as herein used, the term also includes those natural subsurface conduits in the form of buried streams at or near the base of the water-bearing formations. These buried underflow conduits connect with underground reservoirs which, as they are filled with recharge waters, permit excess ground waters to flow downdip to points where such waters overflow into lower subterranean reservoirs outside the Carrizo structural basin.

As ground water is withdrawn from the water body by pumping or other means, this underflow may be lessened or prevented. In the case of the Carrizo, it is estimated that the 55,000 - 80,000 acre-feet of ground-water recharge annually, most of which currently escapes the basin as underflow, could be captured by pumping this additional amount from properly-located wells.

Surface Water Outflow

There is no surface water outflow from the Carrizo topographic basin. This situation means that all of the waters falling upon the Carrizo watershed which do not find their way underground evaporate before they do so, or are consumed through transpiration, collect in the Soda Lake depression whence they in part percolate underground but are mostly ultimately evaporated. Because there is no surface outflow, the amount of water in this lake (or the depth of the water table below the lake bed when it is dry) functions, more or less, as a barometer which indicates the degree to which the ground-water body of the Carrizo is filled.

Unlike the Cuyama hydrologic unit joining the Carrizo on the south, which has a much larger watershed and gross recharge than the Carrizo, the Cuyama has a large surface outflow mainly down the Cuyama River. As a result the Cuyama Basin has even a lesser average annual net recharge than the Carrizo.[20/]

Pumping from Wells

To date, the discharge of ground water in the Carrizo Plain through pumping from wells has been small. As heretofore pointed out, the total net amount of ground water being withdrawn through wells is currently at the rate of less than 4,000 acre-feet annually, or less than 5 percent of

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20/ For the Cuyama, "Olmstead and Bradshaw estimate average yearly recharge to be about 12,000 acre-feet, and the United States Bureau of Reclamation estimates it to be not more than 8,000 acre-feet." Upson, J.E. and G.F. Worts, Jr., Ground Water in the Cuyama Valley, California. Geological Survey Water-Supply Paper 1110-B, p. 47, U.S. Department of the Interior, Washington, D.C., 1951.

the estimated maximum average annual recharge, and less than 7 percent of the minimum average annual recharge (see Table 4, p. 40).

Well Classification and Numbering

Data from the pumping of water wells together with those data from other perforations into the subsurface, such as bore holes for oil and gas, are used in determining the potentialities of ground water development. In the Carrizo Plain 89 wells have been drilled for water, 43 deep test wells have been drilled for oil and gas, and 19 shallower core holes have been drilled for stratigraphic information relating to oil and gas exploration. All of these wells have been invaluable to the interpretation of the ground water potentialities of the Carrizo. Water wells are listed in Table 8. Following is a classification of wells, the number drilled, and range in depths for each class of well drilled in the Carrizo Plain to date.

TABLE 7.- Classification of wells, number drilled, and range in depths in the Carrizo Plain area, California, January 1, 1967

Class of wells	Number drilled		Depth range (feet)	
Water wells:				
Irrigation wells	11		200- 700	
Household and livestock wells	89		50- 100	
Community wells	3		550-1,865	
Total water wells		103		50- 1,865
Wells for oil and gas:				
Exploratory wells	43		1,443-11,684	
Core holes	19		568- 3,906	
Total wells for oil and gas		62		568-11,684
Total wells:		165		50-11,684

<u>Water Wells</u>. Water wells are numbered within each of sixteen 40-acre plots in a 640-acre section according to the chronological order in which they are located in the plot. For example, a well in Township 29 South, Range 18 East, in Section 28 and plot L, and the third well to be drilled in that plot, would be designated as T29S-R18E/S28-L3. Most of the wells in the Carrizo Plain refer to the Mount Diablo Base Line and Meridian (MDB&M) except those in the southernmost part of the plain where the numbers refer to the San Bernardino Base Line and Meridian (SBB&M). Following is a diagram showing the water well numbering system.

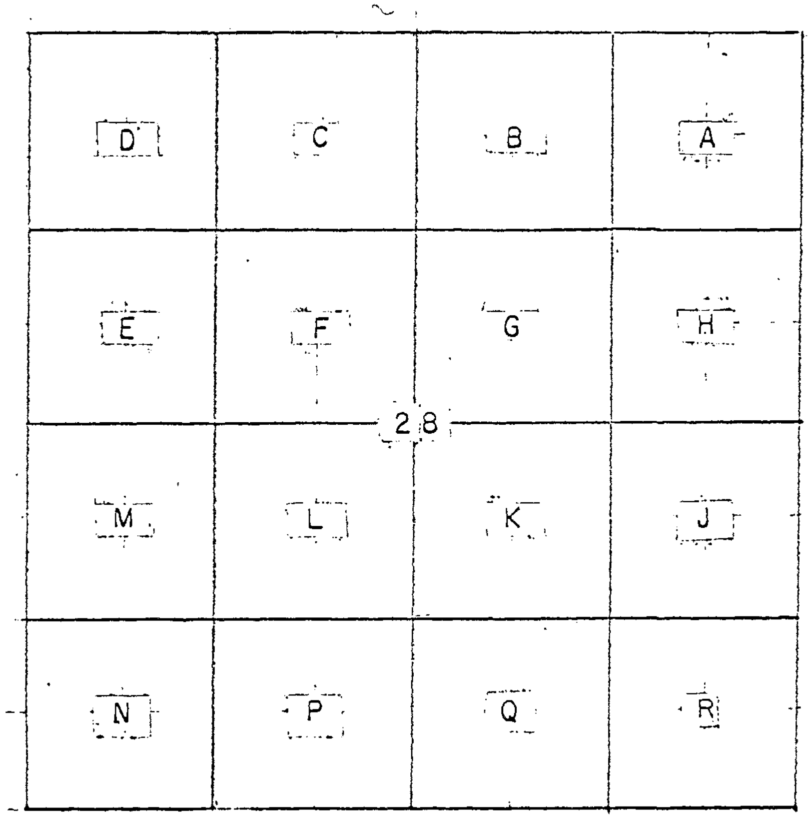

TABLE 8.- List of water wells in the Carrizo Plain area, San Luis Obispo County, California, January 1, 1967, by township, range, and section

Township-Range Sec.-well no.	Property or owner	Year completed	Total depth (feet)	Depth to water (feet)	Water level above sea-level (ft)	Rated capacity (gpm)	Remarks
T28S-R17E							
S17-C1							Windmill
S18-L1							Windmill
S22-F1							Domestic 1/
T28S-R18E							
S18-A1							Pinole Spring
S20-C1	W.Wreden	pre-1958	105	48	2,302	-	Windmill
S20-E1	W.Wreden	-					Windmill
S28-H1		pre-1958			2,405		Windmill;not in u
S34-A1	W.Wreden						Windmill
T29S-R17E							
S2-F1							Carnaza Spring
S11-H1	H.Wreden	pre-1958	200	40	2,030		Irrigation
S13-R1	R.Cooper	pre-1958	200	35	2,006	100	Irrigation
S25-J1		pre-1958	80	59	1,994		Windmill
T29S-R18E							
S14-D1	C.Wreden						Mustang Spring
S16-M1	Polin	pre-1958	100	37	2,043		Domestic
S20-E1	Polin	pre-1958	-	19	2,015		Windmill;not in u
S21-P1	Lewis	pre-1958	70	35	2,005		Windmill
S28-G1	King	1964					Irrigation
S28-K1	W.King	pre-1958	500				Irrigation;abd.
S28-L1	W.King	pre-1958	175	31			Domestic
S28-L2	King	pre-1958	325				Irrigation;abd.
S28-L3	King	1965	600				Irrigation
S29-E1	Lewis	pre-1958	700	36	1,995	500	Irrigation
S30-N1	Garcia	1918	80				Domestic
T29S-R19E							
S31-F1	Beck	pre-1958	16	10			Domestic
S31-F2	Beck						Thompson Spring
T30S-R18E							
S1 -B1							
S1 -B2							
S1 -G1							
S1- D1		pre-1958					Domestic
S1 -L1		pre-1958					Domestic
S2 -D1		pre-1958					Irrigation
S3 -E1	King	pre-1958	300	41	1,944	600	Irrigation
S3 -D1	F.King	pre-1958	600	22	1,978	1,100	Irrigation
S4 -R1							
S9 -E1							
S12-N1	Chilcote	1963	550				Community
S13-M1	Smith	pre-1958	285	13	1,968	500	Irrigation
S14-A1							
S14-A2		pre-1958					

(Continued...

1/ "Domestic" includes household, livestock, etc.

TABLE 8.- (Continued)

Well location Township-Range Sec.-Well no.	Property or owner	Year completed	Total depth (feet)	Depth to water (feet	Water level above sea-level (ft)	Rated capacity (gpm)	Remarks
T30RR18E (Continued)							
S17-G1.......							Domestic
S23-B1.......							Domestic
S23-D1.......							Domestic
S25-B1.......							Domestic
T30S-R19E							
S1-B1.......							Spring
S2-H1.......	Martins	pre-1958	250				Domestic;not used
S8-E1.......							Domestic
S19-K1.......							Domestic
S19-L1.......							Domestic
S19-P1.......							Domestic
S22-H1.......							Domestic
S22-K1.......							Domestic
S23-J1.......							Domestic
S23-J2.......							Domestic
S23-K1.......							Domestic
S23-M1.......							Domestic
S24-E1.......							Domestic
S25-D1.......							Domestic
S27-A1.......							Domestic
S27-B1.......							Domestic
S27-H1.......							Domestic
S29-K1.......							Domestic
S29-M1.......		pre-1958					Domestic
S29-M2.......		pre-1958					Domestic
S29-N1.......							Domestic
S29-Q1.......							Domestic
S29-Q2.......							Domestic
S30-E1.......							Domestic
S30-G1.......							Domestic
S30-G2.......							Domestic
S30-J1.......							Domestic
S30-L1.......							Domestic
S30-R1.......							Domestic
S32-C1.......							Domestic
S32-G1.......							Domestic
S32-G2.......							Domestic
S32-J1.......							Domestic
S32-J2.......							Domestic
S34-M1.......	Cal.Valley	1962	1,019	10			Community;comp.995
S34-M2.......	Cal.Valley	1962	1,865				Community
S36-P1.......							Domestic

(Continued...

TABLE 8.- (Continued)

Well location Township-Range Sec.-Well no.	Property or owner	Year completed	Total depth (feet)	Depth to water (feet)	Water level above sea-level (ft)	Rated capacity (gpm)	Remarks
T30S-R20E							
S17-Q1.......							Domestic
S18-C1.......							Domestic
S19-M1.......							Domestic
S20-G1.......							Domestic
S20-M1.......							Domestic
S29-M2.......							Domestic
S29-E1.......							Domestic
S30-K1.......							Domestic
S31-E1.......							Domestic
S31-C1.......							Domestic
S33-N1.......							Domestic
T31S-R19E							
S 5-L1.......	Goodwin						Domestic
S10-A1.......	Goodwin						Domestic
S24-H1.......		pre-1958					Domestic
T31S-R20E							
S 4-H1.......		pre-1958					Domestic
S 5-L1.......							Domestic
S 5-R1.......							Domestic
S10-G1.......							Domestic
S11-M1.......							Domestic
S30-K1.......							Domestic
T32S-R20E							
S 4-H1.......							Domestic
S15-D1.......							Domestic
S16-D1.......							Domestic
S21-G1.......							Five Willow Spr
S22-A1.......							Domestic
T32S-R21E							
S18-A1.......		pre-1958					Domestic
T32S-R22E							
S32-L1.......							Domestic
S32-L2.......							Domestic
T11N-R26W							
S2-C1.......							Domestic

Exploratory Wells for Oil and Gas. Exploratory wells for oil and gas, and core holes for stratigraphic information relating to oil and gas are named and numbered in a fairly conformable manner but they do not correspond to the standardized system used for water wells. Wells and core holes relating to oil and gas usually first bear the name of the owner of the well, such as Shell Oil Company. This is followed by the name of the property owner or some other more or less arbitrary name like "McDonald Estate- One." Lastly, will appear any one or a combination of figures such as a number in the well owner's drilling pattern, the sequence in which the well was drilled, or the number of the Section in which the well is drilled such as 83-25. Thus this well would be designated Shell Oil Company "McDonald Estate- One" 83-25. The list of wells in Table 8 indicates the manner of naming and numbering wells in this category.

TABLE 9.– List of wells drilled for oil and gas and core holes drilled for geological information in the Carrizo Plain, San Luis Obispo County, California

Well location Township-Range Sec.-Well no.	Company	Name	Number	Total depth	Year ab'd	Elevation ground above SL (ft)	Remarks
T27S-R17E							
S17-	Shell	C.H.[1]	87-17	2,995	1949	2,000	Basement
T28S-R17E							
S24-	Sunray	Wreden	1	5,087	1936	2,269	Sta Margarita 12
S29-	San Juan	Wreden	1	4,770	1917	927	
S33-	Union	Wreden	4	5,113	1949	2,107	Sta Margarita 12
T28S-R18E							
S26-	Carrizo	Carrizo	1	2,204	1950	2,325	Paso Robles 2204
S34-	Grey	Wreden	1	2,773	1965	2,419	
S36-	Reid	Intex-	67-36	5,204	1949		
T29S-R17E							
S24-	Shell	Stauffer	41-24	5,120	1955	2,062	
S24-	Shell	C.H.	46X-24			2,073	
S24-	Shell	C.H.	47X-24	810	1952	2,077	
S24-	Shell	C.H.	55X-24	781	1954	2,060	
S24-	Shell	C.H.	56X-24	644	1954	2,075	
S24-	Shell	C.H.	65X-24				
S24-	Shell	C.H.	72X-24	568	1952	2,063	
S25-	Shell	McDonald-	83-25	4,921	1953	2,039	
T29S-R18E							
S 1-	Union	Wreden	7	3,700	1949	2,515	
S 5-	Union	Wreden	5	6,655	1949	2,166	Sta Margarita 16[illegible]
S 5-	Sunray	Wreden	63-5	10,995	1952	2,176	
S10-	Young	Mustang	61X	3,676	1957	2,295	Sta Margarita 25[illegible]
S10-	Young	Jaramas	1	3,402	1958	2,278	
S30-	Shell	Lewis	56-30	9,681	1955	2,028	Temblor 1070
S30-	Shell	C.H.	76-30	3,497	1949	2,010	
S30-	Shell	McDonald-	28-30	11,684	1951	2,064	
S30-	Shell	C.H.	13X-30	880	1952	2,038	
S30-	Shell	C.H.	14X-30	1,001	1952	2,041	
S30-	Shell	C.H.	37X-30	1,216	1952	2,033	
T29S-R19E							
S20-	Associated	-	1	3,506	1918	2,337	
T30S-R18E							
S 5-	Shell	C.H.	71-5	2,245	1949	1,998	
S 5-	Shell	C.H.	58X-5	943	1954	2,080	
S 5-	Shell	C.H.	58Y-5	1,171	1954	2,057	
S 5-	Shell	C.H.	67X-5	976	1954	2,035	
S 8-	Shell	C.H.	32X-8	1,205	1954	2,145	

[1] Core hole

(Continued...

TABLE 9.- (Continued)

Well location Township-Range Sec.-Well no.	Company	Name	Number	Total depth	Year ab'd	Elevation ground above SL (ft)	Remarks
T30S-R19E							
S 8-	Shell	Smith	61-8	7,556	1955	2,144	
S15-	Shell	Twisselman	84-15	4,350	1951	1,999	
S16-	Shell	C.H.	36-16	3,906	1949	1,958	
S18-	Dawson	C.H.	2	2,091	1955	1,955	
S19-	Dawson	C.H.	1	1,506	1955	2,000	
S19-	Shell	C.H.	48X-19	628	1954	1,943	
S19-	Shell	C.H.	48Y-19	904	1954	1,945	
S22-	Shell	Smith	32-22	5,506	1954	1,950	Paso Robles 2155 (bot
S30-	Shell	C.H.	51X-30	714	1954	1,947	
S30-	Shell	C.H.	51Y-30	675	1954	1,970	
S30-	Shell	C.H.	37X-30	1,216	1952		
S30-	Shell	C.H.	41X-30	800	1954	1,943	
T30S-R20E							
S31-	Berry	-	1	2,885	1921		
T31S-R19E							
S12-	von Glahn	Soda Lake	1	2,575	1949	1,964	
T31S-R20E							
S 5-	McCarthy	Polizzoto	88-5	4,785	1949	1,944	
S20-	Richfield	Blakey	1	2,462	1942	1,924	
T32S-R20E							
S 1-	Sunray	Barnsdall-	1	5,217	1957	1,938	
S16-	Texaco	Blakey	1	6,324	1950	2,360	
S36-	von Glahn	Washburn	1	7,203	1954	2,560	
T32S-R21E							
S22-	Howell	Pam	1	86	1949		
T11N-R25W							
S19-	Carlisle	-	1	2,690	1926	2,500	Cretaceous ?
T11N-R26E							
S 2-	G.& W. Oil	-	1	1,714	1964		
S3 -	Murray	North Dome	1	2,330	1948	2,175	
S 6-	Navy Oil	Navy	2	5,024	1952		
S 6-	D & D	-	1	1,905	1950	2,400	Pleistocene 2,400 ?
S 9-	Mid Cal	Community	1	1,445	1949		Pliocene 2,200 ?
S 9-	Mid Cal	C.H.	C-9	1,190	1949		Pleistocene 2,355 ?
S12-	Texaco	KCL-Travers	1	5,999	1954		
S12-	Lewis	-	1	2,312	1920		Miocene 2,300 ?
S15-	Meeker	Smith	1	2,714	1950		Pliocene 2,692

Fluctuations in the Ground Water Level

Fluctuations in the ground water levels of the Carrizo Basin have been of low amplitude between seasonal periods of recharge and discharge mainly because pumping from wells has been relatively small and the long-term balance between recharge and discharge has been little disturbed. Depth to the ground water table in the central Soda Lake area, even when the lake bed is dry, is rarely more than 10 feet below the surface. Away from the lake bed proper, the water level is encountered at from 20 to 70 feet below the surface. Contours on the top of the Soda Lake ground water table range in elevation above sea level from 1,910 feet at its lowest point in the center of this depression, to more than 1,980 feet along its periphery.

Below the Soda Lake ground water body in the lower Recent Alluvium and upper Pleistocene Paso Robles formation is the more extensive Carrizo ground water body confined to the middle and lower Paso Robles and which has been tapped by the deeper irrigation wells in the northwestern part of the basin.[21/] Data relating to the water level of the Carrizo ground water body are limited to a few wells,

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21/ A confined water body is a body of ground water overlain by materials sufficiently impervious to sever free hydraulic connection with overlying water, and moving under pressure caused by the difference in head between intake and discharge areas of a confined water body.

but such data as are available show that the depth to water below the surface in this area ranges from around 40 to 80 feet below the surface. Contours on the top of the Carrizo water body range from 1,970 feet above sea level just south of State Highway 58 to 2,040 feet 4 miles to the north.

In neither of these ground water bodies have enough wells been drilled or has sufficient water been discharged from wells to lower the ground waters from their original levels established by the natural balance between recharge and discharge. Measurements of drawdown[22/] and specific capacity[23/] have not been made over any regular periods of time to indicate appreciable changes in water levels. Even if such records had been kept, it is doubtful that the few wells pumping from the ground water bodies would discharge enough water between the periods of recharge and discharge to show any appreciable change or pattern in ground water levels. Contours on ground water levels of the Soda Lake and the Carrizo ground water bodies are shown in Figure .

22/ Drawdown is the lowering of the water level in a well in the local area around the well caused by pumping, measured in feet.

23/ Specific capacity is the number of gallons per minute per foot of drawdown by a pumping well.

PROSPECTIVE REQUIREMENTS IN RELATION TO POTENTIAL SUPPLY

The over-all requirements for ground water in the Carrizo Plain in the long run are certain to be in excess of the ground water supply--not because the water supply is small (which it is not) but because the area of irrigable land is so large. There exists within the Carrizo, a potential area of irrigable land of around 100,000 acres. To irrigate all of this acreage for pasture, alfalfa, hay and grain and a few other crops, would require some 172,000 acre-feet of water annually, or practically as much as the total rainfall over the Carrizo watershed.

Actually, only from less than one-third (31%) to less than one-half (45%) of the 177,000 acre-feet of water falling upon the Carrizo watershed annually, or from 55,000 acre-feet to 80,000 acre-feet of ground water annually is estimated to be available for irrigation of these selected crops, depending largely on the acreage of crops dry-farmed. As is indicated in Table 10 , these amounts of ground water recharge would be sufficient to irrigate from 32,000 to 46,000 acres of land.

It is anticipated that the predominant irrigated crops under ultimate conditions in the Carrizo will be pasture, alfalfa, hay and grain. It is anticipated that the livestock industry will increase in valuation with a

TABLE 10.– Estimates of ground water required for irrigation of selected crops in the Carrizo Plain Basin based on irrigable land and on ground water available[1]

Crop	Unit of applied water (feet of depth)[3]	On basis of irrigable land available: Land[2] available (acres)	On basis of irrigable land available: Water required (acre-feet)	On basis of ground water available, Maximum: Water available (acre-feet)	Maximum: Land required (acres)	Minimum: Water available (acre-feet)	Minimum: Land required (acres)
Pasture........	[a] 3.2	19,000	60,800	36,160	11,300	24,854	7,767
Alfalfa........	[a] 3.2	20,000	64,000	20,089	6,278	13,808	4,315
Hay and grain...	0.7	53,800	37,660	14,464	20,663	9,942	14,203
Truck and Misc..	1.7	6,700	11,390	6,428	3,781	4,419	2,599
Subtotal......	1.84	99,500	173,850	77,142	42,022	53,023	28,884
Domestic	[b] 0.8	1,000	800	3,214	4,017	2,209	2,761
Total.........	1.75	100,500	174,650	80,356	46,039	55,232	31,645

1/ No factor has been applied for return of irrigation water to the ground water body.

2/ Probable ultimate water service according to the Calif. Dept. of Water Resources, *ibid.*, p. 151.

3/ To obtain total seasonal consumption, add 0.7 ft. from precipitation.

a/ Based on average of 3 crops per year.

b/ Irrigation equivalent for domestic consumption (household, livestock, and community.

greater proportion of the animals being raised on permanent pasture. Demand will increase for supplemental feed, and proportional increases are expected for irrigated hay and grain.

Under ultimate conditions of development in the Carrizo Plain Unit, it is assumed that lands will remain in relatively large holdings as at present, and that most of the urban development serving that unit will continue to be located outside of the Unit. Of course some subdivisions may take place in the form of small plots for intermittent residence by persons desiring to take advantage of the clean air and invigorating climate but such subdivisions are not expected to result in any large permanent settlements of the urban type.

PERENNIAL YIELD

The rate at which water can be withdrawn year after year without depleting the ground water storage to such an extent that a withdrawal at this rate is no longer feasible because of increased pumping costs or deterioration of water quality is called the perennial yield.

In the case of the Carrizo Basin, the perennial yield would probably amount to the quantity of that underflow of ground water recharge which may be recovered before such water overflows the natural underground spillway at the northern end of the structural basin into the Las Yeguas and San Juan drainage areas. Such recovery could amount to from 55,000 to 80,000 acre-feet, the minimum and maximum estimates to flow annually out of the underground basin through natural underflow conduits as a result of keeping the natural balance between recharge and discharge.

In a newly-developed basin such as the Carrizo Plain, there is usually a large amount of stored water that can be drawn upon before the economic limit of pumping is approached. As this limit is approached, the yearly rate at which withdrawals can be made then becomes the difference between average yearly recharge and the average yearly natural discharge.

At the present stage of ground water development in the Carrizo, it is practically impossible to ascertain within a reasonable degree of accuracy what the economic limit of recovering such waters with the maximum of efficiency and minimum of waste might be. To arrive at a practical figure of perennial yield involves the collection of much basic data such as adequate coverage of accurate precipitation records, monthly measurements of water levels in observation wells, measurement of drawdown and water levels, and estimate of ground water flow by field tests of permeability.

SAFE YIELD

The maximum rate of net extraction from the ground water basin which, if continued over an indefinitely long period of years, and would result in maintenance of certain desirable fixed conditions, is termed the safe yield. The calculation of safe yield is dependent on many factors such as one or more of the following conditions:

1. Mean seasonal extraction of water from the ground water basin does not exceed mean seasonal replacement to the basin.

2. Water levels are not so lowered as to cause harmful impairment of quality of the ground water by intrusion of other water of undesirable quality, or by accumulation and concentration of objectionable elements.

3. Water levels are not so lowered as to imperil the economy of ground water users by excessive costs of pumping from the ground water basin or by exclusion of the users from a supply therefrom.

Despite any favorable balance between water supply and demand, there are always drawbacks to total water development, and especially so in the Carrizo.

With further utilization of water and the resultant lowering of ground water levels, a mixing of water and consequent degradation of the better quality water is possible. Also, the threat of an unfavorable salt balance, which is likely to build up through constant re-use of irrigation return flow if lands overlying the basin were extensively irrigated, would tend to limit the yield which could be obtained. However, only further development of ground waters from the several reservoirs of different geological ages will prove the various qualities of waters to be dealt with whence application can be so distributed and otherwise controlled through a system of unit operation or cooperation in the best interests of conservation and quality control.

It is believed that the Soda Lake depression may function as a disposal pond for irrigation runoff where most of the salts could be deposited and concentrated through evaporation as has been done naturally over the years. Thus the problem of return irrigation flows may be solved. With full development of the irrigable acreage, the lake may increase in size until a stabilized condition would be reached wherein the net evaporation from the lake surface would equal the total return flow from the applied irrigation water.

CLASSIFICATION OF LAND FOR GROUND WATER DEVELOPMENT

The total area of arable land in the Carrizo Plain spreads over the entire area of the topographic basin floor which is estimated to cover some 350 square miles, or 224,000 acres. About half of this vast acreage, or around 100,000 acres is irrigable, and there is calculated to be enough ground water available to irrigate an average of around 40,000 acres annually for pasture, alfalfa, hay and grain. Just how much of the available ground water is to be applied to which lands for what crops are factors to be determined by the economics of the problems. In general, however, it is supposed that most of the lands to be irrigated will follow the paths where most ground water can be developed, and any classification of land for ground-water development will follow that pattern.

Broadly, the classification presented herein is on the basis of soil and topography in relation to the amount and quality of the ground-water potential by areas. The Plain is divided into the North Carrizo, Central (Soda Lake) Carrizo, and South Carrizo. The areal extent of the ground-water bodies in these respective divisions of the Plain, are outlined in Figure .

NORTH CARRIZO

This area, north of the northern limits of the Soda Lake depression, offers the best soil and most favorable topography, and the best quality and largest quantity of ground water in the Carrizo. The main subterranean channel of ground water underflow curves northwestward in a band averaging something more than two miles wide through the area. Within the confines of this underflow, the water-bearing formations range in thickness from 200 to 900 feet, but porosity, permeability, and compactness of the individual water "sands" are highly variable. Water-bearing sands are often fine-grained and loosely consolidated, giving considerable trouble to inexperienced well drillers. However, with proper drilling and completion technique, wells which are favorably located and intelligently spaced should result in output capacities within the range of from 500 to 1,000 gallons per minute from depths ranging from 500 to 1,000 feet.

In addition to this northwestern belt of ground water, another underflow conduit lies along the western side of the San Andreas fault zone. Here, no deep wells have yet been drilled to test ground-water capacity or quality. It may be that the shallower waters would be too contaminated with soluble mineral salts and alkalis and that "fresh" waters would lie too deep for commercial exploitation, but both zones are worthy of tests. Depths to ground water here would be within the 500 to 1,500-feet range, but surface elevations of the well heads might be high enough to irrigate some of the hill lands.

CENTRAL (SODA LAKE) CARRIZO

This area is confined to the Soda Lake bed and its immediate borders. It is the least attractive for ground-water development from the standpoint of soil and water quality. The Soda Lake ground water body is so contaminated with mineral salts and alkalis that it would not serve for either irrigation or most other uses. These waters lie at depths of from a few feet to several hundred feet below the surface of the lake bed and only two wells are known to have tested them both unsuccessfully.

Underlying the Soda Lake water body eastward, is the deeper-seated Carrizo ground-water body which contains waters of qualities generally adaptable to irrigation and most other uses. These better waters, however, lie at depths ranging from 900 to 1,300 feet below the surface. Eastward from the Soda Lake bed, the soils improve in character but the depths to the better ground waters increase. It is a question, therefore, whether exploitation of these deeper waters in this area would be profitable.

SOUTH CARRIZO

This area affords naturally, excellent conditions for seasonal livestock grazing but not for any extensive program of irrigation. Eastward, along the San Andreas fault zone, the water-bearing Paso Robles formation is more than 3,000 feet thick, and may hold considerable water where the porosity and permeability of the beds are suitable. This zone has not been tested. Excepting possibly in the northeast quarter of the area, the Carrizo ground-water body may lie too deep below the surface to be commercially exploitable.

The southwestern part of the South Carrizo may hold considerable ground water in the "Morales Sub-Basin" (see Figures 6 and 7 on pages 30 and 30a) which is well developed here. However, no wells have yet tested this sub-basin. If sufficient water should be available, the comparatively higher elevation of the locality would afford irrigation of large acreages of the irrigable land lying at lower elevations in this area.

SUMMARY OF CONCLUSIONS AND RECOMMENDATIONS

CONCLUSIONS

The conclusions drawn from this preliminary investigation of ground water in the Carrizo Plain Basin are as follows:

1. The ground water resources of the Carrizo Plain Basin have been developed enough to prove the actual existence and application of considerable ground water for irrigation and other uses. It is estimated that a minimum of less than 5 percent, and a maximum of slightly more than 7 percent, of the estimated average net annual ground water recharge is currently being pumped from wells.

2. There appear to be two distinctive ground water bodies underlying the Carrizo Plain; (1) the Soda Lake in the central part of the Plain; and (2) the Carrizo, extending beneath nearly all of the Plain. The waters of the Soda Lake ground water body are contaminated with a variety of soluble mineral salts and other impurities enough to make them practically useless for irrigation and other water requirements. The waters of the Carrizo ground water body are generally of good to fair quality and are adaptable for irrigation and most other water requirements.

3. The average net recharge of ground water to the Carrizo ground-water body will range from a minimum of around 55,000 acre-feet annually to a maximum of 80,000 acre-feet, depending largely on the amount of vegetal discharge related to the acreage of dry-farmed (non-irrigated) crops sown.

4. It is believed that the ultimate requirements for ground water in the Carrizo Plain area will be mostly for the irrigation of pasture and other forage crops and supplementary feeds for an expanded livestock industry. A safe yield minimum of 55,000 acre-feet of ground water available annually would be sufficient to irrigate approximately 32,000 acres of land in these crops; and the maximum of 80,000 acre-feet would be sufficient for 46,000 acres.

5. During periods of recharge deficiency, the reserves in natural underground reservoirsare believed to be large enough to permit withdrawal therefrom for a number of years until the average annual natural balance between recharge and discharge is reestablished.

6, The Soda Lake bed has been functioning naturally throughout geologic time as a disposal pond for the collection of surface waters, and could serve the same purpose for surplus irrigation waters which become contaminated by re-use, and are not reabsorbed into the subsoil.

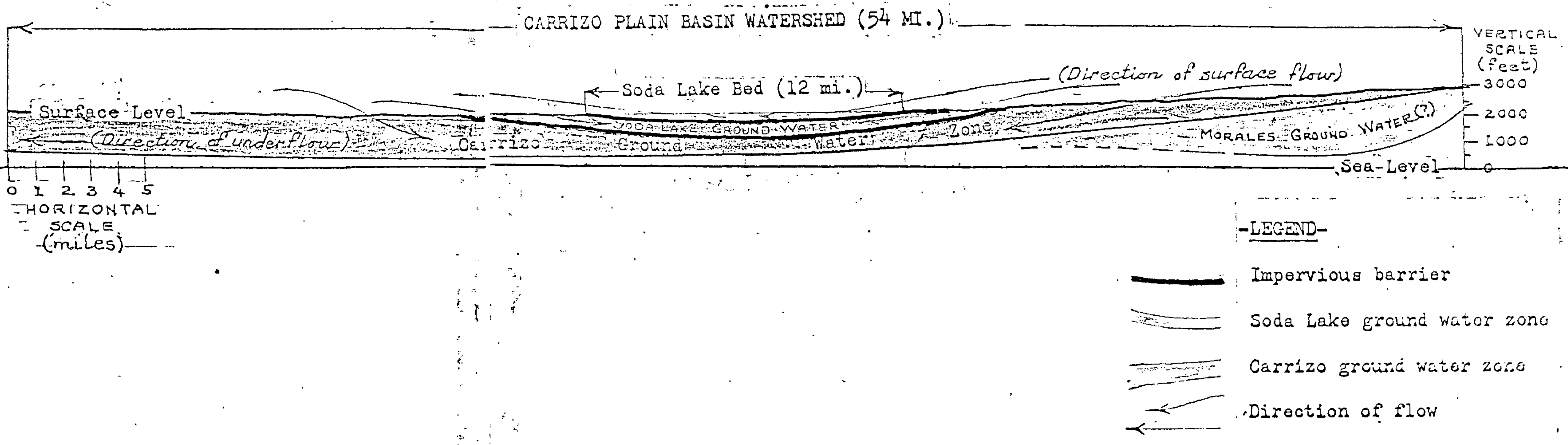


FIGURE 9.- Longitudinal section showing relative positions of the main ground water zones in the Carrizo Plain Basin, California.
(Section is along a northwest-southeast line through the center of the Soda Lake depression)

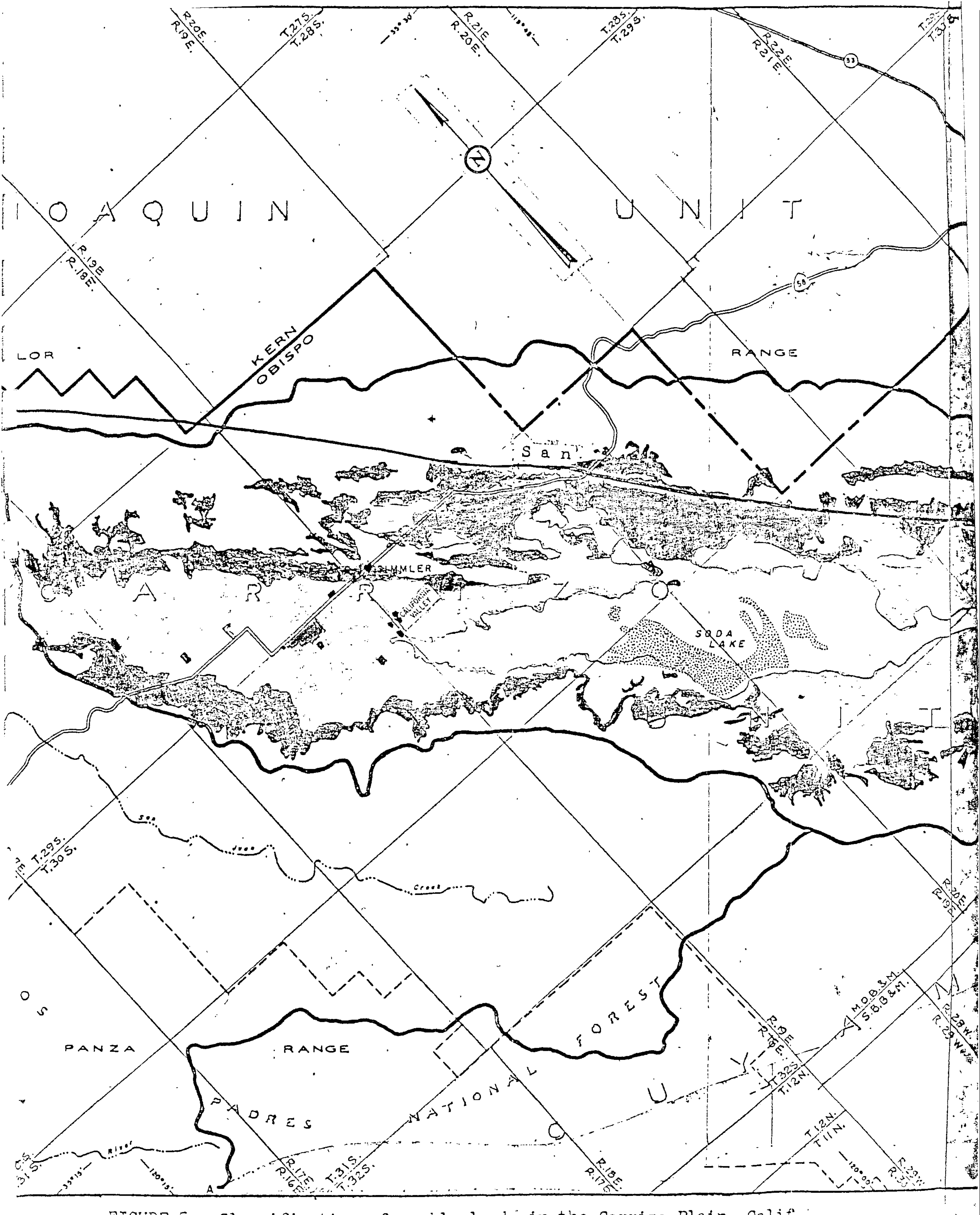
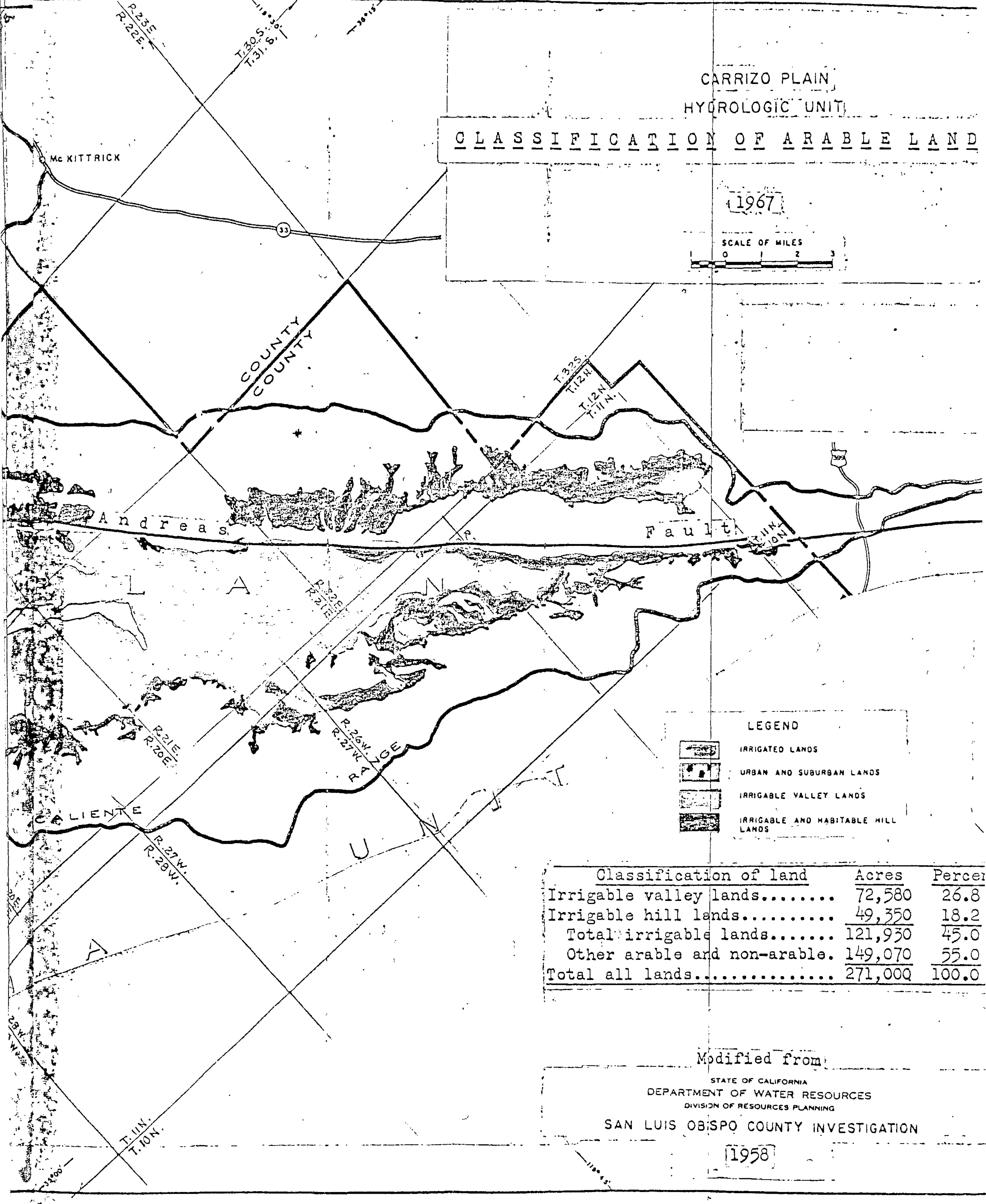


FIGURE 5.- Classification of arable lands in the Carrizo Plain, Calif.

CARRIZO PLAIN HYDROLOGIC UNIT

CLASSIFICATION OF ARABLE LAND

1967



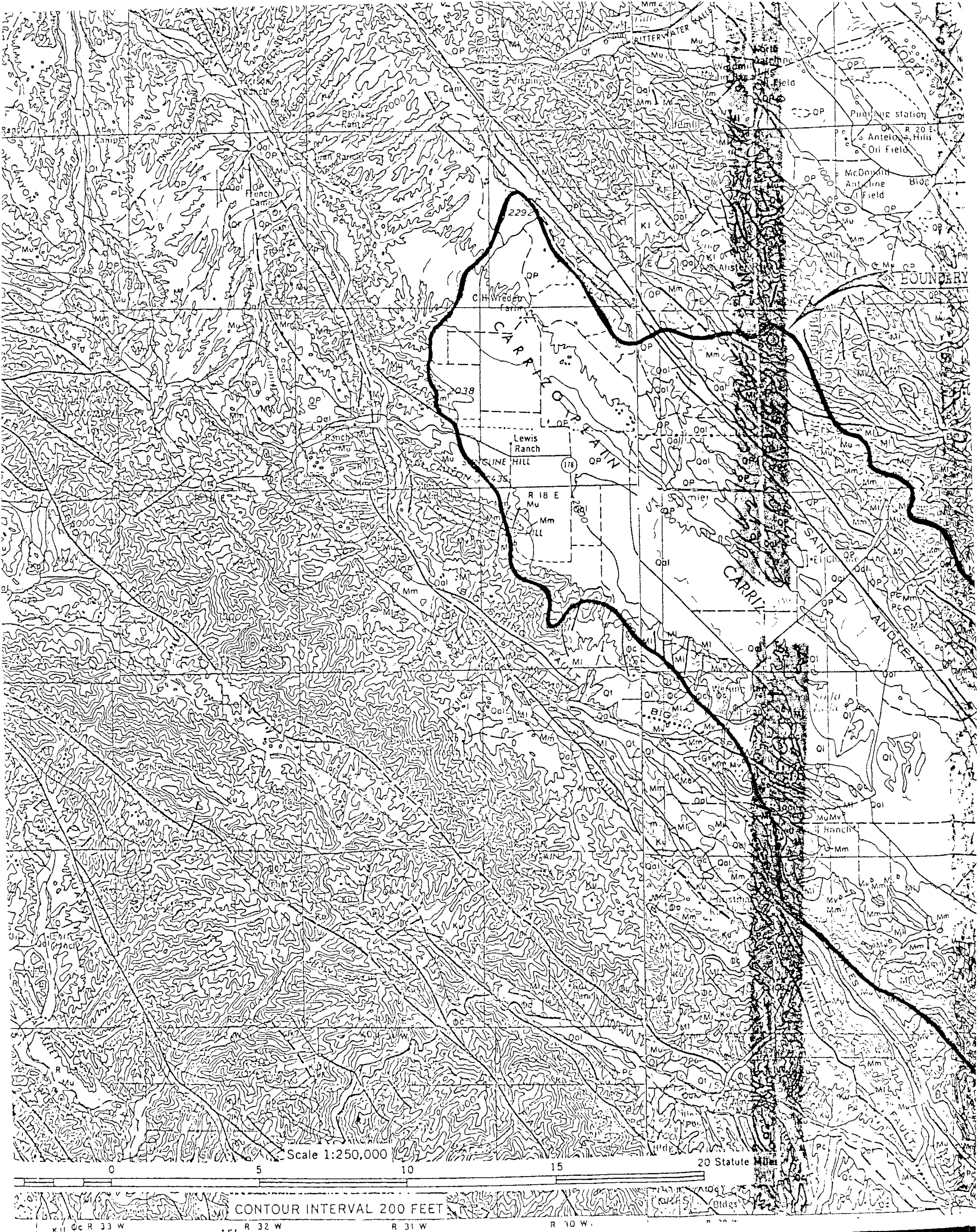
Classification of land	Acres	Percen[t]
Irrigable valley lands........	72,580	26.8
Irrigable hill lands..........	49,350	18.2
Total irrigable lands.......	121,930	45.0
Other arable and non-arable.	149,070	55.0
Total all lands.............	271,000	100.0

Modified from

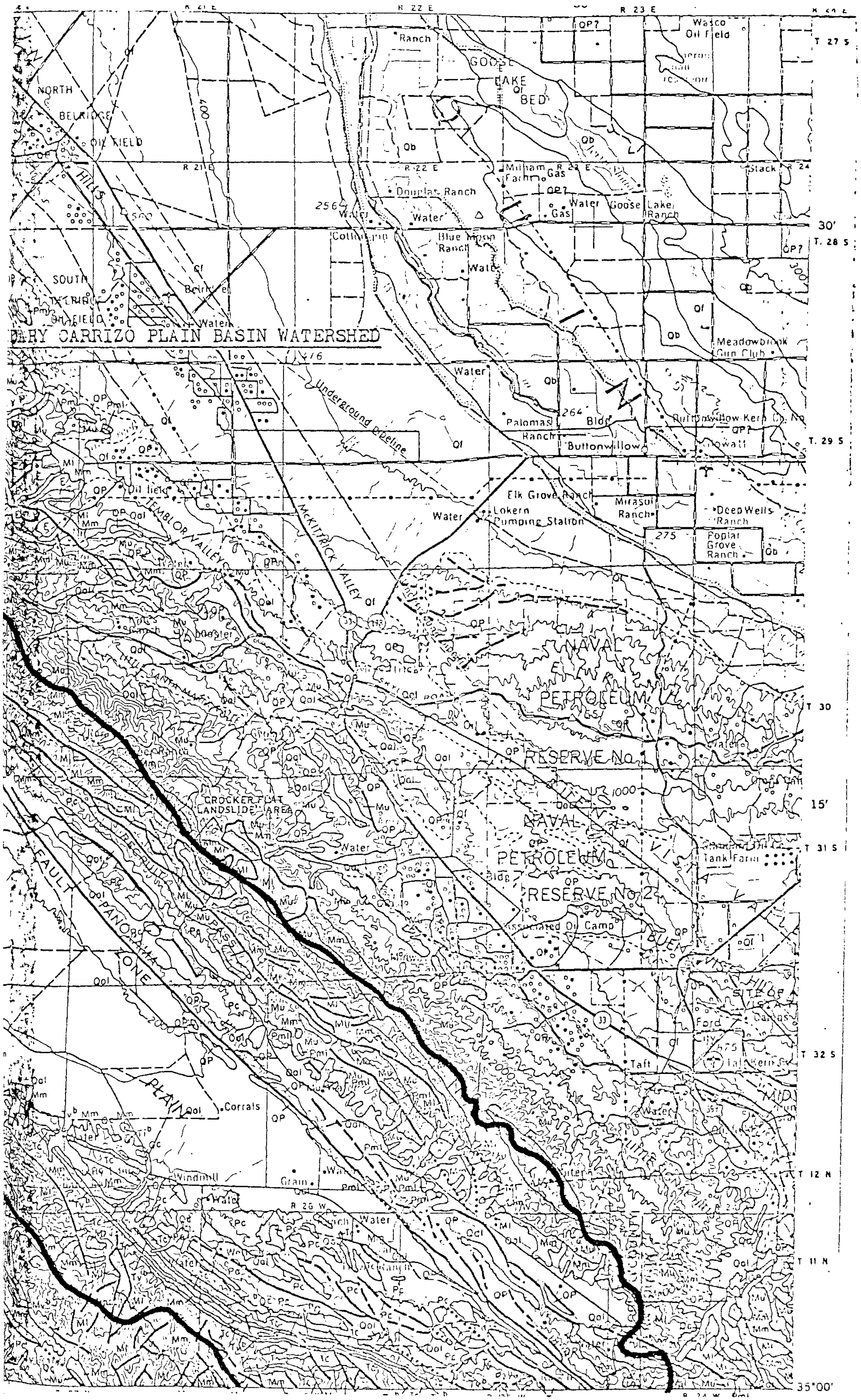
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING

SAN LUIS OBISPO COUNTY INVESTIGATION

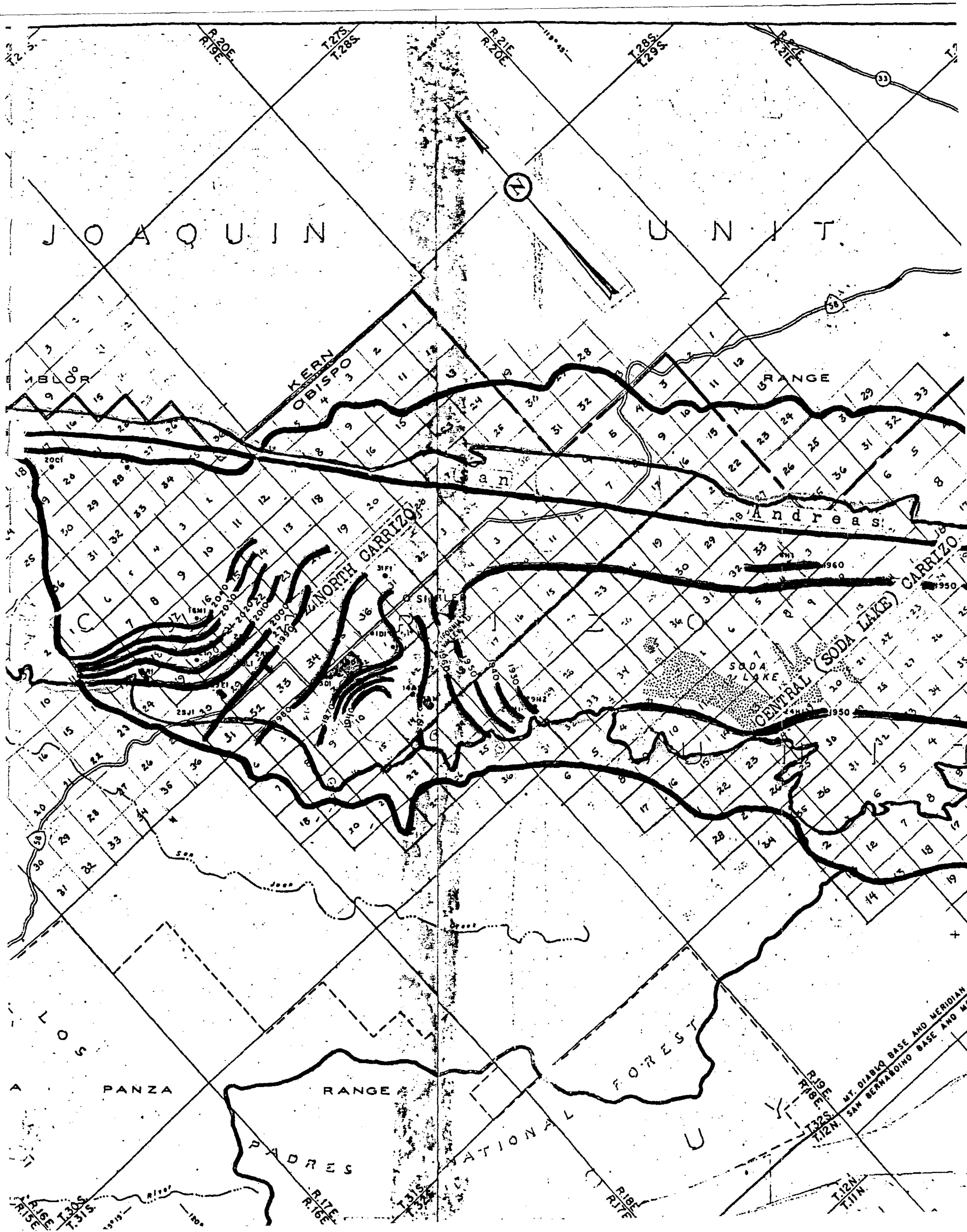
1958



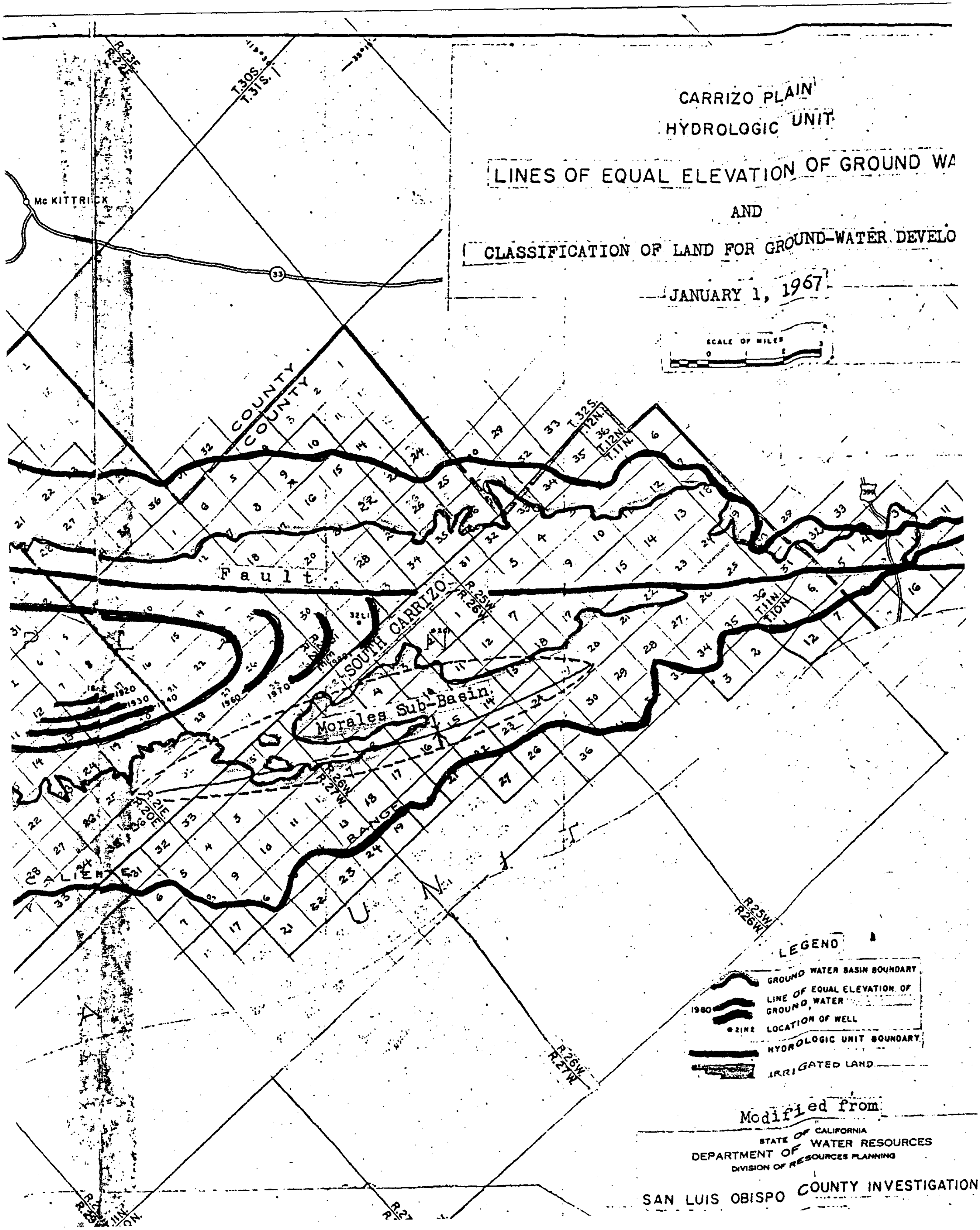
BOUNDARY
Pumping station
Antelope Hills Oil Field
McDonald Anticline Oil Field
French Camp
C.H. Wreden Farm
CARRIZO PLAIN
Lewis Ranch
SYNCLINE HILL
R 18 E
R 20 E
SAN ANDREAS
Scale 1:250,000
0
5
10
15
20 Statute Miles
CONTOUR INTERVAL 200 FEET
R 33 W
R 32 W
R 31 W
R 30 W



R 21 E
R 22 E
R 23 E
T 27 S
Wasco Oil Field
Ranch
GOOSE LAKE BED
NORTH BELRIDGE OIL FIELD
Milham Farm
Gas
Douglas Ranch
Water
Goose Lake Ranch
30'
T. 28 S
Blue Moon Ranch
SOUTH BELRIDGE OIL FIELD
CARRIZO PLAIN BASIN WATERSHED
Meadowbrook Gun Club
Underground pipeline
Palomas Ranch
Bldg
Buttonwillow
Buttonwillow Kern Co. No
T. 29 S
Elk Grove Ranch
Mirasol Ranch
Deep Wells Ranch
Lokern Pumping Station
Poplar Grove Ranch
TEMBLOR VALLEY
McKITTRICK VALLEY
Oil field
NAVAL PETROLEUM RESERVE No 1
T 30
15'
CROCKER FLAT LANDSLIDE AREA
NAVAL PETROLEUM RESERVE No 2
T 31 S
Tank Farm
Associated Oil Camp
BUENA VISTA HILLS
BUENA VISTA VALLEY
Ford
Taft
T 32 S
SAN ANDREAS FAULT ZONE
PANORAMA
CARRIZO PLAIN
Corrals
Windmill
Grain
T 12 N
R 26 W
T 11 N
35°00'



JOAQUIN
UNIT
KERN
OBISPO
RANGE
San Andreas
NORTH CARRIZO
CENTRAL (SODA LAKE) CARRIZO
SODA LAKE
LOS
PANZA
RANGE
PADRES
NATIONAL
FOREST
MT. DIABLO BASE AND MERIDIAN
SAN BERNARDINO BASE AND MERIDIAN
R.20E.
R.19E.
T.27S.
T.28S.
R.21E.
R.20E.
T.28S.
T.29S.
T.30S.
T.31S.
T.32S.
T.12N.
T.11N.
R.19E.
R.18E.


CARRIZO PLAIN
HYDROLOGIC UNIT
LINES OF EQUAL ELEVATION OF GROUND WA
AND
CLASSIFICATION OF LAND FOR GROUND-WATER DEVELO
JANUARY 1, 1967
SCALE OF MILES
McKITTRICK
33
T.30S.
T.31S.
R.23E.
R.22E.
COUNTY
COUNTY
T.32S.
T.12N.
T.12N.
T.11N.
Fault
SOUTH CARRIZO
R.25W.
R.26W.
Morales Sub-Basin
R.26W.
R.27W.
R.21E.
R.20E.
RANGE
CALIENTE
T.11N.
T.10N.
1920
1930
1940
1960
1970
R.25W.
R.26W.
R.26W.
R.27W.
LEGEND
GROUND WATER BASIN BOUNDARY
LINE OF EQUAL ELEVATION OF GROUND WATER
1980
LOCATION OF WELL
HYDROLOGIC UNIT BOUNDARY
IRRIGATED LAND
Modified from
STATE OF CALIFORNIA
DEPARTMENT OF WATER RESOURCES
DIVISION OF RESOURCES PLANNING
SAN LUIS OBISPO COUNTY INVESTIGATION

AUSRA RAINFALL VOLUMES

			EXISTING										PROPOSED						
			AMC I (CN=70)			AMC II (CN=85)			AMC I (CN=70)		AMC II (CN=85)			AMC I		AMC II		AMC I	AMC II
	Area	Ave. Yearly Precip.	Ave. Yearly Runoff	Ave. Yearly Infiltration	Ave. Yearly Evapo-Trans.	Ave. Yearly Runoff	Ave. Yearly Infiltration	Ave. Yearly Evapo-Trans.	Runoff Volume	Infiltration Volume	Runoff Volume	Infiltration Volume	Net Reduction to Evapotranspiration	Ave Yrly Evapo-Trans	Ave. Yearly Infiltration	Ave Yrly Evapo-Trans	Ave. Yearly Infiltration	Infiltration Volume	Infiltration Volume
Basin	(acre)	(in)	(in)	(in)	(in)	(in)	(in)	(in)	(ac-ft)	(ac-ft)	(ac-ft)	(ac-ft)	(%)	(in)	(in)	(in)	(in)	(ac-ft)	(ac-ft)
1	20,224	10.1	2.5	5.2	2.4	5.1	2.7	2.3	4,213	8,764	8,595	4,550	70	0.7	6.9	0.7	4.3	11,595	7,264
2	2,496	10.1	2.5	5.2	2.4	5.1	2.7	2.3	520	1,082	1,061	562	70	0.7	6.9	0.7	4.3	1,431	896
3	2,752	10.1	2.5	5.2	2.4	5.1	2.7	2.3	573	1,193	1,170	619	70	0.7	6.9	0.7	4.3	1,578	988
4 (site)*	1,024	10.1	2.5	5.2	2.4	5.1	2.7	2.3	213	444	435	230	70	0.7	6.9	0.7	4.3	587	368
Facility	640	10.1	2.5	5.2	2.4	5.1	2.7	2.3	133	277	272	144	70	0.7	6.9	0.7	4.3	367	230
Const. Area	384	10.1	2.5	5.2	2.4	5.1	2.7	2.3	80	166	163	86	70	0.7	6.9	0.7	4.3	220	138

* Total site area includes laydown area

AMC	Antecedant Moisture Condition
ac-ft	Acre-Feet
CN	Curve Number
in	Inches

Rainfall information based on rainfall data from Simmler #71 Gage Station (Lat:35° 21' 06" Long:119° 59' 51").
Daily rainfall data from 1981 to 1994 was analyzed. AMC I & II were analyzed for the varying antecedent soil moisture conditions.
Evapotranspiration rates are based on California Irrigation Management Information System (CIMIS) Reference Evapotranspiration Map (Zone 10)
For proposed condition, the assumed reduction in the evapotransporation is 70% based on mirror coverage, roadways, other site area coverage.

AUSRA PRECIPITATION INFORMATION
STATION: SIMMLER #71
CN AMC I = 70

SEASON	1993-1994											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	0	2	1	2	4	6	4	2	3	0
TOTAL (IN)	0.00	0.32	0.00	0.51	0.40	0.86	1.14	2.64	1.17	0.13	0.55	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.18	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.00	0.20	0.05	0.06	0.12	0.36	0.40	0.30	0.57	0.00
INFILTRATION (IN)	0.00	0.09	0.00	0.31	0.35	0.80	1.02	2.10	0.77	0.00	0.00	0.00
YEARLY TOTAL (IN)												7.72
YEARLY RUNOFF (IN)												0.18
YEARLY INFILTRATION (IN)												5.44

SEASON	1992-1993											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	1	0	0	6	0	7	9	10	6	1	0	1
TOTAL (IN)	0.40	0.00	0.00	0.84	0.00	3.10	4.69	4.06	2.64	0.03	0.00	0.18
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	1.31	0.90	1.17	1.66	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.26	0.00	0.00	0.60	0.00	0.21	0.27	0.60	0.60	0.15	0.00	0.24
INFILTRATION (IN)	0.14	0.00	0.00	0.24	0.00	1.58	3.52	2.29	0.38	0.00	0.00	0.00
YEARLY TOTAL (IN)												15.76
YEARLY RUNOFF (IN)												5.04
YEARLY INFILTRATION (IN)												8.15

SEASON	1991-1992											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	1	1	1	2	2	8	7	2	1	0
TOTAL (IN)	0.00	0.00	0.04	0.20	0.05	2.22	1.71	4.13	2.11	0.10	0.58	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	1.10	0.40	3.02	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.17	0.10	0.05	0.06	0.06	0.48	0.70	0.30	0.19	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.10	0.00	1.06	1.25	0.63	1.41	0.00	0.39	0.00
YEARLY TOTAL (IN)												11.14
YEARLY RUNOFF (IN)												4.52
YEARLY INFILTRATION (IN)												4.84

SEASON	1990-1991											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	2	0	2	3	5	2	13	1	0	0
TOTAL (IN)	0.00	0.26	1.10	0.00	0.17	0.16	0.73	1.16	7.01	0.14	0.00	0.00
RUNOFF (IN)	0.00	0.00	0.25	0.00	0.00	0.00	0.00	0.29	3.32	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.34	0.00	0.10	0.09	0.15	0.12	1.30	0.15	0.00	0.00
INFILTRATION (IN)	0.00	0.03	0.51	0.00	0.07	0.07	0.58	0.75	2.39	0.00	0.00	0.00
YEARLY TOTAL (IN)												10.73
YEARLY RUNOFF (IN)												3.86
YEARLY INFILTRATION (IN)												4.40

SEASON	1989-1990											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	4	1	1	0	3	5	1	1	2	0
TOTAL (IN)	0.00	0.00	0.77	0.04	0.26	0.00	1.17	1.63	0.14	0.20	0.47	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	0.00	0.10	0.00	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.68	0.10	0.05	0.00	0.09	0.30	0.10	0.15	0.38	0.00
INFILTRATION (IN)	0.00	0.00	0.09	0.00	0.21	0.00	0.98	1.33	0.04	0.05	0.09	0.00
YEARLY TOTAL (IN)												4.68
YEARLY RUNOFF (IN)												0.10
YEARLY INFILTRATION (IN)												2.79

SEASON	1988-1989											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	0	0	3	6	4	5	5	2	1	0
TOTAL (IN)	0.00	0.00	0.00	0.00	0.53	2.54	0.47	1.22	0.42	0.03	0.23	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	0.95	0.00	0.00	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.00	0.00	0.15	0.18	0.12	0.30	0.50	0.30	0.19	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.00	0.38	1.41	0.35	0.92	0.00	0.00	0.04	0.00
YEARLY TOTAL (IN)												5.44
YEARLY RUNOFF (IN)												0.95
YEARLY INFILTRATION (IN)												3.10

SEASON	1987-1988											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	0	5	5	8	4	1	2	6	3	2
TOTAL (IN)	0.00	0.00	0.00	1.57	4.21	1.76	1.56	0.84	1.60	2.63	0.12	0.11
RUNOFF (IN)	0.00	0.00	0.00	0.35	2.90	0.00	0.33	0.00	1.59	0.64	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.00	0.50	0.25	0.24	0.12	0.06	0.20	0.90	0.57	0.48
INFILTRATION (IN)	0.00	0.00	0.00	0.72	1.06	1.52	1.11	0.78	0.00	1.09	0.00	0.00
YEARLY TOTAL (IN)												14.40
YEARLY RUNOFF (IN)												5.81
YEARLY INFILTRATION (IN)												6.28

SEASON	1986-1987											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	2	2	2	3	5	7	7	0	0	1
TOTAL (IN)	0.00	0.00	0.13	0.05	0.59	0.55	1.87	0.92	1.81	0.00	0.00	0.40
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	0.00	0.13	0.00	0.27	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.34	0.20	0.10	0.09	0.15	0.42	0.70	0.00	0.00	0.24
INFILTRATION (IN)	0.00	0.00	0.00	0.00	0.49	0.46	1.59	0.50	0.84	0.00	0.00	0.16
YEARLY TOTAL (IN)												6.32
YEARLY RUNOFF (IN)												0.40
YEARLY INFILTRATION (IN)												4.04

SEASON	1985-1986											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	2	1	3	3	4	6	6	2	0	0
TOTAL (IN)	0.00	0.15	0.21	0.23	1.83	1.04	0.89	3.41	3.19	0.28	0.00	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.63	0.13	0.00	1.30	0.82	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.34	0.10	0.15	0.09	0.12	0.36	0.60	0.30	0.00	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.13	1.05	0.82	0.77	1.75	1.77	0.00	0.00	0.00
YEARLY TOTAL (IN)												11.23
YEARLY RUNOFF (IN)												2.88
YEARLY INFILTRATION (IN)												6.29

SEASON	1984-1985											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	1	2	8	11	4	2	9	2	0	0
TOTAL (IN)	0.00	0.00	0.13	0.15	1.82	3.39	0.79	0.30	0.98	0.26	0.00	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	1.86	0.00	0.00	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.17	0.20	0.40	0.33	0.12	0.12	0.90	0.30	0.00	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.00	1.42	1.20	0.67	0.18	0.08	0.00	0.00	0.00
YEARLY TOTAL (IN)												7.82
YEARLY RUNOFF (IN)												1.86
YEARLY INFILTRATION (IN)												3.55

SEASON	1983-1984											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	2	2	2	5	4	2	3	1	3	0	0
TOTAL (IN)	0.00	1.34	0.67	0.88	1.71	2.24	0.14	0.13	0.30	0.21	0.00	0.00
RUNOFF (IN)	0.00	0.09	0.00	0.00	0.00	0.40	0.00	0.00	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.46	0.34	0.20	0.25	0.12	0.06	0.18	0.10	0.45	0.00	0.00
INFILTRATION (IN)	0.00	0.79	0.33	0.68	1.46	1.72	0.08	0.00	0.20	0.00	0.00	0.00
YEARLY TOTAL (IN)												7.62
YEARLY RUNOFF (IN)												0.49
YEARLY INFILTRATION (IN)												5.26

SEASON	1982-1983											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	2	2	9	6	7	7	14	11	2	0
TOTAL (IN)	0.00	0.19	0.79	0.31	3.77	1.16	4.14	1.86	3.48	0.98	0.35	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.81	0.26	1.42	0.00	1.67	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.34	0.20	0.45	0.18	0.21	0.42	1.40	1.65	0.38	0.00
INFILTRATION (IN)	0.00	0.00	0.45	0.11	2.51	0.72	2.51	1.44	0.41	0.00	0.00	0.00
YEARLY TOTAL (IN)												17.03
YEARLY RUNOFF (IN)												4.16
YEARLY INFILTRATION (IN)												8.15

SEASON	1981-1982											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	0	3	5	3	6	5	14	4	0	1
TOTAL (IN)	0.00	0.00	0.00	0.38	0.89	0.25	1.76	1.11	4.31	2.57	0.00	0.10
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	0.00	0.34	0.17	1.32	0.57	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.00	0.30	0.25	0.09	0.18	0.30	1.40	0.60	0.00	0.24
INFILTRATION (IN)	0.00	0.00	0.00	0.08	0.64	0.16	1.24	0.64	1.59	1.40	0.00	0.00
YEARLY TOTAL (IN)												11.37
YEARLY RUNOFF (IN)												2.40
YEARLY INFILTRATION (IN)												5.75

Evapotranspiration (Eto) Rates - Zone 10

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
in/month	0.93	1.68	3.1	4.5	5.89	7.2	8.06	7.13	5.1	3.1	1.5	0.93
in/day	0.03	0.06	0.1	0.15	0.19	0.24	0.26	0.23	0.17	0.1	0.05	0.03

AVERAGE YEARLY RUNOFF (IN) 2.51 AVERAGE YEARLY TOTAL (IN) 10.1 AVERAGE YEARLY INFILTRATION (IN) 5.23

AUSRA PRECIPITATION INFORMATION
STATION: SIMMLER #71
CN AMC II = 85

SEASON	1993-1994											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	0	2	1	2	4	6	4	2	3	0
TOTAL (IN)	0.00	0.32	0.00	0.51	0.40	0.86	1.14	2.64	1.17	0.13	0.55	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.05	0.27	0.44	0.97	0.38	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.00	0.20	0.05	0.06	0.12	0.36	0.40	0.30	0.57	0.00
INFILTRATION (IN)	0.00	0.09	0.00	0.31	0.30	0.53	0.58	1.31	0.39	0.00	0.00	0.00
YEARLY TOTAL (IN)												7.72
YEARLY RUNOFF (IN)												2.11
YEARLY INFILTRATION (IN)												3.51

SEASON	1992-1993											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	1	0	0	6	0	7	9	10	6	1	0	1
TOTAL (IN)	0.40	0.00	0.00	0.84	0.00	3.10	4.69	4.06	2.64	0.03	0.00	0.18
RUNOFF (IN)	0.05	0.00	0.00	0.18	0.00	1.94	2.64	2.67	2.16	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.26	0.00	0.00	0.60	0.00	0.21	0.27	0.60	0.60	0.15	0.00	0.24
INFILTRATION (IN)	0.09	0.00	0.00	0.06	0.00	0.95	1.78	0.79	0.00	0.00	0.00	0.00
YEARLY TOTAL (IN)												15.76
YEARLY RUNOFF (IN)												9.64
YEARLY INFILTRATION (IN)												3.67

SEASON	1991-1992											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	1	1	1	2	2	8	7	2	1	0
TOTAL (IN)	0.00	0.00	0.04	0.20	0.05	2.22	1.71	4.13	2.11	0.10	0.58	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	1.60	1.01	3.52	0.65	0.00	0.23	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.17	0.10	0.05	0.06	0.06	0.48	0.70	0.30	0.19	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.10	0.00	0.56	0.64	0.13	0.76	0.00	0.16	0.00
YEARLY TOTAL (IN)												11.14
YEARLY RUNOFF (IN)												7.01
YEARLY INFILTRATION (IN)												2.35

SEASON	1990-1991											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	2	0	2	3	5	2	13	1	0	0
TOTAL (IN)	0.00	0.26	1.10	0.00	0.17	0.16	0.73	1.16	7.01	0.14	0.00	0.00
RUNOFF (IN)	0.00	0.00	0.75	0.00	0.00	0.00	0.04	0.79	5.04	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.34	0.00	0.10	0.09	0.15	0.12	1.30	0.15	0.00	0.00
INFILTRATION (IN)	0.00	0.03	0.01	0.00	0.07	0.07	0.54	0.25	0.67	0.00	0.00	0.00
YEARLY TOTAL (IN)												10.73
YEARLY RUNOFF (IN)												6.62
YEARLY INFILTRATION (IN)												1.64

SEASON	1989-1990											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	4	1	1	0	3	5	1	1	2	0
TOTAL (IN)	0.00	0.00	0.77	0.04	0.26	0.00	1.17	1.63	0.14	0.20	0.47	0.00
RUNOFF (IN)	0.00	0.00	0.12	0.00	0.00	0.00	0.60	0.49	0.00	0.00	0.04	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.68	0.10	0.05	0.00	0.09	0.30	0.10	0.15	0.38	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.00	0.21	0.00	0.48	0.84	0.04	0.05	0.05	0.00
YEARLY TOTAL (IN)												4.68
YEARLY RUNOFF (IN)												1.25
YEARLY INFILTRATION (IN)												1.67

SEASON	1988-1989											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	0	0	3	6	4	5	5	2	1	0
TOTAL (IN)	0.00	0.00	0.00	0.00	0.53	2.54	0.47	1.22	0.42	0.03	0.23	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.00	1.51	0.00	0.50	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.00	0.00	0.15	0.18	0.12	0.30	0.50	0.30	0.19	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.00	0.38	0.85	0.35	0.42	0.00	0.00	0.04	0.00
YEARLY TOTAL (IN)												5.44
YEARLY RUNOFF (IN)												2.01
YEARLY INFILTRATION (IN)												2.04

SEASON	1987-1988											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	0	5	5	8	4	1	2	6	3	2
TOTAL (IN)	0.00	0.00	0.00	1.57	4.21	1.76	1.56	0.84	1.60	2.63	0.12	0.11
RUNOFF (IN)	0.00	0.00	0.00	0.87	3.45	0.83	0.83	0.49	1.60	1.54	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.00	0.50	0.25	0.24	0.12	0.06	0.20	0.90	0.57	0.48
INFILTRATION (IN)	0.00	0.00	0.00	0.20	0.51	0.69	0.61	0.29	0.00	0.19	0.00	0.00
YEARLY TOTAL (IN)												14.40
YEARLY RUNOFF (IN)												9.61
YEARLY INFILTRATION (IN)												2.49

SEASON	1986-1987											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	2	2	2	3	5	7	7	0	0	1
TOTAL (IN)	0.00	0.00	0.13	0.05	0.59	0.55	1.87	0.92	1.81	0.00	0.00	0.40
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.20	0.00	0.88	0.18	0.79	0.00	0.00	0.05
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.34	0.20	0.10	0.09	0.15	0.42	0.70	0.00	0.00	0.24
INFILTRATION (IN)	0.00	0.00	0.00	0.00	0.29	0.46	0.84	0.32	0.32	0.00	0.00	0.11
YEARLY TOTAL (IN)												6.32
YEARLY RUNOFF (IN)												2.10
YEARLY INFILTRATION (IN)												2.34

SEASON	1985-1986											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	2	1	3	3	4	6	6	2	0	0
TOTAL (IN)	0.00	0.15	0.21	0.23	1.83	1.04	0.89	3.41	3.19	0.28	0.00	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	1.13	0.63	0.30	2.36	2.14	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.34	0.10	0.15	0.09	0.12	0.36	0.60	0.30	0.00	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.13	0.55	0.32	0.47	0.69	0.45	0.00	0.00	0.00
YEARLY TOTAL (IN)												11.23
YEARLY RUNOFF (IN)												6.56
YEARLY INFILTRATION (IN)												2.61

SEASON	1984-1985											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	1	2	8	11	4	2	9	2	0	0
TOTAL (IN)	0.00	0.00	0.13	0.15	1.82	3.39	0.79	0.30	0.98	0.26	0.00	0.00
RUNOFF (IN)	0.00	0.00	0.00	0.00	0.30	2.36	0.05	0.00	0.08	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.17	0.20	0.40	0.33	0.12	0.12	0.90	0.30	0.00	0.00
INFILTRATION (IN)	0.00	0.00	0.00	0.00	1.12	0.70	0.62	0.18	0.00	0.00	0.00	0.00
YEARLY TOTAL (IN)												7.82
YEARLY RUNOFF (IN)												2.79
YEARLY INFILTRATION (IN)												2.62

SEASON	1983-1984											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	2	2	2	5	4	2	3	1	3	0	0
TOTAL (IN)	0.00	1.34	0.67	0.88	1.71	2.24	0.14	0.13	0.30	0.21	0.00	0.00
RUNOFF (IN)	0.00	0.64	0.32	0.47	0.61	1.11	0.00	0.00	0.00	0.00	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.46	0.34	0.20	0.25	0.12	0.06	0.18	0.10	0.45	0.00	0.00
INFILTRATION (IN)	0.00	0.24	0.01	0.21	0.85	1.01	0.08	0.00	0.20	0.00	0.00	0.00
YEARLY TOTAL (IN)												7.62
YEARLY RUNOFF (IN)												3.15
YEARLY INFILTRATION (IN)												2.60

SEASON	1982-1983											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	1	2	2	9	6	7	7	14	11	2	0
TOTAL (IN)	0.00	0.19	0.79	0.31	3.77	1.16	4.14	1.86	3.48	0.98	0.35	0.00
RUNOFF (IN)	0.00	0.00	0.20	0.00	1.30	0.54	2.72	0.49	2.49	0.17	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.23	0.34	0.20	0.45	0.18	0.21	0.42	1.40	1.65	0.38	0.00
INFILTRATION (IN)	0.00	0.00	0.25	0.11	2.02	0.44	1.21	0.95	0.00	0.00	0.00	0.00
YEARLY TOTAL (IN)												17.03
YEARLY RUNOFF (IN)												7.91
YEARLY INFILTRATION (IN)												4.98

SEASON	1981-1982											
MONTH	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN
# OF DAY OF RAINFALL	0	0	0	3	5	3	6	5	14	4	0	1
TOTAL (IN)	0.00	0.00	0.00	0.38	0.89	0.25	1.76	1.11	4.31	2.57	0.00	0.10
RUNOFF (IN)	0.00	0.00	0.00	0.02	0.00	0.00	0.91	1.02	2.57	1.57	0.00	0.00
EVAPOTRANSPIRATION (IN)	0.00	0.00	0.00	0.30	0.25	0.09	0.18	0.30	1.40	0.60	0.00	0.24
INFILTRATION (IN)	0.00	0.00	0.00	0.06	0.64	0.16	0.67	0.00	0.34	0.40	0.00	0.00
YEARLY TOTAL (IN)												11.37
YEARLY RUNOFF (IN)												6.09
YEARLY INFILTRATION (IN)												2.27

Evapotranspiration (Eto) Rates - Zone 10

	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec
in/month	0.93	1.68	3.1	4.5	5.89	7.2	8.06	7.13	5.1	3.1	1.5	0.93
in/day	0.03	0.06	0.1	0.15	0.19	0.24	0.26	0.23	0.17	0.1	0.05	0.03

SIMMLER#71 MONTHLY PRECIPITATION VALUES

WaterYear	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	Total
1993-1994	0.00	0.32	0.00	0.51	0.40	0.86	1.14	2.64	1.17	0.13	0.55	0.00	7.72
1992-1993	0.40	0.00	0.00	0.84	0.00	3.10	4.69	4.06	2.64	0.03	0.00	0.18	15.94
1991-1992	0.00	0.00	0.04	0.20	0.05	2.22	1.71	4.13	2.11	0.10	0.58	0.00	11.14
1990-1991	0.00	0.26	1.10	0.00	0.17	0.16	0.73	1.16	7.01	0.14	0.00	0.00	10.73
1989-1990	0.00	0.00	0.77	0.04	0.26	0.00	1.17	1.63	0.14	0.20	0.47	0.00	4.68
1988-1989	0.00	0.00	0.00	0.00	0.53	2.54	0.47	1.22	0.42	0.03	0.23	0.00	5.44
1987-1988	0.00	0.00	0.00	1.57	4.21	1.76	1.56	0.84	1.60	2.63	0.12	0.11	14.40
1986-1987	0.00	0.00	0.13	0.05	0.59	0.55	1.87	0.92	1.81	0.00	0.00	0.40	6.32
1985-1986	0.00	0.15	0.21	0.23	1.83	1.04	0.89	3.41	3.19	0.28	0.00	0.00	11.23
1984-1985	0.00	0.00	0.13	0.15	1.82	3.39	0.79	0.30	0.98	0.26	0.00	0.00	7.82
1983-1984	0.00	1.34	0.67	0.88	1.71	2.24	0.14	0.13	0.30	0.21	0.00	0.00	7.62
1982-1983	0.00	0.19	0.79	0.31	3.77	1.16	4.14	1.86	3.48	0.98	0.35	0.00	17.03
1981-1982	0.00	0.00	0.00	0.38	0.89	0.25	1.76	1.11	4.31	2.57	0.00	0.10	11.37
1980-1981	0.00	0.00	0.00	0.07	0.00	0.55	2.09	1.20	3.13	0.15	0.07	0.00	7.26
1979-1980	0.00	0.00	0.00	0.50	0.39	1.16	2.67	4.53	2.08	1.10	0.24	0.00	12.67
1978-1979	0.00	0.00	2.08	0.00	0.69	1.42	3.12	3.28	2.73	0.00	0.27	0.00	13.59
1977-1978	0.00	0.01	0.00	0.00	0.16	3.56	3.59	5.96	5.19	1.92	0.00	0.00	20.39
1976-1977	0.00	0.34	3.40	0.03	0.56	0.33	0.98	0.00	0.81	0.00	1.01	0.00	7.46
1975-1976	0.00	0.00	0.01	0.40	0.00	0.00	0.00	2.30	0.90	1.09	0.17	0.00	4.87
1974-1975	0.12	0.00	0.00	1.86	0.37	2.93	0.19	2.96	1.46	0.87	0.00	0.00	10.76
1973-1974	0.00	0.00	0.00	0.42	1.51	1.27	3.58	0.14	3.01	0.85	0.00	0.00	10.78
1972-1973	0.01	1.20	0.00	0.37	2.19	0.45	3.10	4.31	2.09	0.00	0.14	0.00	13.86
1971-1972	0.00	0.00	0.07	0.04	0.24	2.47	0.25	0.00	0.00	0.09	0.00	0.08	3.24
1970-1971	0.00	0.00	0.00	0.02	2.43	2.00	0.45	0.09	0.35	1.05	0.45	0.00	6.84
1969-1970	0.15	0.00	0.17	0.04	0.90	0.14	1.43	0.49	1.99	0.00	0.00	0.00	5.31
1968-1969	0.00	0.00	0.00	1.19	0.43	1.93	7.03	5.88	0.83	1.24	0.00	0.00	18.53
1967-1968	0.00	0.02	0.46	0.02	1.86	0.86	0.43	0.70	1.57	0.43	0.08	0.00	6.43
1966-1967	0.00	0.00	0.54	0.00	1.44	3.87	1.23	0.19	1.32	3.80	0.17	0.05	12.61
1965-1966	0.17	0.00	0.15	0.00	2.91	2.16	0.64	0.82	0.14	0.00	0.00	0.00	6.99
1964-1965	0.00	0.00	0.30	0.75	0.92	1.43	0.66	0.21	0.66	1.82	0.00	0.00	6.75
1963-1964	0.00	0.00	0.59	1.17	0.71	0.00	1.32	0.00	1.71	0.01	0.15	0.00	5.66
1962-1963	0.00	0.00	0.00	0.28	0.00	0.15	0.35	2.53	1.51	1.48	0.49	0.10	6.89
1961-1962	0.00	0.00	0.00	0.00	1.56	1.91	1.16	6.11	1.24	0.28	0.00	0.00	12.26
1960-1961	0.00	0.00	0.00	0.96	2.15	0.42	0.63	0.55	0.57	0.26	0.56	0.00	6.10
1959-1960	0.00	0.00	0.00	0.00	0.00	0.22	1.48	1.98	0.79	1.56	0.03	0.00	6.06
1958-1959	0.00	0.48	1.19	0.00	0.18	0.25	0.93	2.81	0.00	0.25	0.04	0.00	6.13
1957-1958	0.00	0.00	0.00	0.71	0.41	1.94	1.67	3.33	3.28	4.55	1.19	0.00	17.08
1956-1957	0.00	0.00	0.00	1.23	0.00	0.19	1.77	1.13	0.53	1.02	0.37	0.45	6.69
1955-1956	0.00	0.00	0.00	0.00	0.62	3.25	1.36	0.42	0.00	1.01	0.55	0.00	7.21
1954-1955	0.00	0.00	0.00	0.00	0.39	2.04	3.31	0.88	0.43	0.74	1.00	0.00	8.79
1953-1954	0.00	0.00	0.00	0.00	0.86	0.14	3.35	1.06	2.14	0.07	0.00	0.00	7.62
1952-1953	0.00	0.00	0.09	0.00	2.43	2.29	0.73	0.12	0.28	0.87	0.08	0.00	6.89
1951-1952	0.00	0.00	0.00	0.00	1.30	1.35	3.94	0.44	4.10	0.65	0.00	0.00	11.78
1950-1951	0.21	0.00	0.00	0.50	0.41	0.26	1.51	0.24	0.44	0.83	0.00	0.00	4.40
1949-1950	0.00	0.00	0.00	0.00	0.50	1.78	1.42	1.41	0.88	0.99	0.11	0.00	7.09
1948-1949	0.00	0.00	0.00	0.06	0.00	2.17	0.67	0.60	1.45	0.40	0.88	0.00	6.23
1947-1948	0.00	0.00	0.00	0.08	0.03	0.49	0.00	1.59	1.38	0.92	0.31	0.00	4.80
1946-1947	0.00	0.00	0.00	0.12	2.21	1.41	0.39	0.23	0.67	0.27	0.14	0.00	5.44
1945-1946	0.00	0.00	0.00	0.16	0.35	1.05	1.82	1.20	2.77	0.32	0.07	0.00	7.74
1944-1945	0.00	0.00	0.00	0.00	1.54	0.73	0.15	2.69	1.35	0.09	0.00	0.00	6.55
1943-1944	0.00	0.00	0.00	0.56	0.23	1.52	0.96	4.06	0.48	0.33	0.21	0.00	8.35
1942-1943	0.00	0.00	0.00	0.38	0.41	1.38	5.53	0.80	1.54	1.58	0.00	0.00	11.62
1941-1942	0.00	0.03	0.00	0.70	0.28	2.95	0.54	0.64	1.21	1.30	0.14	0.00	7.79
1940-1941	0.00	0.00	0.00	0.47	0.11	4.05	2.29	2.89	4.48	3.79	0.00	0.00	18.08
1939-1940	0.00	0.00	1.16	0.24	0.12	0.68	1.75	2.22	0.16	1.07	0.00	0.00	7.40
1938-1939	0.00	0.00	0.97	0.09	0.02	1.30	2.19	0.78	1.12	0.00	0.00	0.00	6.47
1937-1938	0.00	0.00	0.00	0.00	0.09	2.11	1.08	4.56	3.68	1.48	0.00	0.00	13.00

San Luis Obispo County Public Works

Volunteer Precipitation Gauge Station

MONTHLY PRECIPITATION REPORT

Station Name - Simmler # 71

Station Location -

Latitude - 35° 21' 06"

Longitude - 119° 59' 51"

Description - Simmler

Water Years -

Beginning - 1937-1938

Ending - 1993-1994

Station Statistics -

Month	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
Average	0.02	0.08	0.26	0.33	0.88	1.44	1.66	1.78	1.68	0.84	0.20	0.03	9.19
Maximum	0.40	1.34	3.40	1.86	4.21	4.05	7.03	6.11	7.01	4.55	1.19	0.45	20.39
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.24

San Luis Obispo County Public Works

Volunteer Precipitation Gauge Station

MONTHLY PRECIPITATION REPORT

Station Name - Simmler # 70.1

Station Location -
Latitude - 35° 20' 17"
Longitude - 120° 02' 27"

Description - Santa Margarita-Simmler

Water Years -
Beginning - 1937-1938
Ending - 1986-1987

Station Statistics -

Month	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
Average	0.06	0.07	0.26	0.39	1.01	1.66	1.87	1.95	1.75	0.99	0.24	0.01	10.27
Maximum	2.99	2.18	3.39	1.60	4.18	6.56	8.55	6.95	6.18	5.38	2.43	0.38	20.66
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.47

San Luis Obispo County Public Works

Volunteer Precipitation Gauge Station

MONTHLY PRECIPITATION REPORT

Station Name - Cavanaugh Ranch # 78

Station Location -

Latitude - 35° 21' 30"

Longitude - 120° 02' 30"

Description - Santa Margarita

Water Years -

Beginning - 1938-1939

Ending - 1981-1982

Station Statistics -

Month	JUL	AUG	SEP	OCT	NOV	DEC	JAN	FEB	MAR	APR	MAY	JUN	TOTAL
Average	0.03	0.03	0.14	0.33	0.85	1.51	2.01	1.93	1.68	0.95	0.21	0.03	9.68
Maximum	0.52	0.63	2.07	1.76	3.06	4.90	8.62	7.21	5.10	4.60	1.44	0.34	22.30
Minimum	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	3.88

Precipitation

Water Planning Area: **8**
Station Name: **Carrizo Plain (Kuhnle Ranch)**
Station Number: **151.2**

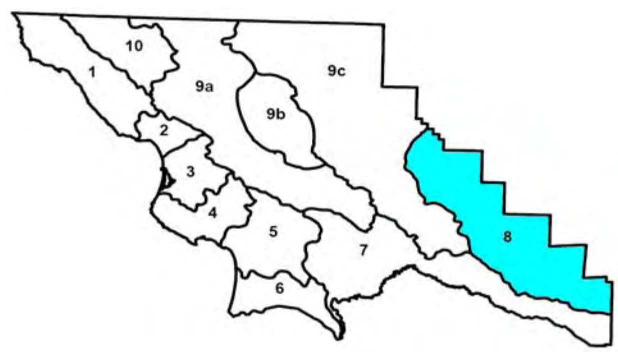
Monthly Totals (in)

	Jul	Aug	Sep	Oct	Nov	Dec	Jan	Feb	Mar	Apr	May	Jun	Annual
2002	0.00	0.00	0.00	0.15	1.23	1.33	0.78	0.22	0.79	0.96	0.00	0.00	5.46
2003	0.00	0.00	0.00	0.00	1.89	3.01	0.14	1.78	1.20	1.09	1.20	0.00	10.31

Historic Annual Totals (in)

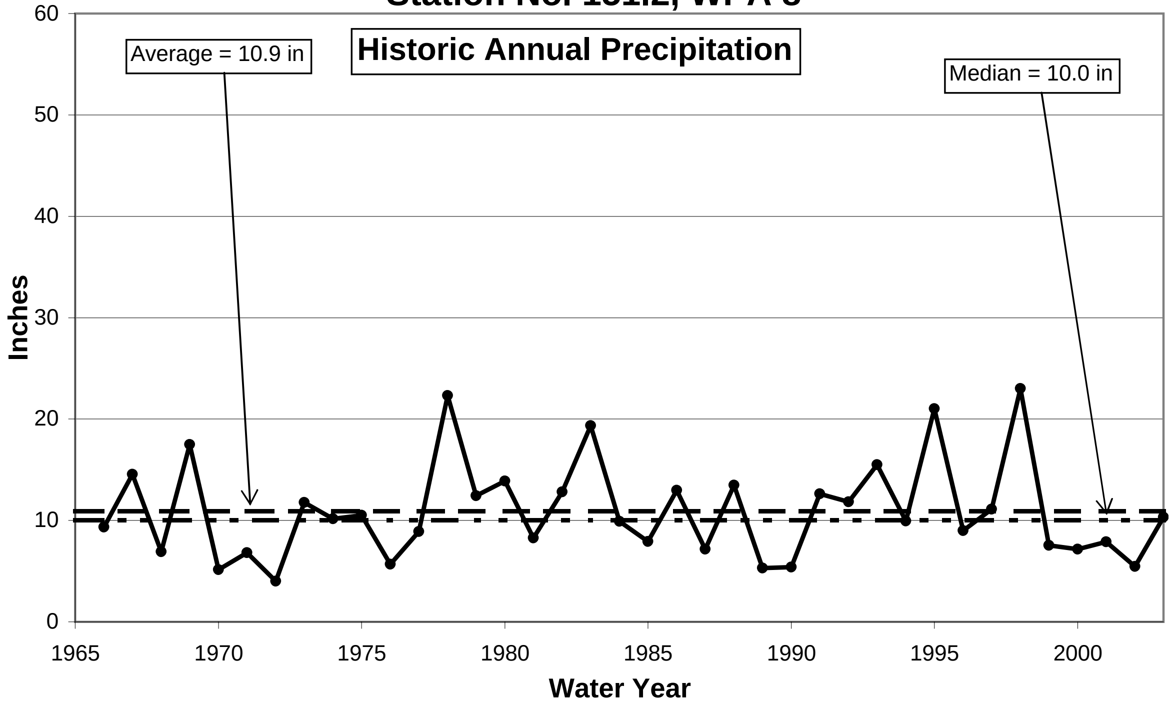
Water Year	Annual Precip Totals	Water Year	Annual Precip Totals
1966	9.33	1985	7.92
1967	14.54	1986	12.96
1968	6.90	1987	7.15
1969	17.47	1988	13.49
1970	5.15	1989	5.31
1971	6.81	1990	5.40
1972	4.01	1991	12.61
1973	11.78	1992	11.83
1974	10.15	1993	15.49
1975	10.52	1994	9.95
1976	5.68	1995	21.03
1977	8.90	1996	8.98
1978	22.32	1997	11.11
1979	12.44	1998	23.02
1980	13.88	1999	7.54
1981	8.28	2000	7.15
1982	12.82	2001	7.90
1983	19.35	2002	5.46
1984	9.92	2003	10.31

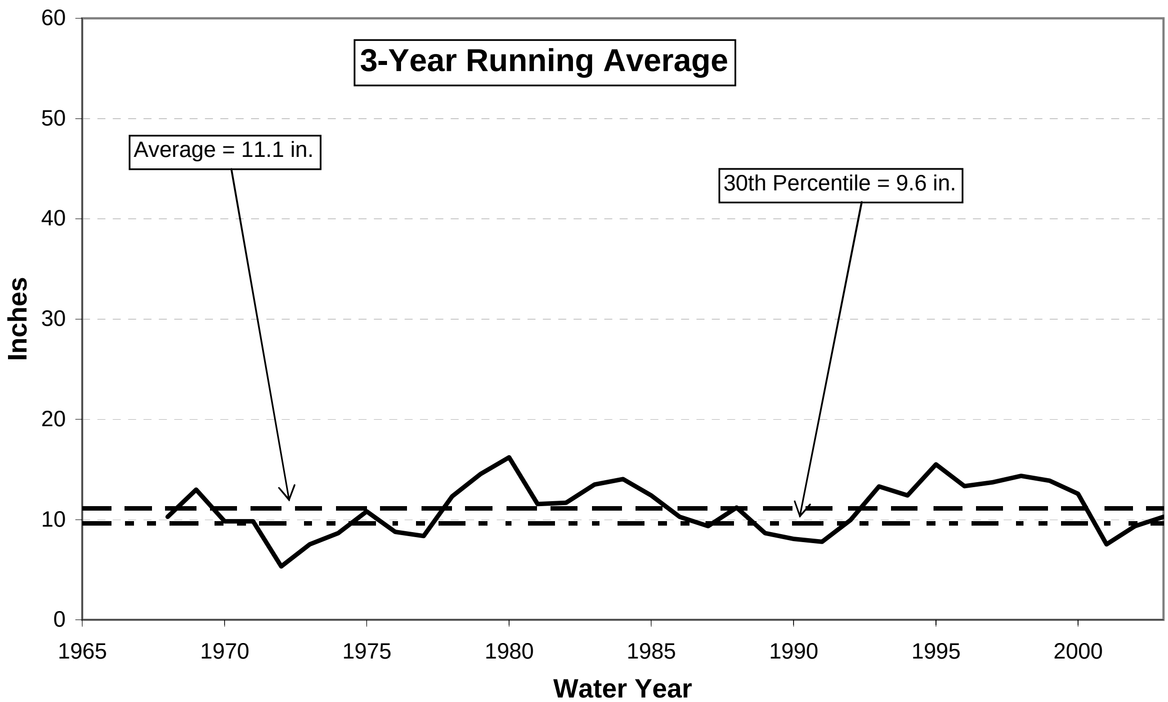
From Historic Annual Totals:	
Average:	10.92 in
Median:	10.05 in
Minimum (1972):	4.01 in
Maximum (1998):	23.02 in



Precipitation Water Year = July 1 - June 30

Carrizo Plain (Kuhnle Ranch)
Station No. 151.2, WPA 8

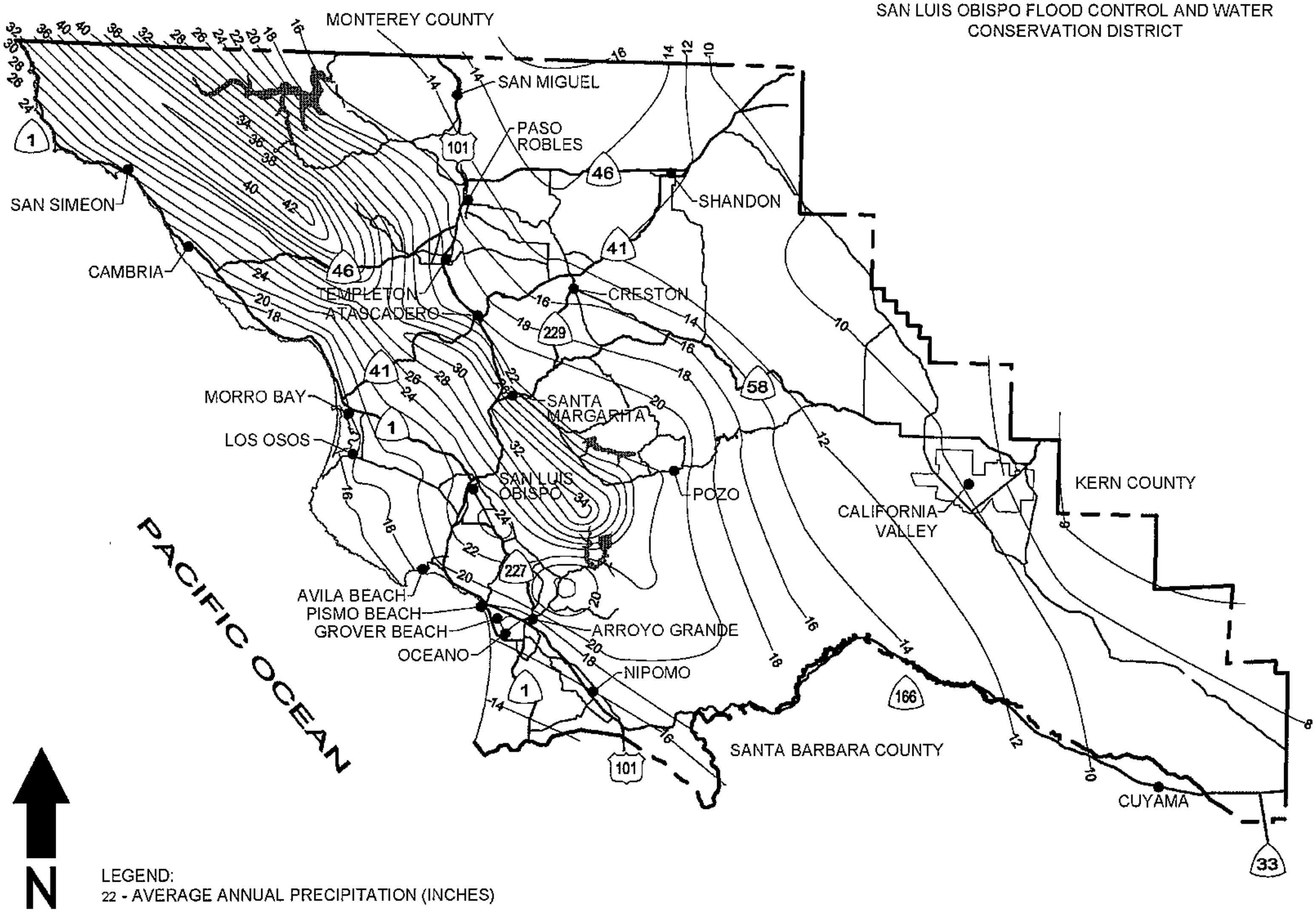




SAN LUIS OBISPO COUNTY AVERAGE ANNUAL PRECIPITATION

(JULY 1 THROUGH JUNE 30) FOR 42 YEAR PERIOD FROM 1955-56 THROUGH 1997-98)

SAN LUIS OBISPO FLOOD CONTROL AND WATER CONSERVATION DISTRICT



LEGEND:
22 - AVERAGE ANNUAL PRECIPITATION (INCHES)

SAN LUIS OBISPO COUNTY DEPARTMENT OF PUBLIC WORKS

AVERAGE ANNUAL RAINFALL

Scale: NTS

Issued: Aug. 2006

Drawing No: H-1

Sheet No: 1 OF 1

Revisions			
Description	Approved	Date	
Description	Approved	Date	

CESF - EXISTING CONDITION BASIN HYDROLOGY PARAMETERS

BASIN	AREA	AREA	AREA	HI ELEV	LO ELEV	FLOW LENGTH	FLOW LENGTH	SLOPE	TC	TC	RUNOFF
	(SQ.FT.)	(ACRES)	(SQ.MI.)	(FT)	(FT)	(FT)	(MI)	(FT/FT)	(HR)	(MIN)	C
1	27878400.0	640.0	1.0	2066.8	2019	6122.0	1.2	0.0078	0.7	42	0.38

EXISTING CONDITION BASIN RUNOFF

STORM EVENT	INTENSITY	Q BASIN 1
(YR)	(IN/HR)	(CFS)
2	0.50	122
5	0.70	170
10	0.80	195
25	1.00	243
50	1.10	268
100	1.20	292

PROPOSED CONDITION BASIN HYDROLOGY PARAMETERS

BASIN	AREA	AREA	AREA	HI ELEV	LO ELEV	FLOW LENGTH	FLOW LENGTH	SLOPE	TC	TC	RUNOFF
	(SQ.FT.)	(ACRES)	(SQ.MI.)	(FT)	(FT)	(FT)	(MI)	(FT/FT)	(HR)	(MIN)	C
1	5028831	115.4	0.2	2045.5	2044.5	2600	0.5	0.0004	1.1	69	0.40
2	4519579	103.8	0.2	2039.5	2038.5	2600	0.5	0.0004	1.1	69	0.40
3	4500204	103.3	0.2	2035.5	2034.5	2600	0.5	0.0004	1.1	69	0.40
4	5086978	116.8	0.2	2029.5	2028.5	2600	0.5	0.0004	1.1	69	0.40
5	4571633	105.0	0.2	2025.5	2024.5	2600	0.5	0.0004	1.1	69	0.40
6	4551844	104.5	0.2	2022.5	2021.5	2600	0.5	0.0004	1.1	69	0.40

PROPOSED CONDITION BASIN RUNOFF RUNOFF

STORM EVENT	INTENSITY	Q BASIN 1	Q BASIN 2	Q BASIN 3	Q BASIN 4	Q BASIN 5	Q BASIN 6	Total
(YR)	(IN/HR)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	Onsite (cfs)
2	0.50	23	21	21	23	21	21	130
5	0.70	32	29	29	33	29	29	182
10	0.80	37	33	33	37	34	33	208
25	1.00	46	42	41	47	42	42	259
50	1.10	51	46	45	51	46	46	285
100	1.20	55	50	50	56	50	50	311

PROPOSED 50-YR STORM, 10-HOUR INTENSITY FOR 10-HOUR DURATION VOLUME RESULTS

STORM EVENT	INTENSITY	Q BASIN 1	Q BASIN 2	Q BASIN 3	Q BASIN 4	Q BASIN 5	Q BASIN 6
(YR)	(IN/HR)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)
50	0.47	21.7	19.5	19.4	22.0	19.7	19.6
DURATION, (HR)		10	10	10	10	10	10
VOLUME REQUIRED, (CF)		781339	702216	699205	790374	710303	707229
VOLUME REQUIRED, (AC-FT)		17.9	16.1	16.1	18.1	16.3	16.2

Note: The rainfall volume is based on the theoretical runoff from a 50-year storm, 10-hour intensity for 10-hour duration.

PROPOSED DETENTION/INIFILTRATION AREA PROVIDED VOLUME

BASIN	TOP WIDTH	DEPTH	LENGTH	VOLUME PROVIDED	VOLUME PROVIDED	VOLUME REQUIRED	SURPLUS VOLUME
	(FT)	(FT)	(FT)	(CF)	(AC-FT)	(AC-FT)	(AC-FT)
1	423	1	5280	1117934	25.7	17.9	7.7
2	827	1	5280	2182462	50.1	16.1	34.0
3	820	1	5280	2165117	49.7	16.1	33.7
4	923	1	5280	2437934	56.0	18.1	37.8
5	827	1	5280	2182462	50.1	16.3	33.8
6	820	1	5280	2165117	49.7	16.2	33.5

Note: Volume required is the volume to store the 50-year, 10-hour intensity for a 10-hour duration (San Luis Obispo County retention standard)

PROPOSED 100-YR STORM, 1-HOUR INTENSITY FOR 10-HOUR DURATION VOLUME RESULTS

STORM EVENT	INTENSITY	Q BASIN 1	Q BASIN 2	Q BASIN 3	Q BASIN 4	Q BASIN 5	Q BASIN 6
(YR)	(IN/HR)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)	(CFS)
100	1.20	55.4	49.8	49.6	56.1	50.4	50.2
DURATION, (HR)		10	10	10	10	10	10
VOLUME REQUIRED, (CF)		1994908.4	1792890.9	1785204.7	2017974.9	1813540.3	1805690.0
VOLUME REQUIRED, (AC-FT)		45.8	41.2	41.0	46.3	41.6	41.5

Note: The rainfall volume is based on the theoretical runoff from a 50-year storm, 10-hour intensity for 10-hour duration.

PROPOSED RETENTION BASIN PROVIDED VOLUME

BASIN	TOP WIDTH	DEPTH	LENGTH	VOLUME PROVIDED	VOLUME PROVIDED	VOLUME REQUIRED	SURPLUS VOLUME
	(FT)	(FT)	(FT)	(CF)	(AC-FT)	(AC-FT)	(AC-FT)
1	423.46	1	5280	1117934.4	25.7	45.8	-20.1
2	826.69	1	5280	2182461.6	50.1	41.2	8.9
3	820.12	1	5280	2165116.8	49.7	41.0	8.7
4	923.46	1	5280	2437934.4	56.0	46.3	9.6
5	826.69	1	5280	2182461.6	50.1	41.6	8.5
6	820.12	1	5280	2165116.8	49.7	41.5	8.3

Project: AusraCESF_2YR6HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:46:44 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	108.5	02Jul2000, 18:40	292.6
Basin02	3.9	22.9	02Jul2000, 06:40	36.1
Basin03	4.3	27.2	02Jul2000, 04:35	39.8
Basin04(site)	1.6	13.7	01Jul2000, 19:45	14.8
Basin04(site-post)	1.6	34.6	01Jul2000, 18:50	30.7
Pre-Soda Lk Wtrshd	414.0	1183.3	02Jul2000, 23:40	3833.5
Pre-Tot.@ N. end Lk	152.0	365.4	03Jul2000, 05:15	1407.5
Pre-Total @ the Site	41.3	138.8	02Jul2000, 19:10	382.4
Pst- Soda Lk Wtrshd	413.0	1180.4	02Jul2000, 23:40	3824.3
Pst- Tot.@ N. end Lk	151.0	363.0	03Jul2000, 05:15	1398.2
Pst- Total @ the Site	40.3	135.5	02Jul2000, 19:10	373.2

Project: AusraCESF_5YR6HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:49:53 Control Specifications: Control 1
Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	242.9	02Jul2000, 17:45	657.2
Basin02	3.9	51.1	02Jul2000, 05:35	81.1
Basin03	4.3	61.4	02Jul2000, 03:15	89.4
Basin04(site)	1.6	35.1	01Jul2000, 19:05	33.3
Basin04(site-post)	1.6	67.6	01Jul2000, 18:25	56.3
Pre-Soda Lk Wtrshd	414.0	2653.2	02Jul2000, 22:50	8609.7
Pre-Tot.@ N. end Lk	152.0	820.0	03Jul2000, 04:25	3161.1
Pre-Total @ the Site	41.3	310.9	02Jul2000, 18:20	858.9
Pst- Soda Lk Wtrshd	413.0	2646.8	02Jul2000, 22:50	8588.9
Pst- Tot.@ N. end Lk	151.0	814.6	03Jul2000, 04:25	3140.3
Pst- Total @ the Site	40.3	303.4	02Jul2000, 18:20	838.1

Project: AusraCESF_10YR6HR Simulation Run: Run 1

Start of Run:	01Jul2000, 04:00	Basin Model:	Basin 1
End of Run:	01Aug2000, 04:00	Meteorologic Model:	Met 1
Compute Time:	08Sep2008, 11:42:48	Control Specifications:	Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	321.6	02Jul2000, 17:30	870.3
Basin02	3.9	67.8	02Jul2000, 05:15	107.4
Basin03	4.3	81.8	02Jul2000, 02:50	118.4
Basin04(site)	1.6	48.3	01Jul2000, 18:55	44.1
Basin04(site-post)	1.6	85.8	01Jul2000, 18:20	70.2
Pre-Soda Lk Wtrshd	414.0	3513.1	02Jul2000, 22:35	11401.8
Pre-Tot.@ N. end Lk	152.0	1086.1	03Jul2000, 04:05	4186.2
Pre-Total @ the Site	41.3	411.6	02Jul2000, 18:05	1137.4
Pst- Soda Lk Wtrshd	413.0	3504.7	02Jul2000, 22:35	11374.3
Pst- Tot.@ N. end Lk	151.0	1078.9	03Jul2000, 04:05	4158.6
Pst- Total @ the Site	40.3	401.7	02Jul2000, 18:05	1109.9

Project: AusraCESF_25YR6HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:45:12 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	405.9	02Jul2000, 17:20	1098.8
Basin02	3.9	85.7	02Jul2000, 05:00	135.6
Basin03	4.3	103.8	02Jul2000, 02:40	149.5
Basin04(site)	1.6	62.8	01Jul2000, 18:45	55.6
Basin04(site-post)	1.6	104.8	01Jul2000, 18:15	84.5
Pre-Soda Lk Wtrshd	414.0	4435.7	02Jul2000, 22:20	14396.2
Pre-Tot.@ N. end Lk	152.0	1371.5	03Jul2000, 03:55	5285.5
Pre-Total @ the Site	41.3	519.7	02Jul2000, 17:55	1436.1
Pst- Soda Lk Wtrshd	413.0	4425.0	02Jul2000, 22:20	14361.4
Pst- Tot.@ N. end Lk	151.0	1362.5	03Jul2000, 03:55	5250.8
Pst- Total @ the Site	40.3	507.1	02Jul2000, 17:55	1401.4

Project: AusraCESF_50YR6HR Simulation Run: Run 1

Start of Run:	01Jul2000, 04:00	Basin Model:	Basin 1
End of Run:	01Aug2000, 04:00	Meteorologic Model:	Met 1
Compute Time:	08Sep2008, 11:48:12	Control Specifications:	Control 1
Volume Units:	AC-FT		

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	495.0	02Jul2000, 17:10	1340.1
Basin02	3.9	104.7	02Jul2000, 04:50	165.4
Basin03	4.3	127.2	02Jul2000, 02:25	182.4
Basin04(site)	1.6	78.4	01Jul2000, 18:40	67.9
Basin04(site-post)	1.6	124.4	01Jul2000, 18:15	99.3
Pre-Soda Lk Wtrshd	414.0	5409.9	02Jul2000, 22:10	17557.2
Pre-Tot.@ N. end Lk	152.0	1672.9	03Jul2000, 03:45	6446.1
Pre-Total @ the Site	41.3	633.7	02Jul2000, 17:45	1751.5
Pst- Soda Lk Wtrshd	413.0	5396.8	02Jul2000, 22:10	17514.8
Pst- Tot.@ N. end Lk	151.0	1661.9	03Jul2000, 03:45	6403.7
Pst- Total @ the Site	40.3	618.3	02Jul2000, 17:45	1709.1

Project: AusraCESF_100YR6HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:40:19 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	733.5	02Jul2000, 16:50	1986.2
Basin02	3.9	155.8	02Jul2000, 04:20	245.1
Basin03	4.3	190.2	02Jul2000, 01:55	270.3
Basin04(site)	1.6	120.8	01Jul2000, 18:25	100.6
Basin04(site-post)	1.6	175.0	01Jul2000, 18:05	137.4
Pre-Soda Lk Wtrshd	414.0	8019.1	02Jul2000, 21:45	26021.1
Pre-Tot.@ N. end Lk	152.0	2480.0	03Jul2000, 03:30	9553.7
Pre-Total @ the Site	41.3	939.1	02Jul2000, 17:20	2595.8
Pst- Soda Lk Wtrshd	413.0	7999.7	02Jul2000, 21:45	25958.3
Pst- Tot.@ N. end Lk	151.0	2463.7	03Jul2000, 03:30	9490.8
Pst- Total @ the Site	40.3	916.3	02Jul2000, 17:20	2533.0

Project: AursaCESF_2YR24HF Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:09:26 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	405.9	02Jul2000, 17:20	1098.8
Basin02	3.9	85.7	02Jul2000, 05:00	135.6
Basin03	4.3	103.8	02Jul2000, 02:40	149.5
Basin04(site)	1.6	62.8	01Jul2000, 18:45	55.6
Basin04(site-post)	1.6	104.8	01Jul2000, 18:15	84.5
Pre-Soda Lk Wtrshd	414.0	4435.7	02Jul2000, 22:20	14396.2
Pre-Tot.@ N. end Lk	152.0	1371.5	03Jul2000, 03:55	5285.5
Pre-Total @ the Site	41.3	519.7	02Jul2000, 17:55	1436.1
Pst- Soda Lk Wtrshd	413.0	4425.0	02Jul2000, 22:20	14361.4
Pst- Tot.@ N. end Lk	151.0	1362.5	03Jul2000, 03:55	5250.8
Pst- Total @ the Site	40.3	507.1	02Jul2000, 17:55	1401.4

Project: AursaCESF_5YR24HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:08:06 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	495.0	02Jul2000, 17:10	1340.1
Basin02	3.9	104.7	02Jul2000, 04:50	165.4
Basin03	4.3	127.2	02Jul2000, 02:25	182.4
Basin04(site)	1.6	78.4	01Jul2000, 18:40	67.9
Basin04(site-post)	1.6	124.4	01Jul2000, 18:15	99.3
Pre-Soda Lk Wtrshd	414.0	5409.9	02Jul2000, 22:10	17557.2
Pre-Tot.@ N. end Lk	152.0	1672.9	03Jul2000, 03:45	6446.1
Pre-Total @ the Site	41.3	633.7	02Jul2000, 17:45	1751.5
Pst- Soda Lk Wtrshd	413.0	5396.8	02Jul2000, 22:10	17514.8
Pst- Tot.@ N. end Lk	151.0	1661.9	03Jul2000, 03:45	6403.7
Pst- Total @ the Site	40.3	618.3	02Jul2000, 17:45	1709.1

Project: AusraCESF_10YR24HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:06:26 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	733.5	02Jul2000, 16:50	1986.2
Basin02	3.9	155.8	02Jul2000, 04:20	245.1
Basin03	4.3	190.2	02Jul2000, 01:55	270.3
Basin04(site)	1.6	120.8	01Jul2000, 18:25	100.6
Basin04(site-post)	1.6	175.0	01Jul2000, 18:05	137.4
Pre-Soda Lk Wtrshd	414.0	8019.1	02Jul2000, 21:45	26021.1
Pre-Tot.@ N. end Lk	152.0	2480.0	03Jul2000, 03:30	9553.7
Pre-Total @ the Site	41.3	939.1	02Jul2000, 17:20	2595.8
Pst- Soda Lk Wtrshd	413.0	7999.7	02Jul2000, 21:45	25958.3
Pst- Tot.@ N. end Lk	151.0	2463.7	03Jul2000, 03:30	9490.8
Pst- Total @ the Site	40.3	916.3	02Jul2000, 17:20	2533.0

Project: AusraCESF_25YR24HR Simulation Run: Run 1

Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 11:04:02 Control Specifications: Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	988.5	02Jul2000, 16:35	2676.8
Basin02	3.9	210.6	02Jul2000, 04:00	330.4
Basin03	4.3	258.1	02Jul2000, 01:40	364.2
Basin04(site)	1.6	166.8	01Jul2000, 18:20	135.5
Basin04(site-post)	1.6	227.3	01Jul2000, 18:00	176.7
Pre-Soda Lk Wtrshd	414.0	10808.7	02Jul2000, 21:30	35069.0
Pre-Tot.@ N. end Lk	152.0	3342.8	03Jul2000, 03:20	12875.6
Pre-Total @ the Site	41.3	1265.5	02Jul2000, 17:05	3498.4
Pst- Soda Lk Wtrshd	413.0	10782.6	02Jul2000, 21:30	34984.3
Pst- Tot.@ N. end Lk	151.0	3320.8	03Jul2000, 03:20	12790.9
Pst- Total @ the Site	40.3	1234.9	02Jul2000, 17:05	3413.7

Project: AusraCESF_50YR24HR Simulation Run: Run 1

Start of Run:	01Jul2000, 04:00	Basin Model:	Basin 1
End of Run:	01Aug2000, 04:00	Meteorologic Model:	Met 1
Compute Time:	08Sep2008, 11:01:25	Control Specifications:	Control 1

Volume Units: AC-FT

Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	1529.3	02Jul2000, 16:10	4142.3
Basin02	3.9	327.2	02Jul2000, 03:30	511.2
Basin03	4.3	402.8	02Jul2000, 01:10	563.7
Basin04(site)	1.6	265.2	01Jul2000, 18:10	209.7
Basin04(site-post)	1.6	334.0	01Jul2000, 18:00	257.5
Pre-Soda Lk Wtrshd	414.0	16727.2	02Jul2000, 21:10	54269.0
Pre-Tot.@ N. end Lk	152.0	5172.1	03Jul2000, 03:15	19924.9
Pre-Total @ the Site	41.3	1958.0	02Jul2000, 16:40	5413.8
Pst- Soda Lk Wtrshd	413.0	16686.8	02Jul2000, 21:10	54138.0
Pst- Tot.@ N. end Lk	151.0	5138.1	03Jul2000, 03:15	19793.8
Pst- Total @ the Site	40.3	1910.6	02Jul2000, 16:40	5282.7

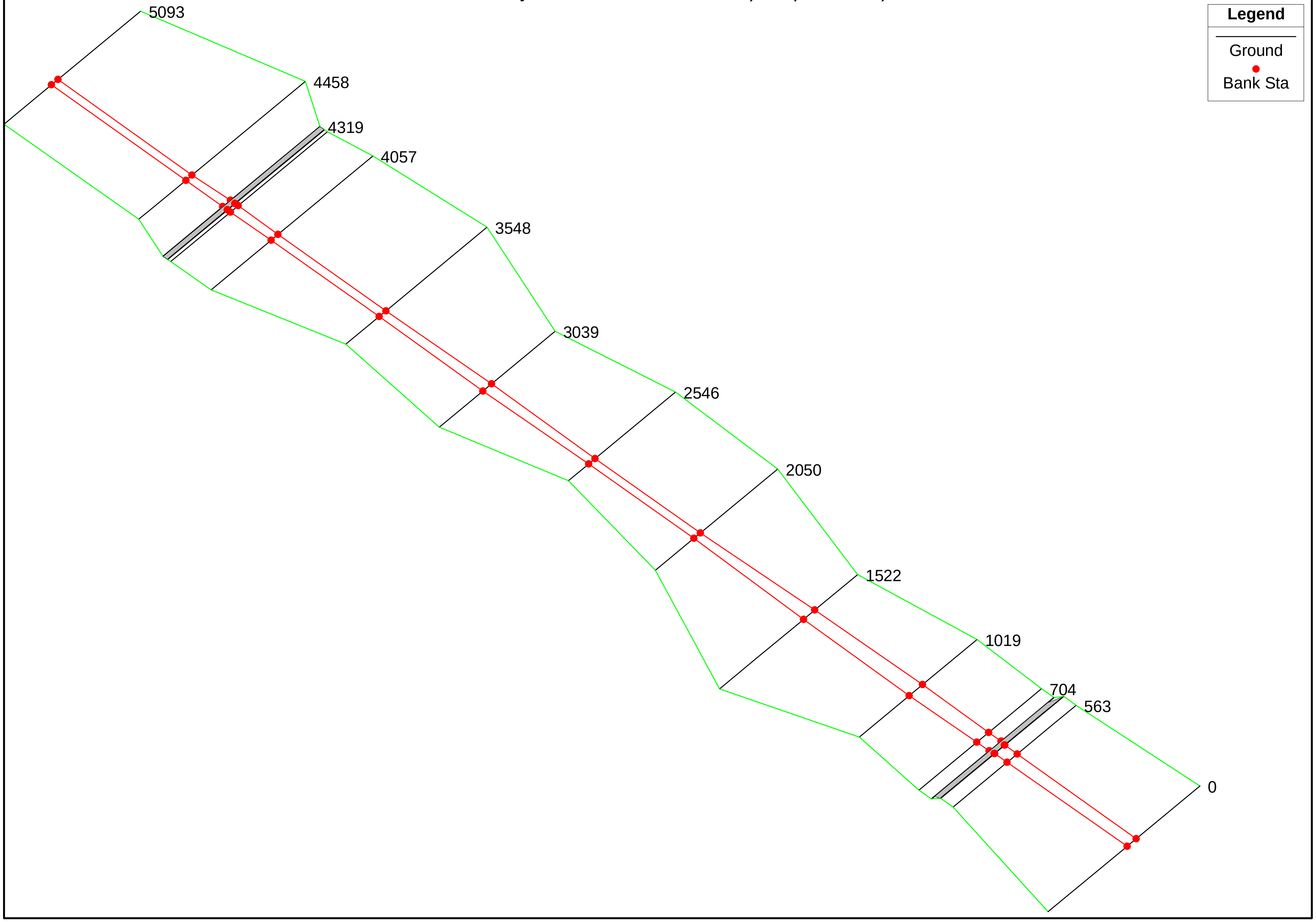
Project: AusraCESF_100YR24HR Simulation Run: Run 1

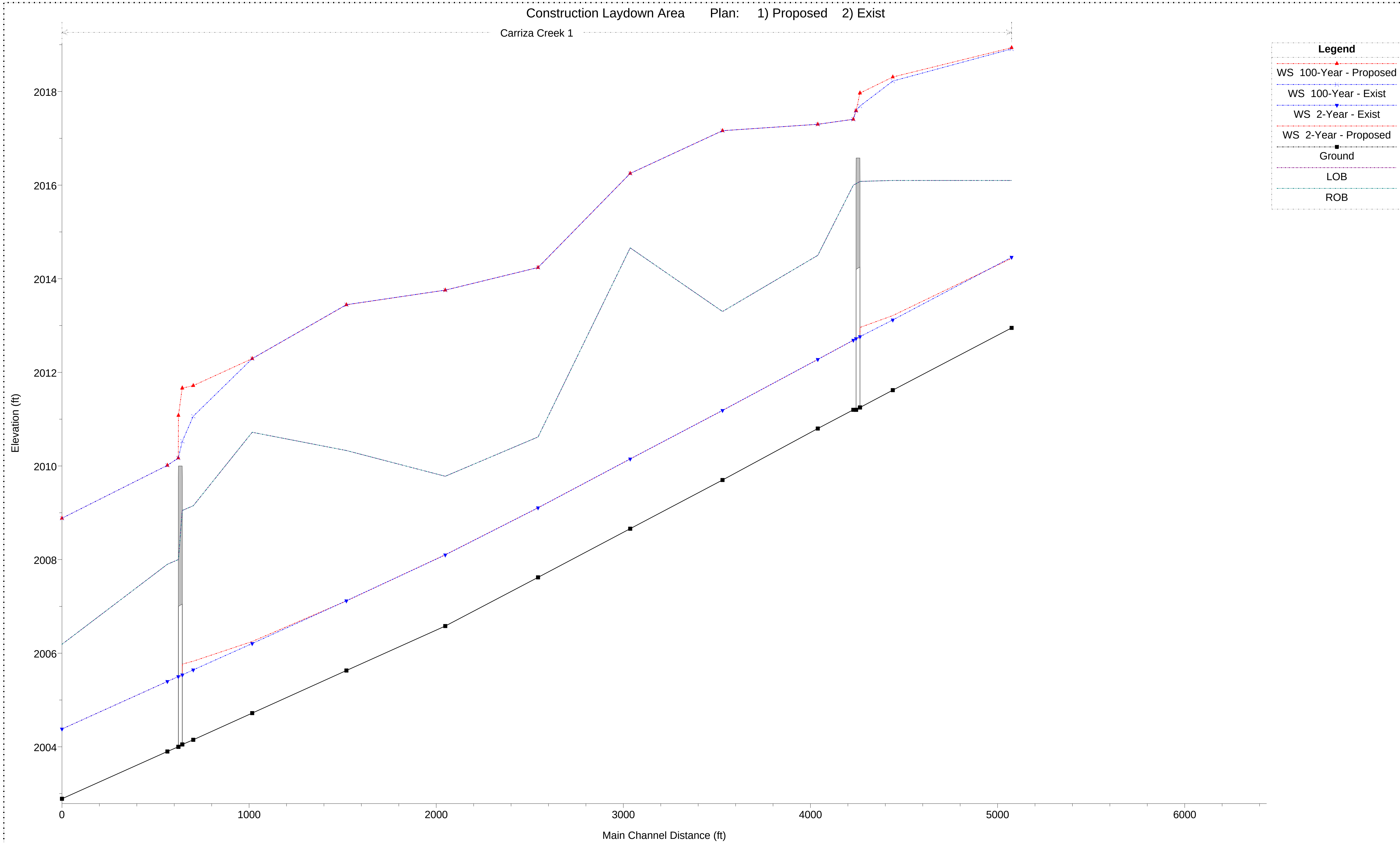
Start of Run: 01Jul2000, 04:00 Basin Model: Basin 1
End of Run: 01Aug2000, 04:00 Meteorologic Model: Met 1
Compute Time: 08Sep2008, 09:58:36 Control Specifications: Control 1

Volume Units: AC-FT

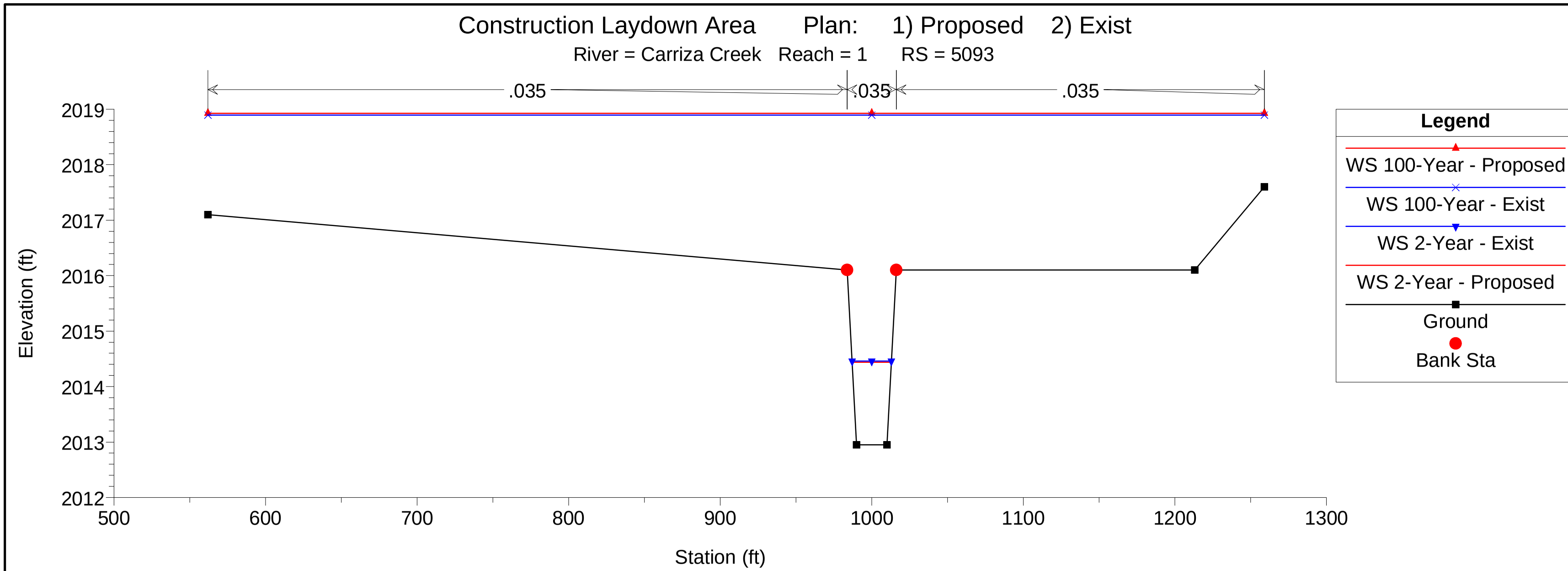
Hydrologic Element	Drainage Area (MI2)	Peak Discharge (CFS)	Time of Peak	Volume (AC-FT)
Basin01	31.6	1809.8	02Jul2000, 16:00	4902.9
Basin02	3.9	387.8	02Jul2000, 03:15	605.1
Basin03	4.3	478.1	02Jul2000, 01:00	667.2
Basin04(site)	1.6	316.4	01Jul2000, 18:05	248.2
Basin04(site-post)	1.6	387.8	01Jul2000, 17:55	298.5
Pre-Soda Lk Wtrshd	414.0	19797.6	02Jul2000, 21:05	64234.4
Pre-Tot.@ N. end Lk	152.0	6120.9	03Jul2000, 03:10	23583.7
Pre-Total @ the Site	41.3	2317.3	02Jul2000, 16:35	6407.9
Pst- Soda Lk Wtrshd	413.0	19749.8	02Jul2000, 21:05	64079.3
Pst- Tot.@ N. end Lk	151.0	6080.6	03Jul2000, 03:10	23428.5
Pst- Total @ the Site	40.3	2261.1	02Jul2000, 16:35	6252.8

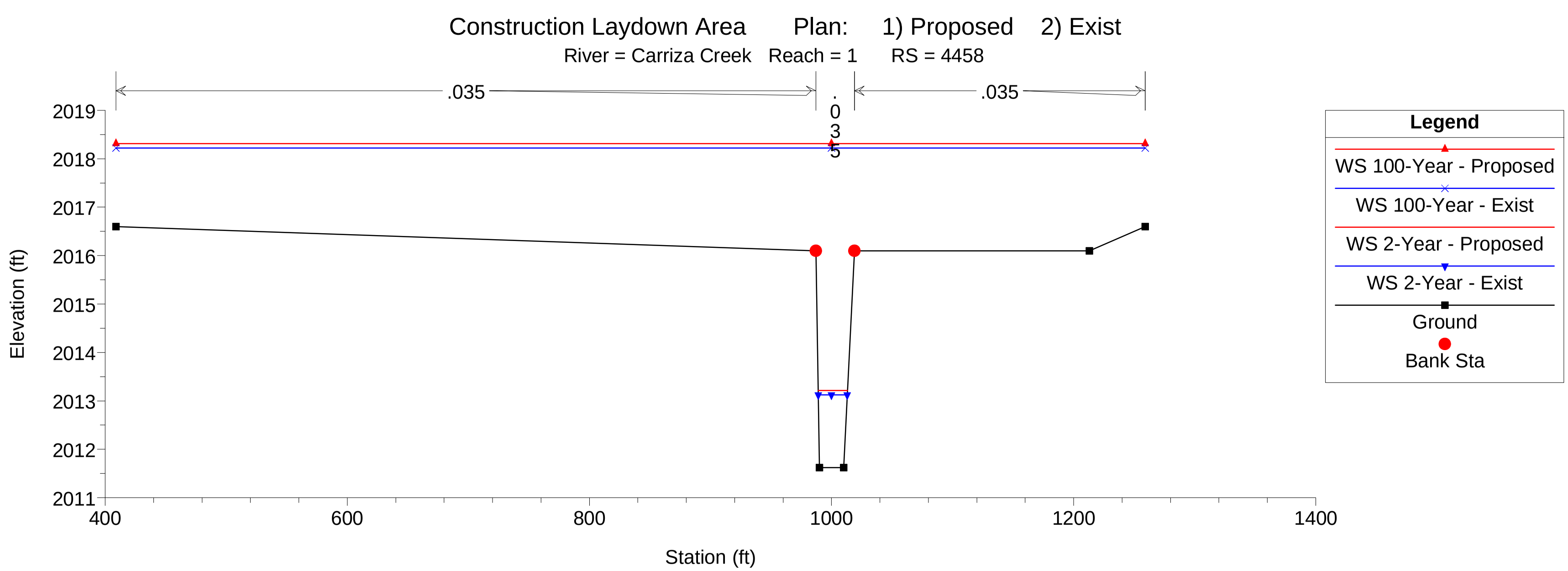
Construction Laydown Area Plan: 1) Proposed 2) Exist





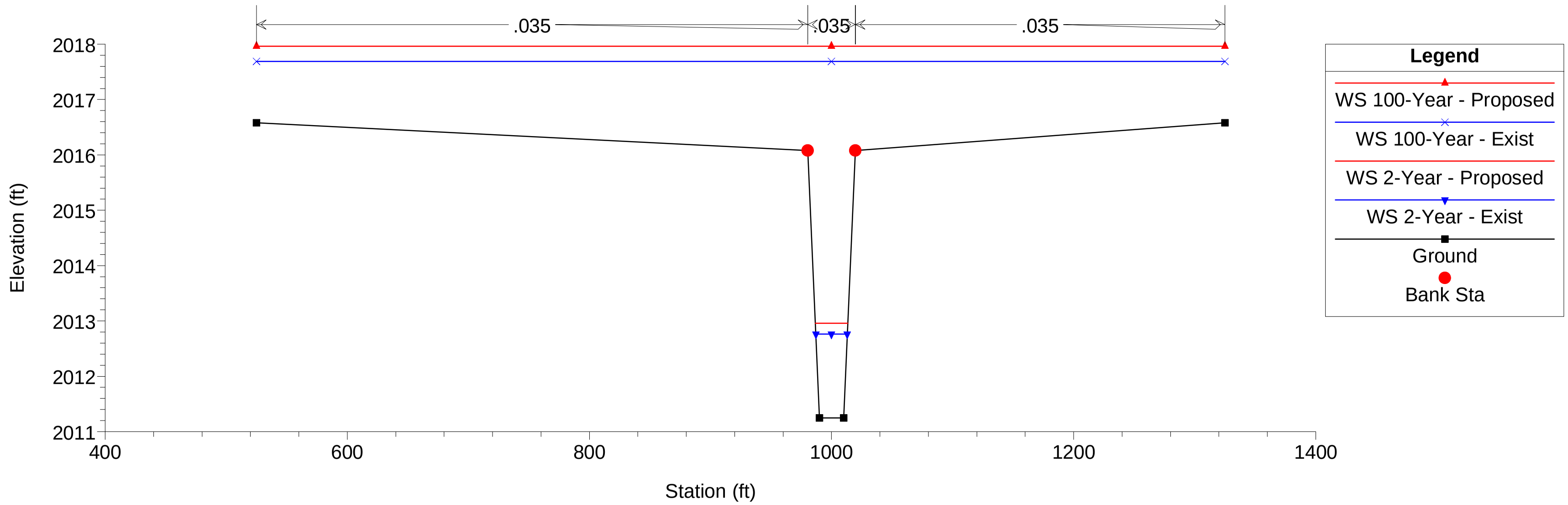
1 in Horiz. = 500 ft 1 in Vert. = 2 ft


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 5093
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 4458
.035
.035
.035
Elevation (ft)
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Proposed
WS 2-Year - Exist
Ground
Bank Sta

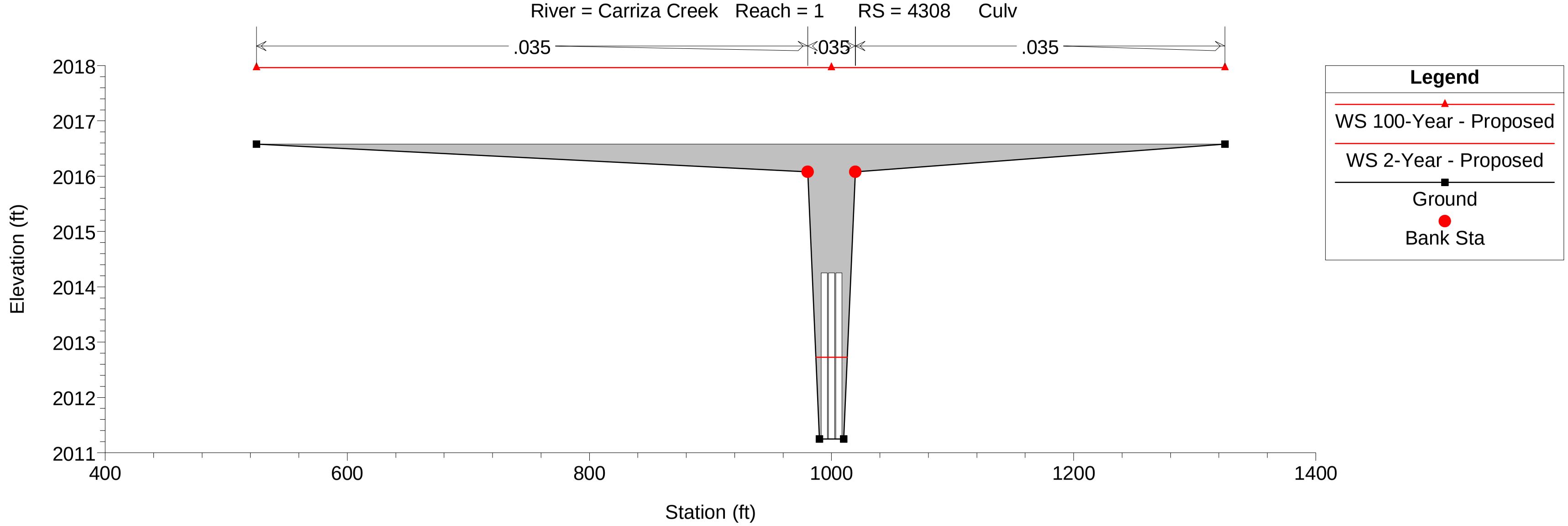
Construction Laydown Area Plan: 1) Proposed 2) Exist

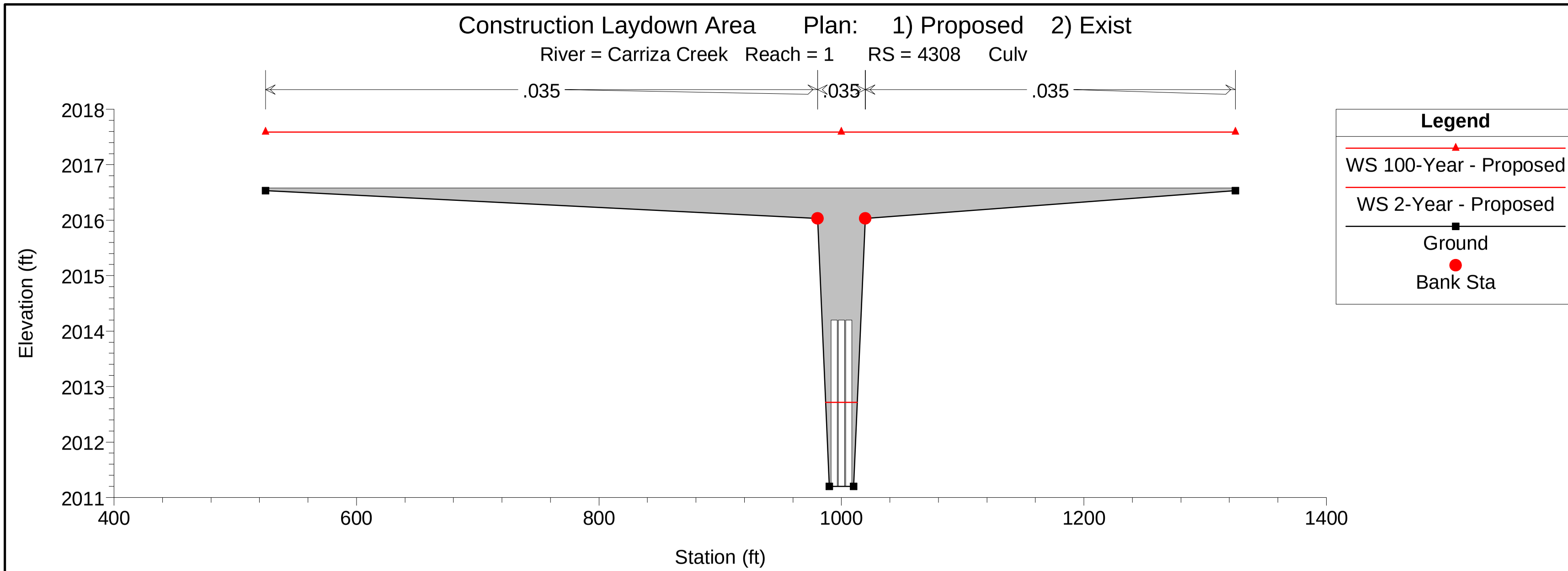
River = Carriza Creek Reach = 1 RS = 4319

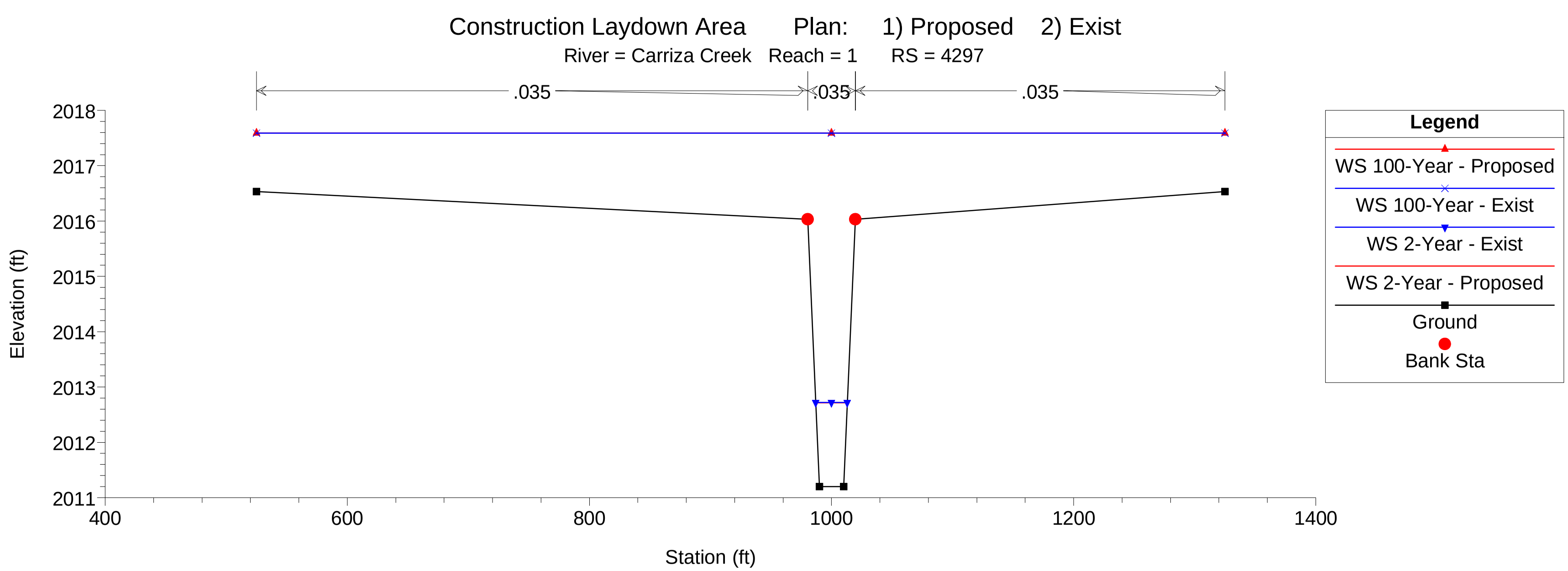


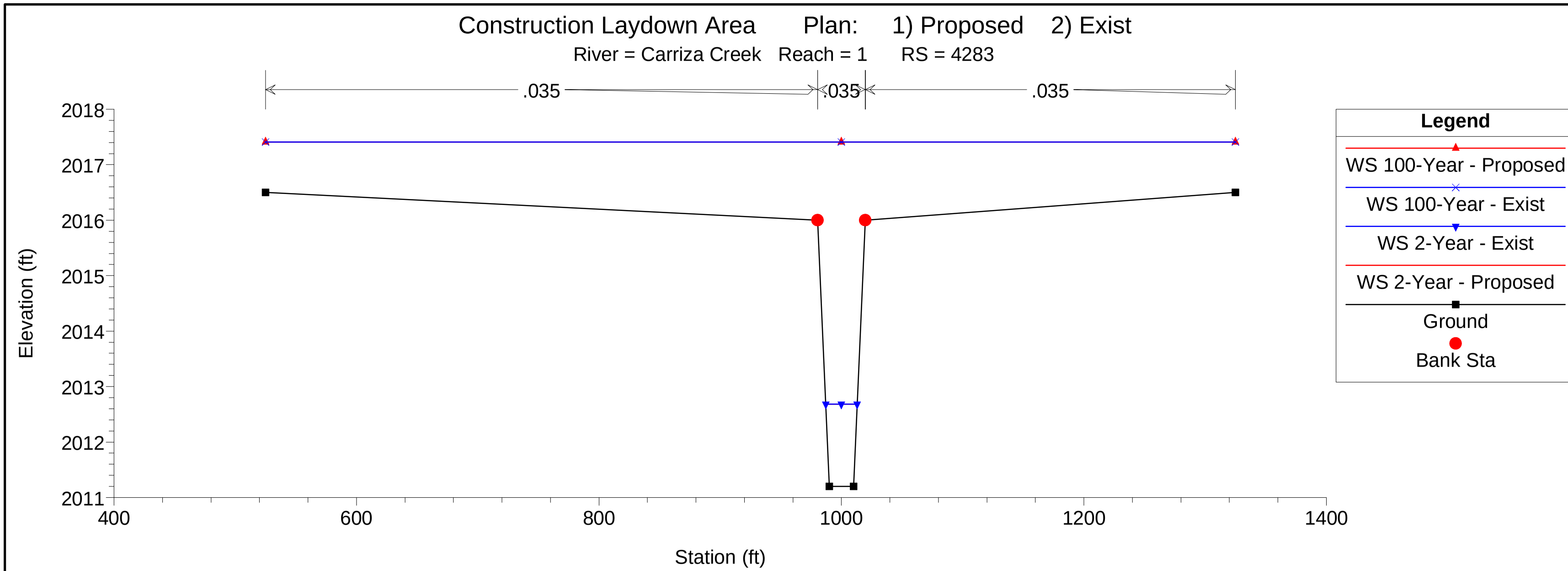
Construction Laydown Area Plan: 1) Proposed 2) Exist

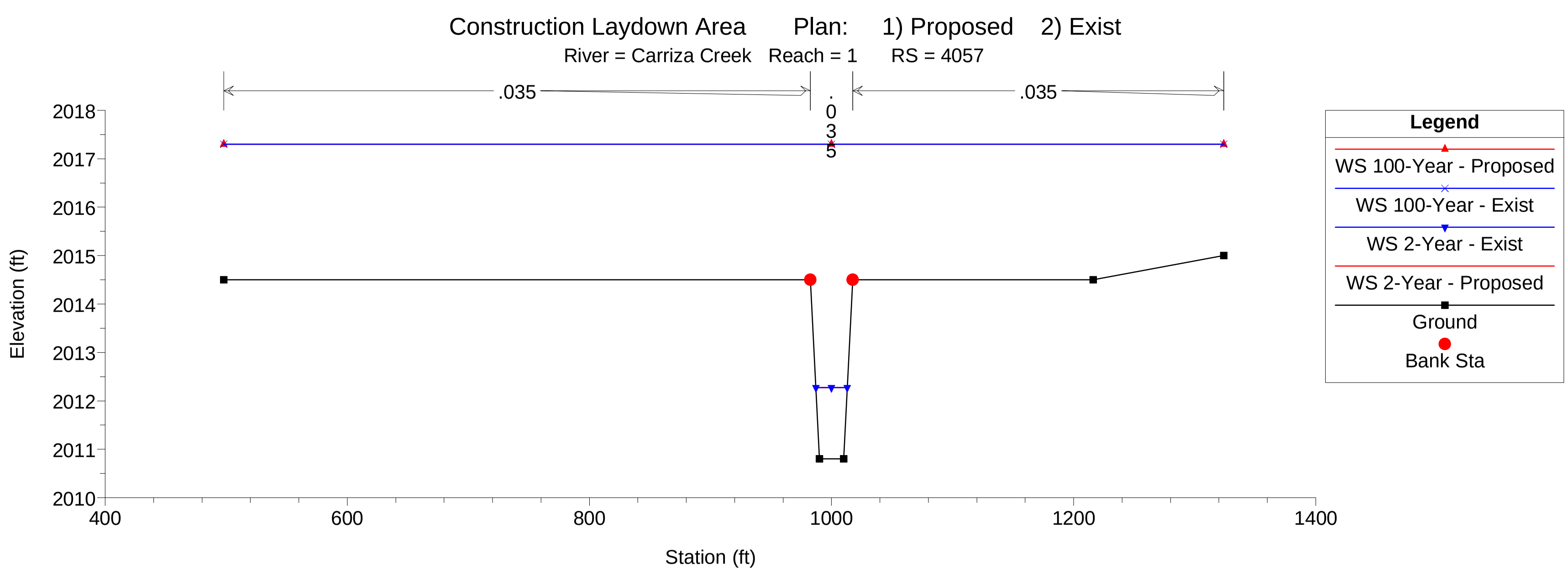
River = Carriza Creek Reach = 1 RS = 4308 Culv



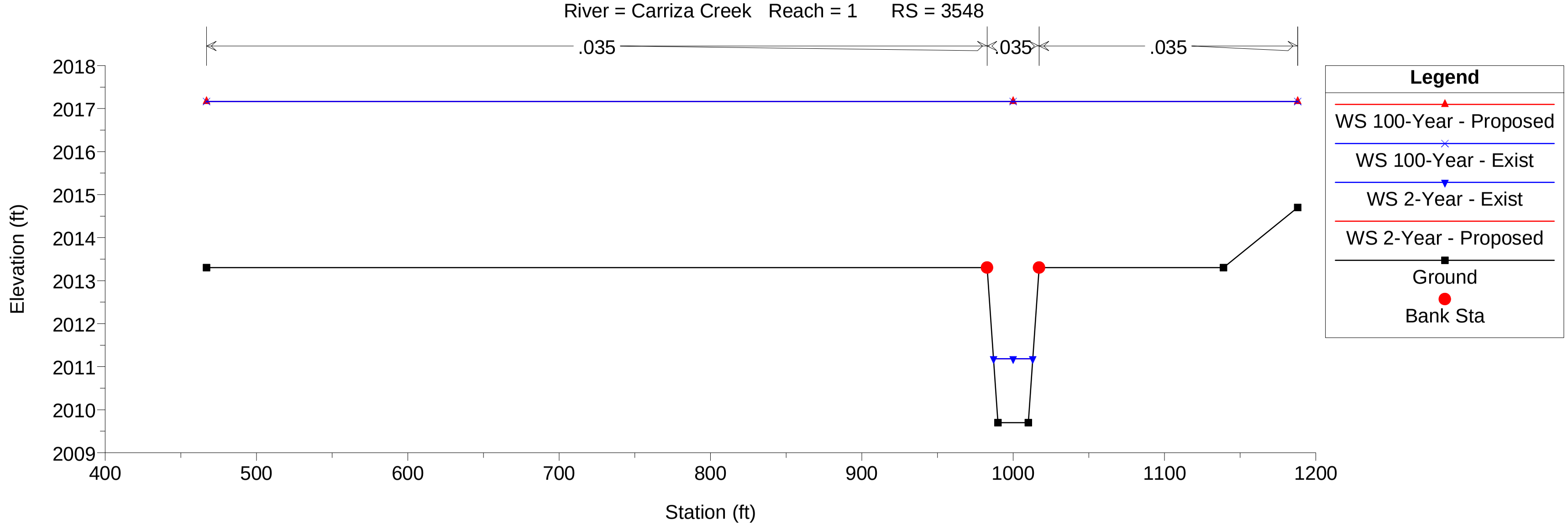

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 4308 Culv
.035
.035
.035
Elevation (ft)
2018
2017
2016
2015
2014
2013
2012
2011
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 2-Year - Proposed
Ground
Bank Sta


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 4297
.035
.035
.035
Elevation (ft)
2018
2017
2016
2015
2014
2013
2012
2011
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta

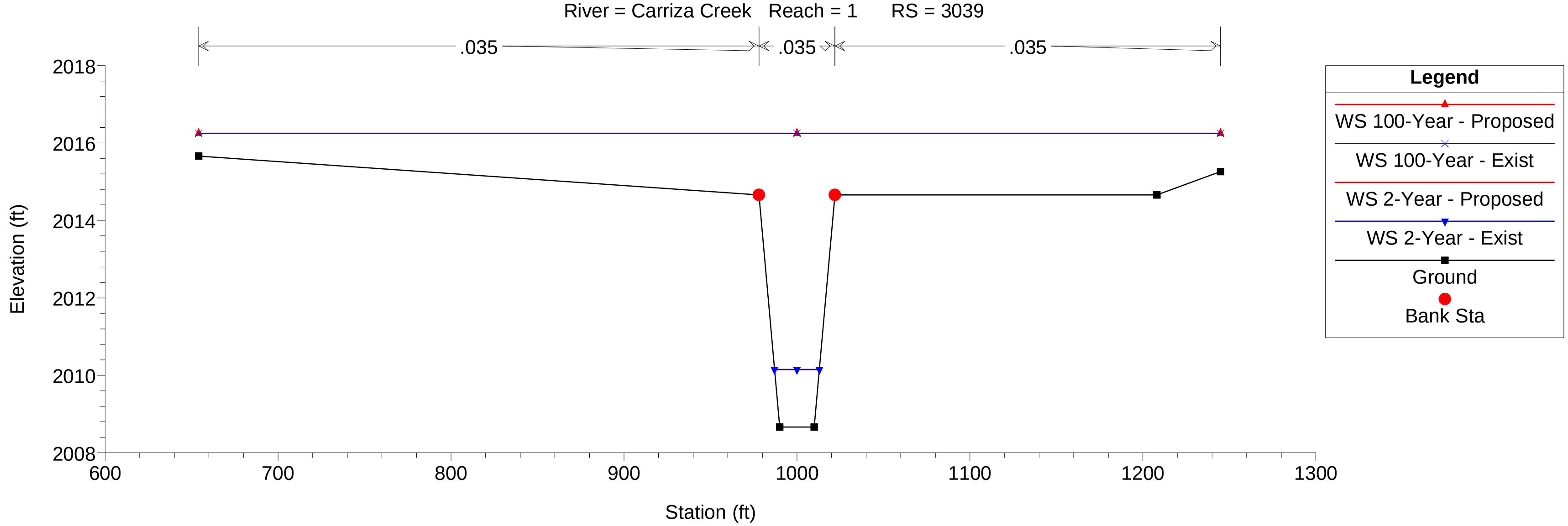

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 4283
.035
.035
.035
Elevation (ft)
2018
2017
2016
2015
2014
2013
2012
2011
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta

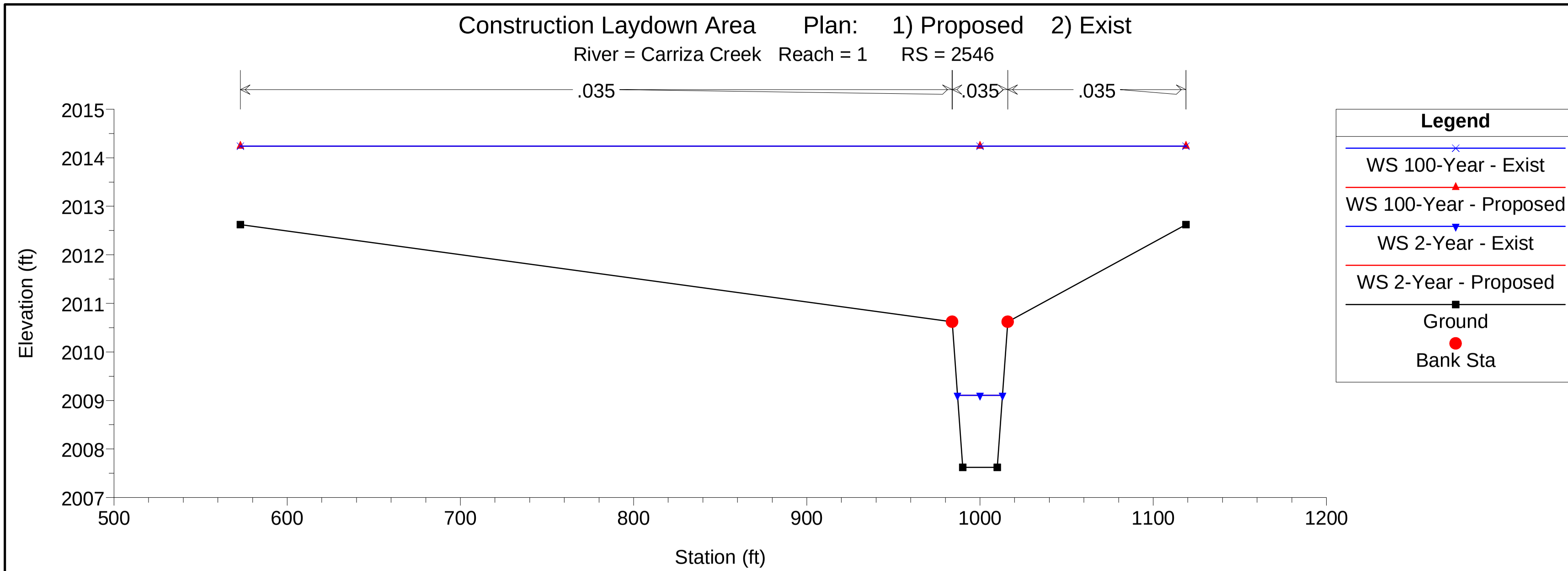

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 4057
.035
.035
.035
Elevation (ft)
2018
2017
2016
2015
2014
2013
2012
2011
2010
400
600
800
1000
1200
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta

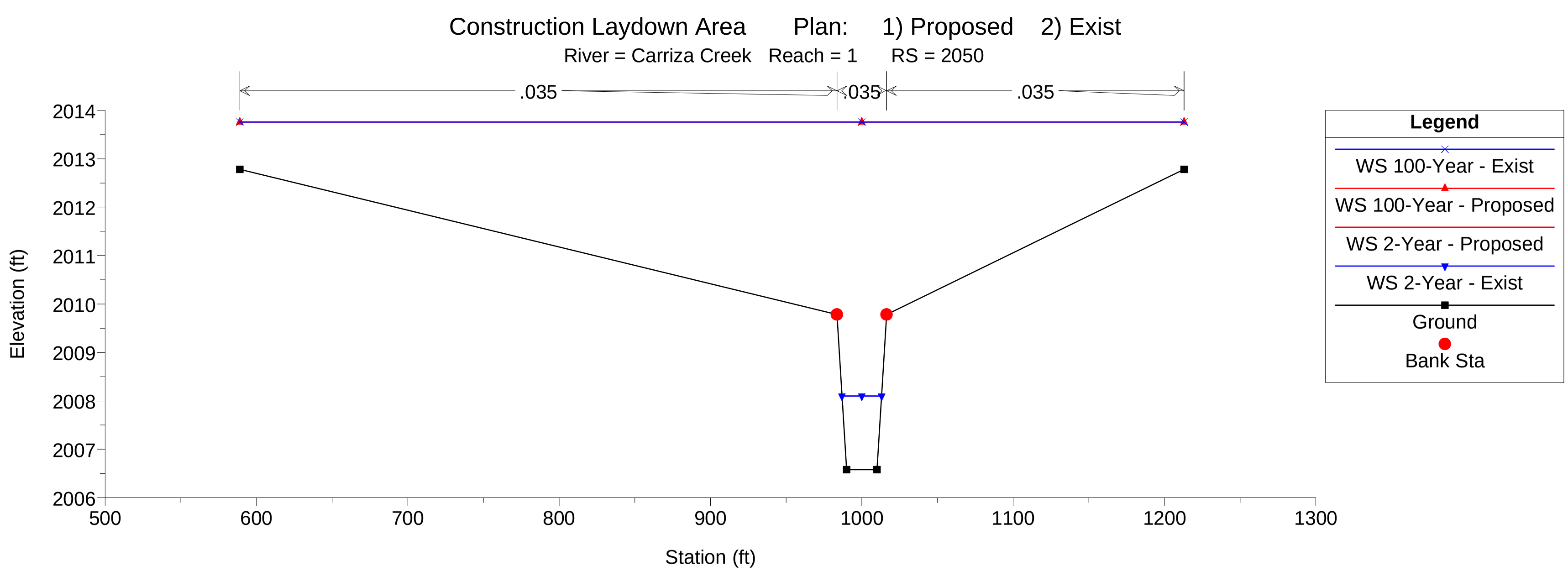
Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 3548

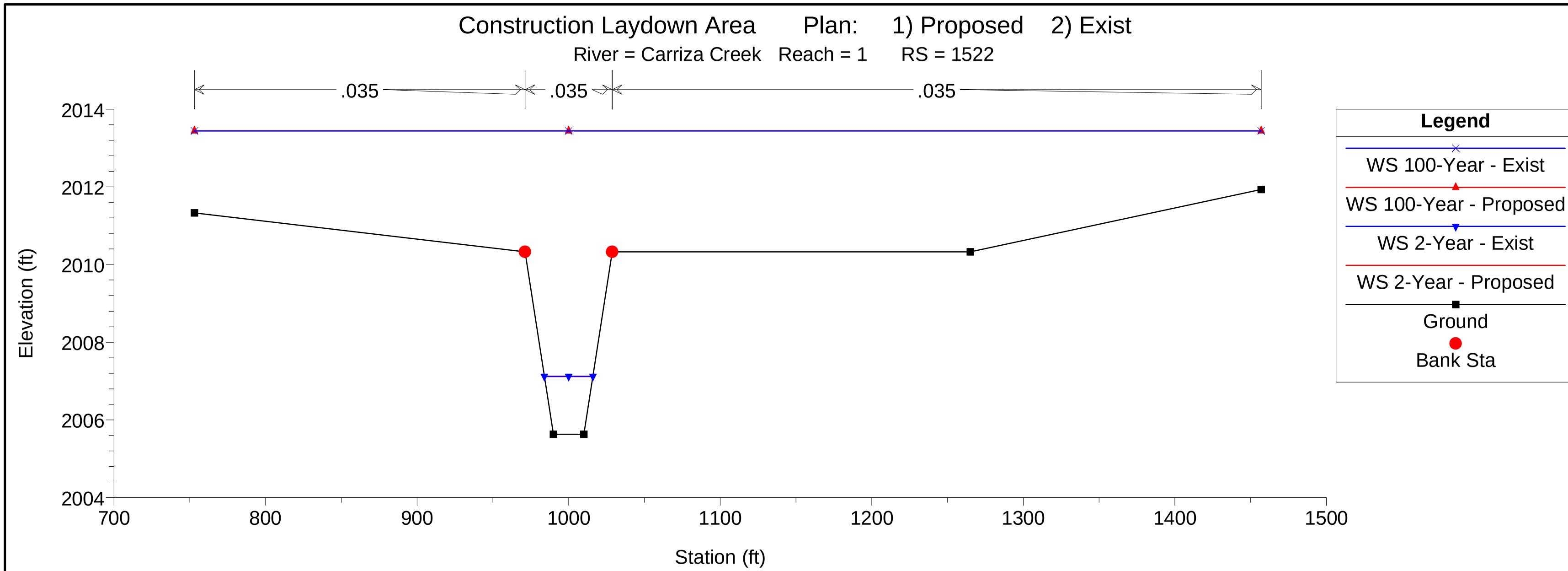


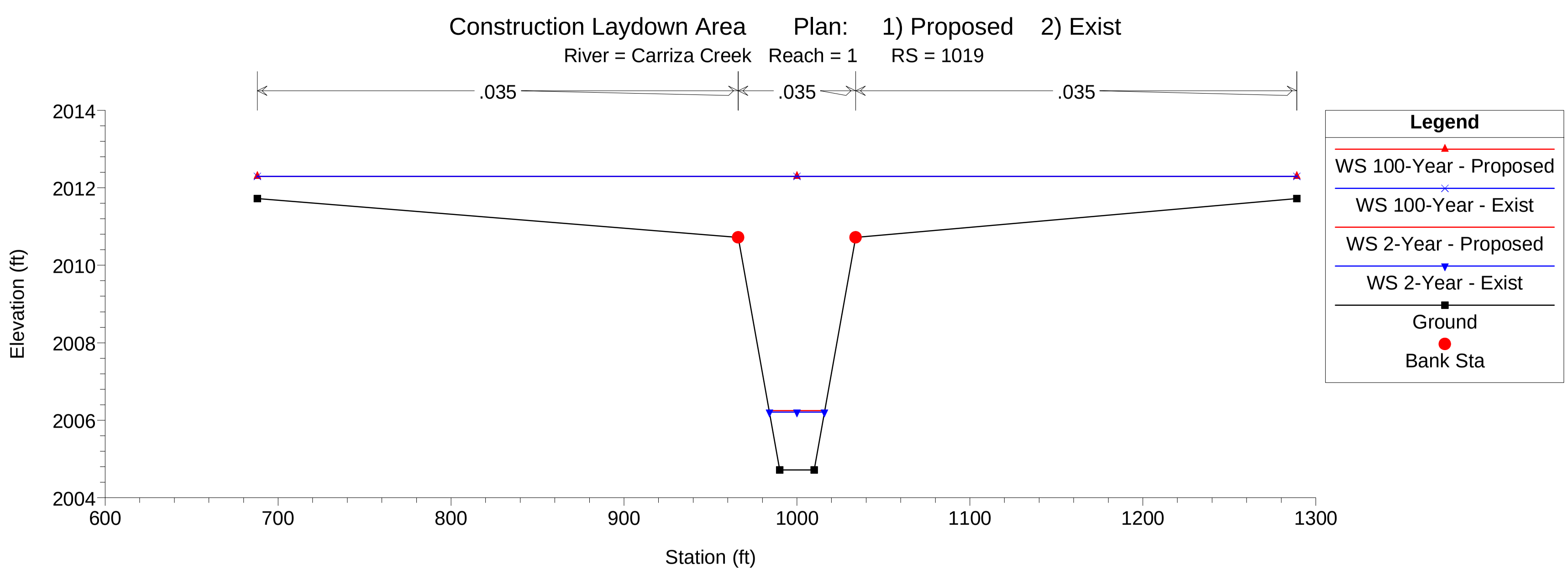
Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 3039

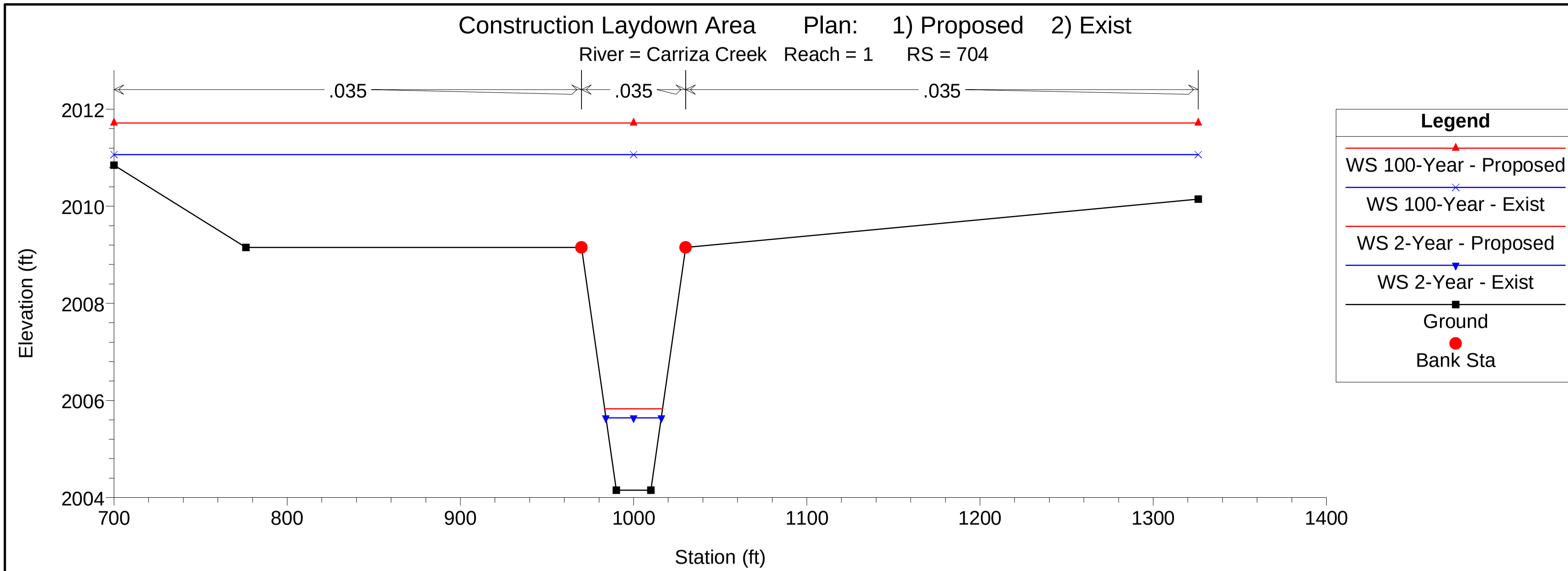


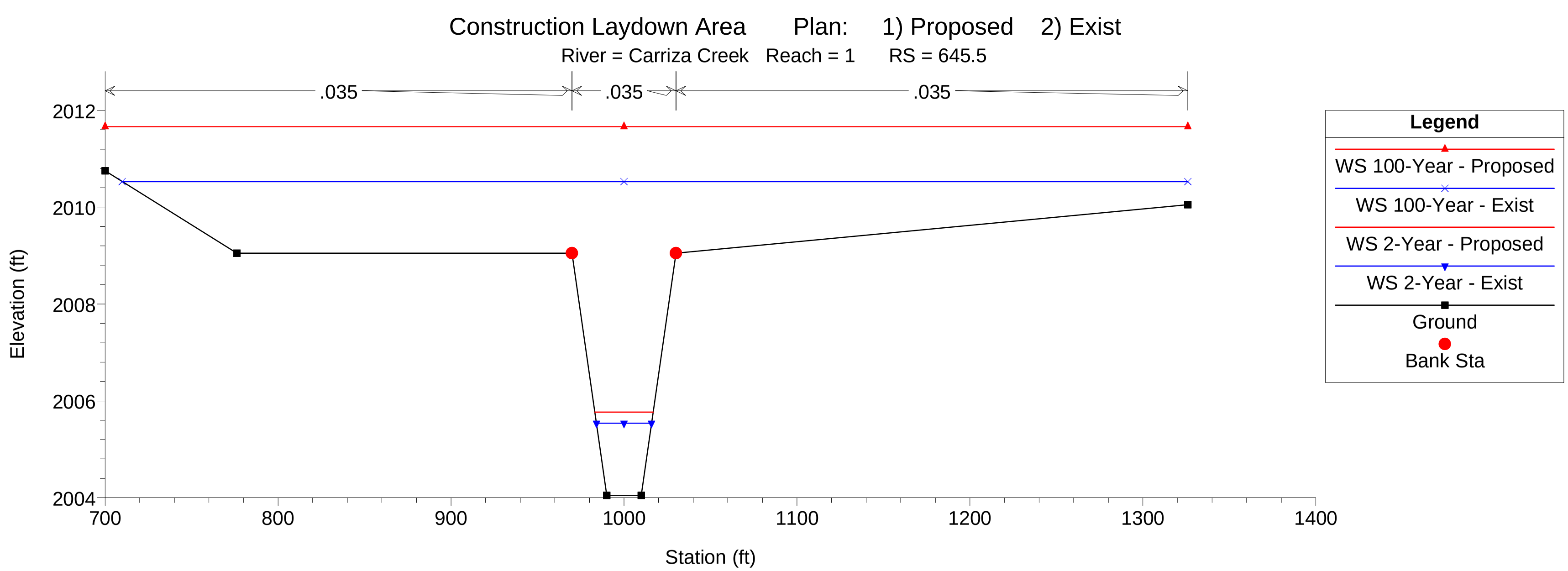

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 2546
.035
.035
.035
Elevation (ft)
2015
2014
2013
2012
2011
2010
2009
2008
2007
500
600
700
800
900
1000
1100
1200
Station (ft)
Legend
WS 100-Year - Exist
WS 100-Year - Proposed
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta

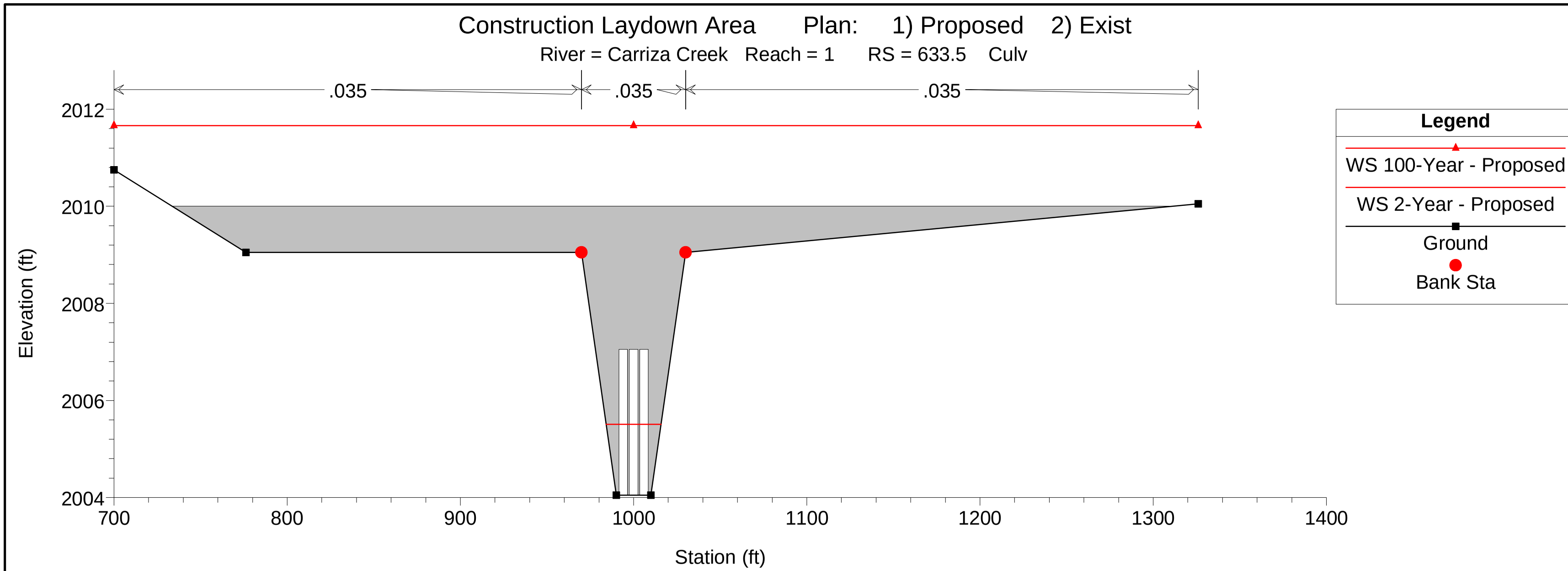

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 2050
.035
.035
.035
Elevation (ft)
2014
2013
2012
2011
2010
2009
2008
2007
2006
500
600
700
800
900
1000
1100
1200
1300
Station (ft)
Legend
WS 100-Year - Exist
WS 100-Year - Proposed
WS 2-Year - Proposed
WS 2-Year - Exist
Ground
Bank Sta

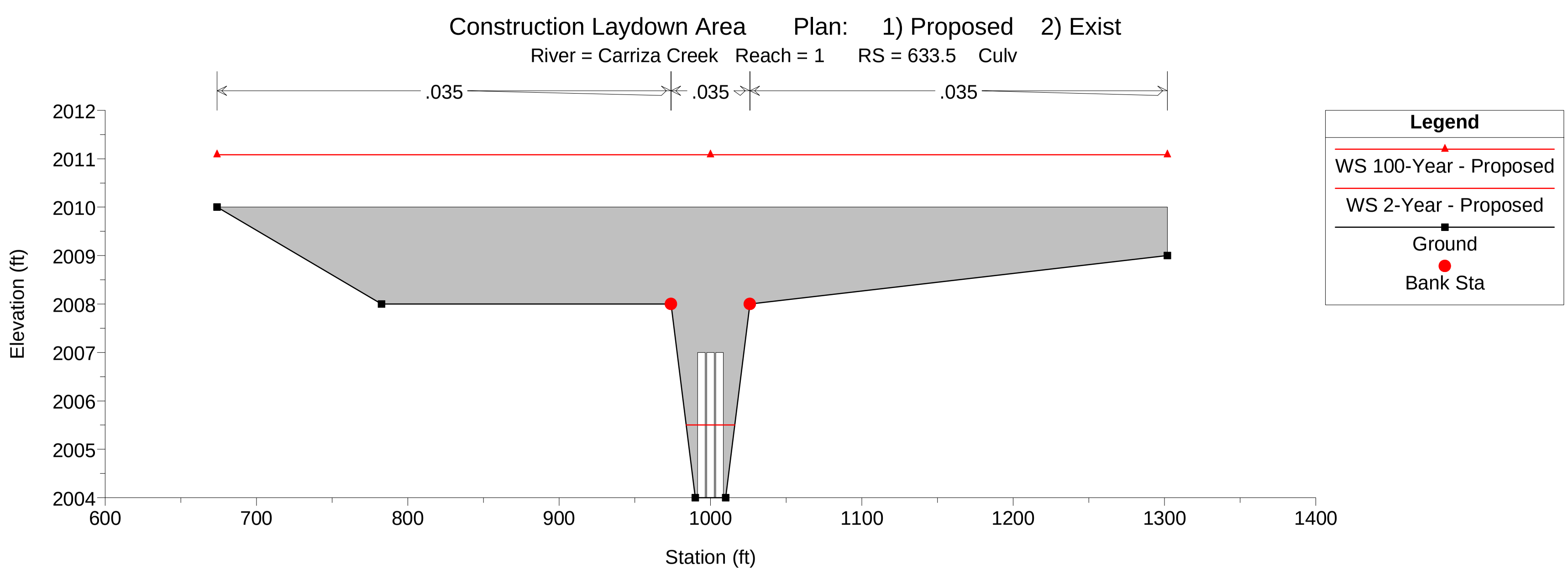

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 1522
.035
.035
.035
Elevation (ft)
2014
2012
2010
2008
2006
2004
700
800
900
1000
1100
1200
1300
1400
1500
Station (ft)
Legend
WS 100-Year - Exist
WS 100-Year - Proposed
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta

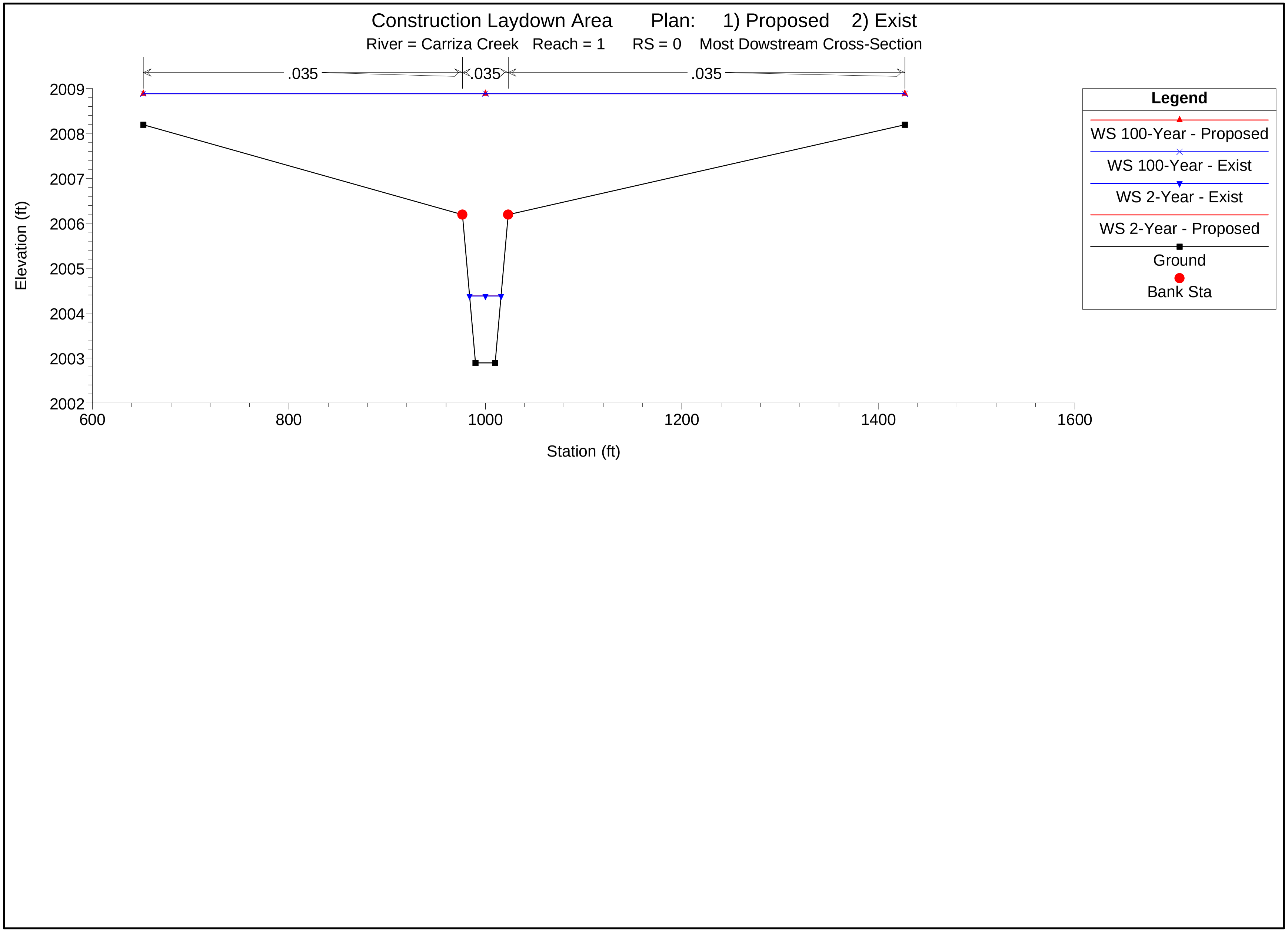

Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 1019
.035
.035
.035
Elevation (ft)
2014
2012
2010
2008
2006
2004
600
700
800
900
1000
1100
1200
1300
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Proposed
WS 2-Year - Exist
Ground
Bank Sta


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 704
.035
.035
.035
Elevation (ft)
2012
2010
2008
2006
2004
700
800
900
1000
1100
1200
1300
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Proposed
WS 2-Year - Exist
Ground
Bank Sta


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 645.5
.035
.035
.035
Elevation (ft)
2012
2010
2008
2006
2004
700
800
900
1000
1100
1200
1300
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Proposed
WS 2-Year - Exist
Ground
Bank Sta


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 633.5 Culv
.035
.035
.035
Elevation (ft)
2004
2006
2008
2010
2012
700
800
900
1000
1100
1200
1300
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 2-Year - Proposed
Ground
Bank Sta


Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 633.5 Culv
.035
.035
.035
Elevation (ft)
2004
2005
2006
2007
2008
2009
2010
2011
2012
600
700
800
900
1000
1100
1200
1300
1400
Station (ft)
Legend
WS 100-Year - Proposed
WS 2-Year - Proposed
Ground
Bank Sta



Construction Laydown Area Plan: 1) Proposed 2) Exist
River = Carriza Creek Reach = 1 RS = 0 Most Dowstream Cross-Section
.035
.035
.035
Elevation (ft)
2009
2008
2007
2006
2005
2004
2003
2002
600
800
1000
1200
1400
1600
Station (ft)
Legend
WS 100-Year - Proposed
WS 100-Year - Exist
WS 2-Year - Exist
WS 2-Year - Proposed
Ground
Bank Sta

HEC-RAS Plan: Exist River: Carriza Creek Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	5093	2-Year	78.70	2012.95	2014.46		2014.54	0.002003	2.26	34.78	26.04	0.35
1	5093	5-Year	390.00	2012.95	2016.56		2016.66	0.001171	2.93	235.66	436.86	0.30
1	5093	10-Year	846.00	2012.95	2017.36		2017.39	0.000545	2.34	713.03	689.49	0.21
1	5093	25-Year	1790.00	2012.95	2017.93		2017.99	0.000666	2.85	1115.66	697.00	0.24
1	5093	50-Year	2950.00	2012.95	2018.42		2018.50	0.000787	3.32	1457.52	697.00	0.27
1	5093	100-Year	4380.00	2012.95	2018.90		2019.00	0.000907	3.79	1786.28	697.00	0.29
1	4458	2-Year	78.70	2011.62	2013.12		2013.21	0.002192	2.38	33.03	23.99	0.36
1	4458	5-Year	390.00	2011.62	2015.31		2015.59	0.002507	4.24	92.01	29.83	0.43
1	4458	10-Year	846.00	2011.62	2016.95		2017.01	0.000651	2.76	685.27	850.00	0.23
1	4458	25-Year	1790.00	2011.62	2017.46		2017.52	0.000799	3.28	1111.83	850.00	0.26
1	4458	50-Year	2950.00	2011.62	2017.84		2017.93	0.001003	3.86	1441.27	850.00	0.29
1	4458	100-Year	4380.00	2011.62	2018.22		2018.34	0.001182	4.38	1764.79	850.00	0.32
1	4319	2-Year	78.70	2011.25	2012.76		2012.84	0.002000	2.26	34.79	26.03	0.34
1	4319	5-Year	390.00	2011.25	2014.94		2015.18	0.002122	3.86	101.08	34.73	0.40
1	4319	10-Year	846.00	2011.25	2016.38	2014.63	2016.78	0.002595	5.20	222.48	492.99	0.46
1	4319	25-Year	1790.00	2011.25	2016.98		2017.27	0.002499	5.61	673.73	800.00	0.46
1	4319	50-Year	2950.00	2011.25	2017.36		2017.65	0.002682	6.13	979.39	800.00	0.49
1	4319	100-Year	4380.00	2011.25	2017.69		2018.01	0.003056	6.83	1240.13	800.00	0.53
1	4297	2-Year	78.70	2011.20	2012.72		2012.80	0.001968	2.25	34.98	26.07	0.34
1	4297	5-Year	390.00	2011.20	2014.90		2015.13	0.002111	3.85	101.30	34.79	0.40
1	4297	10-Year	846.00	2011.20	2016.31	2014.57	2016.72	0.002659	5.25	215.00	468.87	0.47
1	4297	25-Year	1790.00	2011.20	2016.92		2017.22	0.002595	5.70	662.27	800.00	0.47
1	4297	50-Year	2950.00	2011.20	2017.29		2017.59	0.002841	6.29	958.56	800.00	0.50
1	4297	100-Year	4380.00	2011.20	2017.59		2017.94	0.003354	7.11	1200.55	800.00	0.55
1	4283	2-Year	78.70	2011.20	2012.69		2012.77	0.002121	2.31	34.13	25.94	0.35
1	4283	5-Year	390.00	2011.20	2014.86		2015.10	0.002187	3.90	100.06	34.65	0.40
1	4283	10-Year	846.00	2011.20	2016.23	2014.58	2016.68	0.002933	5.45	192.29	392.85	0.49
1	4283	25-Year	1790.00	2011.20	2016.88	2016.88	2017.19	0.002668	5.76	656.18	800.00	0.48
1	4283	50-Year	2950.00	2011.20	2017.16	2017.16	2017.54	0.003614	6.98	876.10	800.00	0.56
1	4283	100-Year	4380.00	2011.20	2017.41	2017.41	2017.88	0.004563	8.11	1077.96	800.00	0.64
1	4057	2-Year	78.70	2010.80	2012.28		2012.36	0.002167	2.32	33.89	25.91	0.36
1	4057	5-Year	390.00	2010.80	2014.44	2012.91	2014.68	0.002244	3.93	99.17	34.54	0.41
1	4057	10-Year	846.00	2010.80	2014.16	2014.16	2015.54	0.014019	9.42	89.84	33.45	1.01

HEC-RAS Plan: Exist River: Carriza Creek Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4057	25-Year	1790.00	2010.80	2016.25		2016.28	0.000314	2.03	1519.78	826.00	0.17
1	4057	50-Year	2950.00	2010.80	2016.75		2016.79	0.000395	2.44	1935.10	826.00	0.19
1	4057	100-Year	4380.00	2010.80	2017.30		2017.36	0.000442	2.76	2386.01	826.00	0.20
1	3548	2-Year	78.70	2009.70	2011.19		2011.27	0.002122	2.31	34.12	25.94	0.35
1	3548	5-Year	390.00	2009.70	2013.36	2011.81	2013.58	0.002064	3.80	136.21	673.99	0.39
1	3548	10-Year	846.00	2009.70	2014.28		2014.31	0.000453	2.14	774.31	706.35	0.19
1	3548	25-Year	1790.00	2009.70	2016.18		2016.20	0.000088	1.24	2143.10	721.00	0.09
1	3548	50-Year	2950.00	2009.70	2016.65		2016.67	0.000149	1.69	2478.61	721.00	0.12
1	3548	100-Year	4380.00	2009.70	2017.16		2017.20	0.000208	2.11	2849.14	721.00	0.14
1	3039	2-Year	78.70	2008.66	2010.15		2010.23	0.002101	2.30	34.24	25.96	0.35
1	3039	5-Year	390.00	2008.66	2012.20		2012.46	0.002471	4.07	95.89	34.16	0.43
1	3039	10-Year	846.00	2008.66	2012.96		2013.69	0.005745	6.89	122.81	37.18	0.67
1	3039	25-Year	1790.00	2008.66	2013.88	2013.88	2015.85	0.012432	11.26	159.01	40.89	1.01
1	3039	50-Year	2950.00	2008.66	2015.89	2015.89	2016.42	0.003190	7.25	746.52	591.00	0.54
1	3039	100-Year	4380.00	2008.66	2016.25	2016.25	2016.87	0.003888	8.34	958.04	591.00	0.60
1	2546	2-Year	78.70	2007.62	2009.11		2009.19	0.002116	2.30	34.15	25.95	0.35
1	2546	5-Year	390.00	2007.62	2011.19		2011.39	0.001863	3.71	137.91	178.38	0.38
1	2546	10-Year	846.00	2007.62	2012.07		2012.22	0.001483	3.93	395.10	404.98	0.35
1	2546	25-Year	1790.00	2007.62	2012.95		2013.06	0.001155	3.97	833.82	546.00	0.32
1	2546	50-Year	2950.00	2007.62	2013.64		2013.76	0.001011	4.07	1214.46	546.00	0.31
1	2546	100-Year	4380.00	2007.62	2014.24		2014.39	0.001056	4.45	1540.58	546.00	0.32
1	2050	2-Year	78.70	2006.58	2008.10		2008.18	0.001955	2.24	35.06	26.09	0.34
1	2050	5-Year	390.00	2006.58	2010.14		2010.38	0.002221	3.98	108.50	102.68	0.41
1	2050	10-Year	846.00	2006.58	2011.45		2011.58	0.001119	3.61	412.49	361.04	0.31
1	2050	25-Year	1790.00	2006.58	2012.38		2012.50	0.001080	4.05	833.84	544.45	0.31
1	2050	50-Year	2950.00	2006.58	2013.18		2013.29	0.000882	4.03	1316.17	624.00	0.29
1	2050	100-Year	4380.00	2006.58	2013.76		2013.89	0.000917	4.37	1679.90	624.00	0.30
1	1522	2-Year	78.70	2005.63	2007.12		2007.19	0.001799	2.03	38.72	31.93	0.33
1	1522	5-Year	390.00	2005.63	2009.13		2009.30	0.001815	3.28	119.08	48.01	0.37
1	1522	10-Year	846.00	2005.63	2010.64		2010.86	0.001640	3.89	290.78	399.55	0.37
1	1522	25-Year	1790.00	2005.63	2012.01		2012.08	0.000577	2.88	1101.62	704.00	0.23
1	1522	50-Year	2950.00	2005.63	2012.90		2012.96	0.000423	2.76	1728.79	704.00	0.20
1	1522	100-Year	4380.00	2005.63	2013.45		2013.53	0.000502	3.19	2112.41	704.00	0.22

HEC-RAS Plan: Exist River: Carriza Creek Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1019	2-Year	78.70	2004.72	2006.21		2006.27	0.001817	2.04	38.59	31.90	0.33
1	1019	5-Year	390.00	2004.72	2008.22		2008.39	0.001821	3.28	118.94	47.99	0.37
1	1019	10-Year	846.00	2004.72	2009.58		2009.88	0.002304	4.42	191.59	58.87	0.43
1	1019	25-Year	1790.00	2004.72	2010.64		2011.39	0.004539	6.92	258.84	67.39	0.62
1	1019	50-Year	2950.00	2004.72	2011.87	2011.87	2012.45	0.003092	6.83	688.08	601.00	0.54
1	1019	100-Year	4380.00	2004.72	2012.29	2012.29	2012.94	0.003541	7.72	943.75	601.00	0.58
1	704	2-Year	78.70	2004.15	2005.64		2005.71	0.001788	2.03	38.80	31.95	0.32
1	704	5-Year	390.00	2004.15	2007.64		2007.81	0.001832	3.29	118.68	47.95	0.37
1	704	10-Year	846.00	2004.15	2008.65		2009.03	0.003143	4.95	171.06	56.01	0.50
1	704	25-Year	1790.00	2004.15	2010.38	2008.78	2010.55	0.001211	4.01	764.58	605.13	0.33
1	704	50-Year	2950.00	2004.15	2010.63		2010.93	0.002142	5.53	917.18	616.32	0.44
1	704	100-Year	4380.00	2004.15	2011.06		2011.40	0.002411	6.21	1185.35	626.00	0.48
1	645.5	2-Year	78.70	2004.05	2005.54		2005.60	0.001815	2.04	38.61	31.90	0.33
1	645.5	5-Year	390.00	2004.05	2007.53		2007.70	0.001851	3.30	118.25	47.88	0.37
1	645.5	10-Year	846.00	2004.05	2008.42		2008.83	0.003552	5.17	163.61	54.93	0.53
1	645.5	25-Year	1790.00	2004.05	2008.68	2008.68	2010.24	0.012592	10.05	178.13	57.01	1.00
1	645.5	50-Year	2950.00	2004.05	2010.17	2010.17	2010.73	0.004071	7.23	693.60	599.86	0.60
1	645.5	100-Year	4380.00	2004.05	2010.53	2010.53	2011.18	0.004752	8.23	914.93	616.16	0.66
1	621.5	2-Year	78.70	2004.00	2005.50		2005.56	0.001765	2.02	38.98	31.99	0.32
1	621.5	5-Year	390.00	2004.00	2007.49		2007.66	0.001831	3.29	118.72	47.95	0.37
1	621.5	10-Year	846.00	2004.00	2008.49		2008.72	0.002049	4.17	302.49	404.87	0.41
1	621.5	25-Year	1790.00	2004.00	2009.19		2009.41	0.002039	4.74	664.29	584.16	0.42
1	621.5	50-Year	2950.00	2004.00	2009.70		2009.93	0.002119	5.24	968.54	611.80	0.44
1	621.5	100-Year	4380.00	2004.00	2010.17		2010.43	0.002223	5.73	1260.58	628.00	0.45
1	563	2-Year	78.70	2003.90	2005.40		2005.46	0.001784	2.03	38.84	31.96	0.32
1	563	5-Year	390.00	2003.90	2007.39		2007.55	0.001849	3.30	118.30	47.88	0.37
1	563	10-Year	846.00	2003.90	2008.32		2008.59	0.002373	4.42	274.98	381.76	0.44
1	563	25-Year	1790.00	2003.90	2009.04		2009.28	0.002264	4.95	635.41	581.47	0.44
1	563	50-Year	2950.00	2003.90	2009.55		2009.80	0.002312	5.43	937.54	609.04	0.46
1	563	100-Year	4380.00	2003.90	2010.01		2010.29	0.002425	5.94	1224.39	628.00	0.47
1	0	2-Year	78.70	2002.89	2004.38	2003.63	2004.45	0.001801	2.03	38.71	31.93	0.33
1	0	5-Year	390.00	2002.89	2006.36	2004.87	2006.53	0.001803	3.31	122.49	107.59	0.37

HEC-RAS Plan: Exist River: Carriza Creek Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	0	10-Year	846.00	2002.89	2007.21	2005.96	2007.40	0.001802	4.01	345.64	417.33	0.38
1	0	25-Year	1790.00	2002.89	2007.94	2007.47	2008.12	0.001804	4.57	747.59	683.39	0.40
1	0	50-Year	2950.00	2002.89	2008.44	2007.93	2008.62	0.001801	4.93	1122.44	775.00	0.40
1	0	100-Year	4380.00	2002.89	2008.88	2008.32	2009.08	0.001801	5.24	1467.46	775.00	0.41

HEC-RAS Plan: Proposed River: Carriza Creek Reach: 1

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	5093	2-Year	78.70	2012.95	2014.44		2014.52	0.002112	2.30	34.17	25.95	0.35
1	5093	5-Year	390.00	2012.95	2016.90		2016.93	0.000417	1.88	412.34	592.18	0.18
1	5093	10-Year	846.00	2012.95	2017.40		2017.43	0.000490	2.24	741.17	690.74	0.20
1	5093	25-Year	1790.00	2012.95	2017.95		2018.00	0.000651	2.82	1124.42	697.00	0.24
1	5093	50-Year	2950.00	2012.95	2018.44		2018.52	0.000768	3.29	1468.84	697.00	0.26
1	5093	100-Year	4380.00	2012.95	2018.92		2019.03	0.000876	3.74	1805.60	697.00	0.28
1	4458	2-Year	78.70	2011.62	2013.21		2013.29	0.001790	2.23	35.27	24.24	0.33
1	4458	5-Year	390.00	2011.62	2016.63		2016.67	0.000396	2.04	409.27	850.00	0.18
1	4458	10-Year	846.00	2011.62	2017.10		2017.14	0.000423	2.27	813.83	850.00	0.19
1	4458	25-Year	1790.00	2011.62	2017.50		2017.56	0.000724	3.14	1150.33	850.00	0.25
1	4458	50-Year	2950.00	2011.62	2017.90		2017.98	0.000909	3.70	1488.17	850.00	0.28
1	4458	100-Year	4380.00	2011.62	2018.31		2018.42	0.001037	4.15	1839.50	850.00	0.30
1	4319	2-Year	78.70	2011.25	2012.96	2012.01	2013.02	0.001306	1.97	40.05	26.82	0.28
1	4319	5-Year	390.00	2011.25	2016.54	2013.36	2016.60	0.000398	2.09	325.20	745.40	0.18
1	4319	10-Year	846.00	2011.25	2016.99	2014.63	2017.06	0.000540	2.61	683.49	800.00	0.22
1	4319	25-Year	1790.00	2011.25	2017.26	2016.95	2017.39	0.001254	4.13	895.02	800.00	0.33
1	4319	50-Year	2950.00	2011.25	2017.58	2017.23	2017.76	0.001698	5.02	1155.27	800.00	0.39
1	4319	100-Year	4380.00	2011.25	2017.97	2017.47	2018.17	0.001886	5.55	1460.93	800.00	0.42
1	4308		Culvert									
1	4297	2-Year	78.70	2011.20	2012.72		2012.80	0.001968	2.25	34.98	26.07	0.34
1	4297	5-Year	390.00	2011.20	2014.90		2015.13	0.002111	3.85	101.30	34.79	0.40
1	4297	10-Year	846.00	2011.20	2016.31	2014.58	2016.72	0.002685	5.27	212.23	459.77	0.47
1	4297	25-Year	1790.00	2011.20	2016.92		2017.22	0.002595	5.70	662.27	800.00	0.47
1	4297	50-Year	2950.00	2011.20	2017.29		2017.59	0.002841	6.29	958.56	800.00	0.50
1	4297	100-Year	4380.00	2011.20	2017.59		2017.94	0.003354	7.11	1200.55	800.00	0.55
1	4283	2-Year	78.70	2011.20	2012.69		2012.77	0.002121	2.31	34.13	25.94	0.35
1	4283	5-Year	390.00	2011.20	2014.86		2015.10	0.002187	3.90	100.06	34.65	0.40
1	4283	10-Year	846.00	2011.20	2016.23	2014.57	2016.68	0.002959	5.46	189.92	383.57	0.49
1	4283	25-Year	1790.00	2011.20	2016.88	2016.88	2017.19	0.002668	5.76	656.18	800.00	0.48
1	4283	50-Year	2950.00	2011.20	2017.16	2017.16	2017.54	0.003614	6.98	876.10	800.00	0.56
1	4283	100-Year	4380.00	2011.20	2017.41	2017.41	2017.88	0.004563	8.11	1077.96	800.00	0.64
1	4057	2-Year	78.70	2010.80	2012.28		2012.36	0.002168	2.32	33.88	25.90	0.36

HEC-RAS Plan: Proposed River: Carriza Creek Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	4057	5-Year	390.00	2010.80	2014.44	2012.91	2014.68	0.002243	3.93	99.17	34.55	0.41
1	4057	10-Year	846.00	2010.80	2014.18	2014.18	2015.54	0.013767	9.36	90.40	33.51	1.00
1	4057	25-Year	1790.00	2010.80	2016.25		2016.28	0.000314	2.03	1519.78	826.00	0.17
1	4057	50-Year	2950.00	2010.80	2016.75		2016.79	0.000395	2.44	1935.10	826.00	0.19
1	4057	100-Year	4380.00	2010.80	2017.30		2017.36	0.000442	2.76	2386.01	826.00	0.20
1	3548	2-Year	78.70	2009.70	2011.19		2011.27	0.002123	2.31	34.12	25.94	0.35
1	3548	5-Year	390.00	2009.70	2013.36	2011.81	2013.58	0.002065	3.80	136.04	673.98	0.39
1	3548	10-Year	846.00	2009.70	2014.28		2014.31	0.000456	2.15	772.76	706.28	0.19
1	3548	25-Year	1790.00	2009.70	2016.18		2016.20	0.000088	1.24	2143.10	721.00	0.09
1	3548	50-Year	2950.00	2009.70	2016.65		2016.67	0.000149	1.69	2478.61	721.00	0.12
1	3548	100-Year	4380.00	2009.70	2017.16		2017.20	0.000208	2.11	2849.14	721.00	0.14
1	3039	2-Year	78.70	2008.66	2010.15		2010.23	0.002100	2.30	34.24	25.96	0.35
1	3039	5-Year	390.00	2008.66	2012.20		2012.46	0.002475	4.07	95.83	34.16	0.43
1	3039	10-Year	846.00	2008.66	2012.95		2013.69	0.005787	6.91	122.50	37.15	0.67
1	3039	25-Year	1790.00	2008.66	2013.88	2013.88	2015.85	0.012429	11.26	159.02	40.89	1.01
1	3039	50-Year	2950.00	2008.66	2015.89	2015.89	2016.42	0.003190	7.25	746.52	591.00	0.54
1	3039	100-Year	4380.00	2008.66	2016.25	2016.25	2016.87	0.003888	8.34	958.04	591.00	0.60
1	2546	2-Year	78.70	2007.62	2009.11		2009.19	0.002117	2.30	34.15	25.95	0.35
1	2546	5-Year	390.00	2007.62	2011.20		2011.39	0.001835	3.69	139.40	180.52	0.37
1	2546	10-Year	846.00	2007.62	2012.08		2012.23	0.001455	3.90	398.86	407.37	0.35
1	2546	25-Year	1790.00	2007.62	2012.95		2013.07	0.001140	3.95	837.42	546.00	0.32
1	2546	50-Year	2950.00	2007.62	2013.64		2013.76	0.001011	4.07	1214.73	546.00	0.31
1	2546	100-Year	4380.00	2007.62	2014.24		2014.39	0.001056	4.45	1540.52	546.00	0.32
1	2050	2-Year	78.70	2006.58	2008.10		2008.18	0.001952	2.24	35.07	26.09	0.34
1	2050	5-Year	390.00	2006.58	2010.36		2010.54	0.001594	3.54	136.20	146.49	0.35
1	2050	10-Year	846.00	2006.58	2011.50		2011.62	0.001025	3.48	430.76	370.88	0.30
1	2050	25-Year	1790.00	2006.58	2012.40		2012.52	0.001044	3.99	846.12	548.87	0.31
1	2050	50-Year	2950.00	2006.58	2013.18		2013.29	0.000881	4.02	1316.78	624.00	0.29
1	2050	100-Year	4380.00	2006.58	2013.76		2013.89	0.000917	4.37	1679.82	624.00	0.30
1	1522	2-Year	78.70	2005.63	2007.12		2007.18	0.001823	2.04	38.55	31.89	0.33
1	1522	5-Year	390.00	2005.63	2009.79		2009.89	0.000921	2.56	152.22	53.25	0.27
1	1522	10-Year	846.00	2005.63	2011.04		2011.14	0.000781	2.89	474.93	533.11	0.26
1	1522	25-Year	1790.00	2005.63	2012.06		2012.12	0.000531	2.78	1135.31	704.00	0.22

HEC-RAS Plan: Proposed River: Carriza Creek Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	1522	50-Year	2950.00	2005.63	2012.90		2012.96	0.000422	2.76	1729.91	704.00	0.20
1	1522	100-Year	4380.00	2005.63	2013.44		2013.53	0.000502	3.20	2112.24	704.00	0.22
1	1019	2-Year	78.70	2004.72	2006.25		2006.31	0.001638	1.97	39.99	32.25	0.31
1	1019	5-Year	390.00	2004.72	2009.46		2009.53	0.000542	2.11	184.67	57.92	0.21
1	1019	10-Year	846.00	2004.72	2010.48		2010.66	0.001141	3.41	247.88	66.08	0.31
1	1019	25-Year	1790.00	2004.72	2010.81	2009.35	2011.49	0.003982	6.62	272.27	115.95	0.59
1	1019	50-Year	2950.00	2004.72	2011.87	2011.87	2012.45	0.003092	6.83	688.08	601.00	0.54
1	1019	100-Year	4380.00	2004.72	2012.29	2012.29	2012.94	0.003541	7.72	943.75	601.00	0.58
1	704	2-Year	78.70	2004.15	2005.83		2005.88	0.001173	1.75	44.86	33.43	0.27
1	704	5-Year	390.00	2004.15	2009.34		2009.39	0.000342	1.79	254.53	318.77	0.17
1	704	10-Year	846.00	2004.15	2010.44		2010.47	0.000246	1.82	797.37	607.55	0.15
1	704	25-Year	1790.00	2004.15	2010.87		2010.95	0.000538	2.86	1066.60	626.00	0.22
1	704	50-Year	2950.00	2004.15	2011.26		2011.38	0.000824	3.72	1310.14	626.00	0.28
1	704	100-Year	4380.00	2004.15	2011.72		2011.87	0.001021	4.37	1593.56	626.00	0.32
1	645.5	2-Year	78.70	2004.05	2005.77	2004.79	2005.81	0.001087	1.71	46.06	33.72	0.26
1	645.5	5-Year	390.00	2004.05	2009.33	2006.02	2009.37	0.000302	1.71	282.80	347.69	0.16
1	645.5	10-Year	846.00	2004.05	2010.43	2007.13	2010.46	0.000210	1.71	852.35	611.59	0.14
1	645.5	25-Year	1790.00	2004.05	2010.85	2008.68	2010.92	0.000478	2.73	1114.05	626.00	0.21
1	645.5	50-Year	2950.00	2004.05	2011.22	2010.17	2011.33	0.000760	3.60	1347.35	626.00	0.27
1	645.5	100-Year	4380.00	2004.05	2011.66	2010.53	2011.81	0.000966	4.27	1622.91	626.00	0.31
1	633.5		Culvert									
1	621.5	2-Year	78.70	2004.00	2005.50		2005.56	0.001765	2.02	38.98	31.99	0.32
1	621.5	5-Year	390.00	2004.00	2007.50		2007.66	0.001830	3.28	118.74	47.96	0.37
1	621.5	10-Year	846.00	2004.00	2008.49		2008.72	0.002049	4.17	302.49	404.87	0.41
1	621.5	25-Year	1790.00	2004.00	2009.19		2009.41	0.002039	4.74	664.29	584.16	0.42
1	621.5	50-Year	2950.00	2004.00	2009.70		2009.93	0.002119	5.24	968.61	611.81	0.44
1	621.5	100-Year	4380.00	2004.00	2010.17		2010.43	0.002223	5.73	1260.58	628.00	0.45
1	563	2-Year	78.70	2003.90	2005.40		2005.46	0.001784	2.03	38.84	31.96	0.32
1	563	5-Year	390.00	2003.90	2007.39		2007.56	0.001848	3.30	118.32	47.89	0.37
1	563	10-Year	846.00	2003.90	2008.32		2008.59	0.002373	4.42	274.98	381.76	0.44
1	563	25-Year	1790.00	2003.90	2009.04		2009.28	0.002264	4.95	635.41	581.47	0.44
1	563	50-Year	2950.00	2003.90	2009.55		2009.80	0.002312	5.43	937.69	609.06	0.46

HEC-RAS Plan: Proposed   River: Carriza Creek   Reach: 1 (Continued)

Reach	River Sta	Profile	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
			(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	563	100-Year	4380.00	2003.90	2010.01		2010.29	0.002425	5.94	1224.39	628.00	0.47
1	0	2-Year	78.70	2002.89	2004.38	2003.63	2004.45	0.001801	2.03	38.71	31.93	0.33
1	0	5-Year	390.00	2002.89	2006.36	2004.87	2006.53	0.001803	3.31	122.49	107.59	0.37
1	0	10-Year	846.00	2002.89	2007.21	2005.96	2007.40	0.001802	4.01	345.64	417.33	0.38
1	0	25-Year	1790.00	2002.89	2007.94	2007.48	2008.12	0.001803	4.57	747.67	683.44	0.40
1	0	50-Year	2950.00	2002.89	2008.44	2007.90	2008.62	0.001803	4.93	1121.96	775.00	0.41
1	0	100-Year	4380.00	2002.89	2008.88	2008.32	2009.08	0.001801	5.24	1467.46	775.00	0.41

HEC-RAS River: Carriza Creek Reach: 1 Profile: 2-Year

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	5093	2-Year	Proposed	78.70	2012.95	2014.44		2014.52	0.002112	2.30	34.17	25.95	0.35
1	5093	2-Year	Exist	78.70	2012.95	2014.46		2014.54	0.002003	2.26	34.78	26.04	0.35
1	4458	2-Year	Proposed	78.70	2011.62	2013.21		2013.29	0.001790	2.23	35.27	24.24	0.33
1	4458	2-Year	Exist	78.70	2011.62	2013.12		2013.21	0.002192	2.38	33.03	23.99	0.36
1	4319	2-Year	Proposed	78.70	2011.25	2012.96	2012.01	2013.02	0.001306	1.97	40.05	26.82	0.28
1	4319	2-Year	Exist	78.70	2011.25	2012.76		2012.84	0.002000	2.26	34.79	26.03	0.34
1	4308			Culvert									
1	4297	2-Year	Proposed	78.70	2011.20	2012.72		2012.80	0.001968	2.25	34.98	26.07	0.34
1	4297	2-Year	Exist	78.70	2011.20	2012.72		2012.80	0.001968	2.25	34.98	26.07	0.34
1	4283	2-Year	Proposed	78.70	2011.20	2012.69		2012.77	0.002121	2.31	34.13	25.94	0.35
1	4283	2-Year	Exist	78.70	2011.20	2012.69		2012.77	0.002121	2.31	34.13	25.94	0.35
1	4057	2-Year	Proposed	78.70	2010.80	2012.28		2012.36	0.002168	2.32	33.88	25.90	0.36
1	4057	2-Year	Exist	78.70	2010.80	2012.28		2012.36	0.002167	2.32	33.89	25.91	0.36
1	3548	2-Year	Proposed	78.70	2009.70	2011.19		2011.27	0.002123	2.31	34.12	25.94	0.35
1	3548	2-Year	Exist	78.70	2009.70	2011.19		2011.27	0.002122	2.31	34.12	25.94	0.35
1	3039	2-Year	Proposed	78.70	2008.66	2010.15		2010.23	0.002100	2.30	34.24	25.96	0.35
1	3039	2-Year	Exist	78.70	2008.66	2010.15		2010.23	0.002101	2.30	34.24	25.96	0.35
1	2546	2-Year	Proposed	78.70	2007.62	2009.11		2009.19	0.002117	2.30	34.15	25.95	0.35
1	2546	2-Year	Exist	78.70	2007.62	2009.11		2009.19	0.002116	2.30	34.15	25.95	0.35
1	2050	2-Year	Proposed	78.70	2006.58	2008.10		2008.18	0.001952	2.24	35.07	26.09	0.34
1	2050	2-Year	Exist	78.70	2006.58	2008.10		2008.18	0.001955	2.24	35.06	26.09	0.34
1	1522	2-Year	Proposed	78.70	2005.63	2007.12		2007.18	0.001823	2.04	38.55	31.89	0.33
1	1522	2-Year	Exist	78.70	2005.63	2007.12		2007.19	0.001799	2.03	38.72	31.93	0.33
1	1019	2-Year	Proposed	78.70	2004.72	2006.25		2006.31	0.001638	1.97	39.99	32.25	0.31
1	1019	2-Year	Exist	78.70	2004.72	2006.21		2006.27	0.001817	2.04	38.59	31.90	0.33
1	704	2-Year	Proposed	78.70	2004.15	2005.83		2005.88	0.001173	1.75	44.86	33.43	0.27
1	704	2-Year	Exist	78.70	2004.15	2005.64		2005.71	0.001788	2.03	38.80	31.95	0.32

HEC-RAS River: Carriza Creek Reach: 1 Profile: 2-Year (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	645.5	2-Year	Proposed	78.70	2004.05	2005.77	2004.79	2005.81	0.001087	1.71	46.06	33.72	0.26
1	645.5	2-Year	Exist	78.70	2004.05	2005.54		2005.60	0.001815	2.04	38.61	31.90	0.33
1	633.5			Culvert									
1	621.5	2-Year	Proposed	78.70	2004.00	2005.50		2005.56	0.001765	2.02	38.98	31.99	0.32
1	621.5	2-Year	Exist	78.70	2004.00	2005.50		2005.56	0.001765	2.02	38.98	31.99	0.32
1	563	2-Year	Proposed	78.70	2003.90	2005.40		2005.46	0.001784	2.03	38.84	31.96	0.32
1	563	2-Year	Exist	78.70	2003.90	2005.40		2005.46	0.001784	2.03	38.84	31.96	0.32
1	0	2-Year	Proposed	78.70	2002.89	2004.38	2003.63	2004.45	0.001801	2.03	38.71	31.93	0.33
1	0	2-Year	Exist	78.70	2002.89	2004.38	2003.63	2004.45	0.001801	2.03	38.71	31.93	0.33

HEC-RAS   River: Carriza Creek   Reach: 1   Profile: 100-Year

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	5093	100-Year	Proposed	4380.00	2012.95	2018.92		2019.03	0.000876	3.74	1805.60	697.00	0.28
1	5093	100-Year	Exist	4380.00	2012.95	2018.90		2019.00	0.000907	3.79	1786.28	697.00	0.29
1	4458	100-Year	Proposed	4380.00	2011.62	2018.31		2018.42	0.001037	4.15	1839.50	850.00	0.30
1	4458	100-Year	Exist	4380.00	2011.62	2018.22		2018.34	0.001182	4.38	1764.79	850.00	0.32
1	4319	100-Year	Proposed	4380.00	2011.25	2017.97	2017.47	2018.17	0.001886	5.55	1460.93	800.00	0.42
1	4319	100-Year	Exist	4380.00	2011.25	2017.69		2018.01	0.003056	6.83	1240.13	800.00	0.53
1	4308			Culvert									
1	4297	100-Year	Proposed	4380.00	2011.20	2017.59		2017.94	0.003354	7.11	1200.55	800.00	0.55
1	4297	100-Year	Exist	4380.00	2011.20	2017.59		2017.94	0.003354	7.11	1200.55	800.00	0.55
1	4283	100-Year	Proposed	4380.00	2011.20	2017.41	2017.41	2017.88	0.004563	8.11	1077.96	800.00	0.64
1	4283	100-Year	Exist	4380.00	2011.20	2017.41	2017.41	2017.88	0.004563	8.11	1077.96	800.00	0.64
1	4057	100-Year	Proposed	4380.00	2010.80	2017.30		2017.36	0.000442	2.76	2386.01	826.00	0.20
1	4057	100-Year	Exist	4380.00	2010.80	2017.30		2017.36	0.000442	2.76	2386.01	826.00	0.20
1	3548	100-Year	Proposed	4380.00	2009.70	2017.16		2017.20	0.000208	2.11	2849.14	721.00	0.14
1	3548	100-Year	Exist	4380.00	2009.70	2017.16		2017.20	0.000208	2.11	2849.14	721.00	0.14
1	3039	100-Year	Proposed	4380.00	2008.66	2016.25	2016.25	2016.87	0.003888	8.34	958.04	591.00	0.60
1	3039	100-Year	Exist	4380.00	2008.66	2016.25	2016.25	2016.87	0.003888	8.34	958.04	591.00	0.60
1	2546	100-Year	Proposed	4380.00	2007.62	2014.24		2014.39	0.001056	4.45	1540.52	546.00	0.32
1	2546	100-Year	Exist	4380.00	2007.62	2014.24		2014.39	0.001056	4.45	1540.58	546.00	0.32
1	2050	100-Year	Proposed	4380.00	2006.58	2013.76		2013.89	0.000917	4.37	1679.82	624.00	0.30
1	2050	100-Year	Exist	4380.00	2006.58	2013.76		2013.89	0.000917	4.37	1679.90	624.00	0.30
1	1522	100-Year	Proposed	4380.00	2005.63	2013.44		2013.53	0.000502	3.20	2112.24	704.00	0.22
1	1522	100-Year	Exist	4380.00	2005.63	2013.45		2013.53	0.000502	3.19	2112.41	704.00	0.22
1	1019	100-Year	Proposed	4380.00	2004.72	2012.29	2012.29	2012.94	0.003541	7.72	943.75	601.00	0.58
1	1019	100-Year	Exist	4380.00	2004.72	2012.29	2012.29	2012.94	0.003541	7.72	943.75	601.00	0.58
1	704	100-Year	Proposed	4380.00	2004.15	2011.72		2011.87	0.001021	4.37	1593.56	626.00	0.32
1	704	100-Year	Exist	4380.00	2004.15	2011.06		2011.40	0.002411	6.21	1185.35	626.00	0.48

HEC-RAS River: Carriza Creek Reach: 1 Profile: 100-Year (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
1	645.5	100-Year	Proposed	4380.00	2004.05	2011.66	2010.53	2011.81	0.000966	4.27	1622.91	626.00	0.31
1	645.5	100-Year	Exist	4380.00	2004.05	2010.53	2010.53	2011.18	0.004752	8.23	914.93	616.16	0.66
1	633.5			Culvert									
1	621.5	100-Year	Proposed	4380.00	2004.00	2010.17		2010.43	0.002223	5.73	1260.58	628.00	0.45
1	621.5	100-Year	Exist	4380.00	2004.00	2010.17		2010.43	0.002223	5.73	1260.58	628.00	0.45
1	563	100-Year	Proposed	4380.00	2003.90	2010.01		2010.29	0.002425	5.94	1224.39	628.00	0.47
1	563	100-Year	Exist	4380.00	2003.90	2010.01		2010.29	0.002425	5.94	1224.39	628.00	0.47
1	0	100-Year	Proposed	4380.00	2002.89	2008.88	2008.32	2009.08	0.001801	5.24	1467.46	775.00	0.41
1	0	100-Year	Exist	4380.00	2002.89	2008.88	2008.32	2009.08	0.001801	5.24	1467.46	775.00	0.41

CALIFORNIA SERENGETI CORP
12900 Soda lake Road (P.O. Box 3058)
Santa Margarita, CA. 93453
Tel.805-475-2200, Lodge 805-475-2363
Fax 805-475-2203

Please Note enclosed is information about water studies that we have done In California Valley, CA and we are happy to share them with you. Info includes Triton's Report of 2002 and some New well reports after that study, if you have any question please feel free to call me at Lodge Number 805-475-2363.

Sincerely

Kenneth Tab 3/19/2008

Kenneth Tab, president

Creek Environmental Laboratories, Inc. Chain-of-Custody

141 Suburban Road, Suite C-5, San Luis Obispo, CA 93401 phone (805) 545-9838 fax (805) 545-0107 www.creeklabs.com sales@creeklabs.com

Order # 06253

Dec. 17. 2007 4:09PM Creek Environmental 805 545 0107 No. 2692 P. 1

• Please Print in Pen Corp. ☐ DW EDT ☐ LUFT EDF ☐ Custom EDD

Client Name California Serengetti	Contact Kenneth Talo	Phone 475-2363	Due Date: 24Hr 48Hr Other (Normal TAT)
Address P.O. Box 3098 City Santa Margarita State CA Zip 93453		Fax 475-2203	Cell Beeper
Project Name/Number 12900 Soda Lake Road		PO#	Copies To:
Bill to: (if different from above) Address		City	State Zip
Sampler Name (Print) Kennith Talo	Comments: $1,000 deposit/advance received ck#1161. 11-29-07		Matrix Key: DW = Drinking Water AQ = Aqueous SL = Soil/Solid

Sample Description	Date/Time Sampled	Analysis	Matrix	# of Bottles	Preservative / Type Bottles	Creek Lab Sample #
072 201 008 N (Glade)	11-29-07 1500	GMPI, Coliform Bacteria P/A	DW	5	1QP unp - A; 8oz P HNO3 - B; ~~8oz P NaOH - C~~; 8oz G unp - D; BT - E	15400
Unit 31 Lot 149	11-29-07 1000	↓	↓	↓	↓	15401
Unit 31 Lot 164	"	↓	↓	↓	↓	15402
072 201 008 S (Gaviota)	11-29-07 1500	↓	↓	↓	↓	15403
072 201 023 (Motel)	11-29-07 1030	↓	↓	↓	↓	15404

RELINQUISHED BY (Sign)	(Print)	(Organization)	DATE/TIME	RECEIVED BY (Sign)	(Print)	(Organization)
Kenneth Talo			11-29-07 1230	[signature]	RO	Creek Environmental Laboratories, Inc.

FOR LAB USE ONLY: Shipping Method: (Client)/ Lab/ Courier: Sample Conditions: **Temp:** 16 Intact: (Y)/N Custody Sealed: Y/(N)

REMARKS $350/ea.

Creek Environmental Laboratories, Inc. — Chain-of-Custody

141 Suburban Road, Suite C-5, San Luis Obispo, CA 93401 phone (805) 545-9838 fax (805) 545-0107 www.creeklabs.com sales@creeklabs.com

Order # 0627

Dec. 18. 2007 1:43PM Creek Environmental 805 545 0107 No. 2718 P. 1

• Please Print in Pen ☐ DW EDT ☐ LUFT EDF ☐ Custom EDD

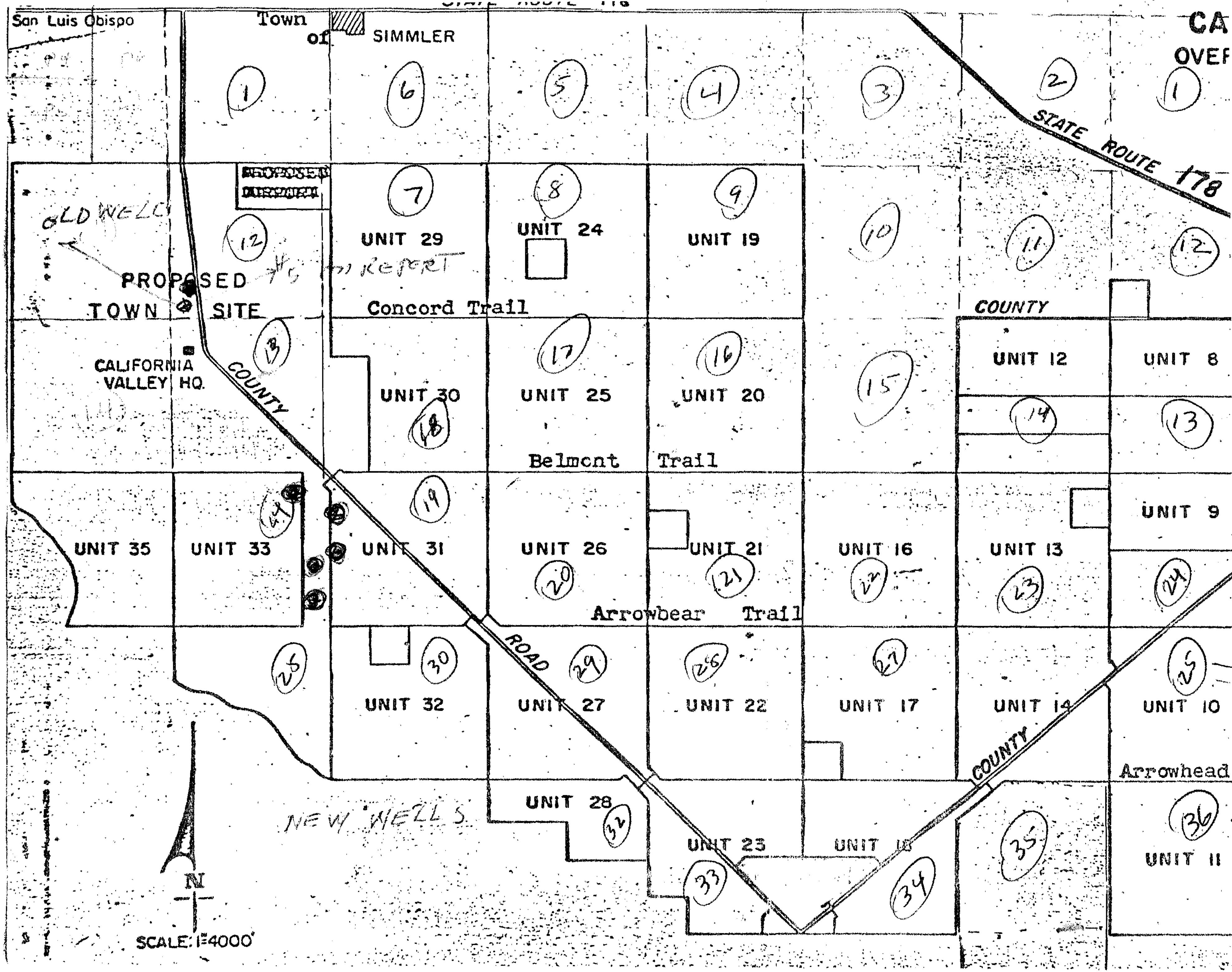
Client Name: California Serengeti	Contact	Phone	Due Date: 24Hr 48Hr Other Normal TAT
Address / City / State / Zip		Fax	Cell / Beeper
Project Name/Number		PO#	Copies To:
Bill to: (if different from above)	Address / City		State / Zip
Sampler Name (Print): KENNETH TAB	Comments:		Matrix Key: DW = Drinking Water, AQ = Aqueous, SL = Soil/Solid

Sample Description	Date/Time Sampled	Analysis	Matrix	# of Bottles	Preservative / Type Bottles	Creek Lab Sample #
Unit 33 Lot 29	11/29/07 6:30	GMPI & P/A	DW	5		15458
Motel Room 14	11/30/07 8:30	P/A	DW	1	BJ	15459
Restarant Sink	11/30/07 8:30	"	DW	1	"	15460
Restarant Rest Room	11/30/07 8:30	"	DW	1	"	15461
Store Sink	11/30/07 8:30	"	DW	1	"	15462

RELINQUISHED BY (Sign)	(Print)	(Organization)	DATE/TIME	RECEIVED BY (Sign)	(Print)	(Organization)
Kenneth Tab	KENNETH TAB		11/30/07 10:20	[signature]	D Osborne	
						Creek Environmental Laboratories, Inc.

FOR LAB USE ONLY: Shipping Method: (Client) / Lab / Courier: Sample Conditions: **Temp:** 12° Intact: (Y) / N Custody Sealed: Y / (N)

REMARKS



STATE ROUTE 178
San Luis Obispo
Town of SIMMLER
CA
OVER
STATE ROUTE 178
OLD WELL
PROPOSED TOWN SITE
#5 in REPORT
CALIFORNIA VALLEY HQ.
UNIT 29
UNIT 24
UNIT 19
Concord Trail
COUNTY
UNIT 12
UNIT 8
UNIT 30
UNIT 25
UNIT 20
Belmont Trail
UNIT 35
UNIT 33
UNIT 31
UNIT 26
UNIT 21
UNIT 16
UNIT 13
UNIT 9
Arrowbear Trail
COUNTY ROAD
UNIT 32
UNIT 27
UNIT 22
UNIT 17
UNIT 14
UNIT 10
COUNTY
Arrowhead
UNIT 28
NEW WELLS
UNIT 23
UNIT 18
UNIT 11
N
SCALE: 1"=4000'

CREEK ENVIRONMENTAL LABORATORIES, INC.
A Minority-owned Business Enterprise
141 SUBURBAN ROAD, SUITE C-5 • SAN LUIS OBISPO, CA 93401 • (805) 545-9838 • FAX (805) 545-0107

COMMERCIAL WELL SUPPLYING MOTEL
& RESTAURNT ~~and~~ and OTHERS
#5 AT TRITON REPORT of 2002

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15404
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
072 201 023 (Motel)	Kenneth Tab	11/29/07@10:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Carbonate Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Bicarbonate Alkalinity as CaCO3	190	2	1	mg/L	SM 2320B	12/10/07		2344
Hydroxide Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Total Alkalinity as CaCO3	190	2	1	mg/L	SM 2320B	12/10/07		2344
Chloride	30	1	1	mg/L	EPA 300.0	11/29/07		1998
Total Cyanide	Not Detected	0.005	1	mg/L	SM 4500-CN C,E	12/10/07	12/10/07	2328
Color	Not Detected	1	1	units	SM 2120B	11/29/07		1966
Electrical Conductance	650	1	1	umhos/cm	SM 2510 B	11/29/07		1966
Fluoride	0.5	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Langlier Index (Corrosivity)	0.1	---	1	pH units	SM 2330B	12/14/07		2542
MBAS(Anionic Surfactants MW=340)	Not Detected	0.05	1	mg/L	SM 5540 C	11/30/07	11/30/07	2040
Nitrate as N	5.3	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Nitrate as NO3	23	0.4	1	mg/L	EPA 300.0			
Nitrite as N	Not Detected	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Odor	Not Detected	1	1	TON	SM 2150B	11/29/07		1966
pH	7.7	0.1	1	pH units	SM 4500-H B	11/29/07		1966
Sulfate	75	0.5	1	mg/L	EPA 300.0	11/29/07		1998
Total Dissolved Solids	410	10	1	mg/L	SM 2540 C	12/04/07		2209
Turbidity	0.1	0.1	1	NTU	SM 2130 B	11/29/07		1966
Total Coliform Bacteria	Absent	---	NA		SM 9223	11/29/07		1990
Calcium	44	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Hardness	190	1	NA	mg/L CaCO3	EPA 200.7			
Iron	0.07	0.02	1	mg/L	EPA 200.7	12/13/07		2523
Mercury	Not Detected	0.001	1	mg/L	EPA 245.1	12/06/07	12/5/07	2220
Potassium	1.6	0.1	1	mg/L	EPA 200.7	12/13/07		2523
Magnesium	19	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Sodium	76	0.05	1	mg/L	EPA 200.7	12/13/07		2523
Aluminum	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2564
Antimony	Not Detected	0.006	1	mg/L	EPA 200.8	12/10/07		2363

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Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15404
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
072 201 023 (Motel)	Kenneth Tab	11/29/07@10:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Arsenic	Not Detected	0.002	1	mg/L	EPA 200.8	12/10/07		2363
Barium	Not Detected	0.1	1	mg/L	EPA 200.8	12/10/07		2363
Beryllium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Cadmium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Chromium	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Copper	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363
Lead	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Manganese	Not Detected	0.02	1	mg/L	EPA 200.8	12/10/07		2363
Nickel	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Selenium	0.005	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Silver	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Thallium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Zinc	0.25	0.05	1	mg/L	EPA 200.8	12/10/07		2363

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

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PARCEL 072-201-008
WELL #1

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15400
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
072 201 008 N (Glade)	Kenneth Tab	11/28/07@15:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Carbonate Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Bicarbonate Alkalinity as CaCO3	180	2	1	mg/L	SM 2320B	12/10/07		2344
Hydroxide Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Total Alkalinity as CaCO3	180	2	1	mg/L	SM 2320B	12/10/07		2344
Chloride	28	1	1	mg/L	EPA 300.0	11/29/07		1998
Total Cyanide	Not Detected	0.005	1	mg/L	SM 4500-CN C,E	12/10/07	12/07/07	2323
Color	Not Detected	1	1	units	SM 2120B	11/29/07		1966
Electrical Conductance	910	1	1	umhos/cm	SM 2510 B	11/29/07		1966
Fluoride	1.3	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Langlier Index (Corrosivity)	0.0	---	1	pH units	SM 2330B	12/14/07		2542
MBAS(Anionic Surfactants MW=340)	Not Detected	0.05	1	mg/L	SM 5540 C	11/30/07	11/30/07	2040
Nitrate as N	4.5	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Nitrate as NO3	20	0.4	1	mg/L	EPA 300.0			
Nitrite as N	Not Detected	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Odor	Not Detected	1	1	TON	SM 2150B	11/29/07		1966
pH	7.5	0.1	1	pH units	SM 4500-H B	11/29/07		1966
Sulfate	220	0.5	1	mg/L	EPA 300.0	11/29/07		1998
Total Dissolved Solids	600	10	1	mg/L	SM 2540 C	12/04/07		2209
Turbidity	0.3	0.1	1	NTU	SM 2130 B	11/29/07		1966
Total Coliform Bacteria	Present	---	NA		SM 9223	11/29/07		1990
E. coli	Absent	---	NA		SM 9223	11/29/07		1990
Calcium	60	0.2	5	mg/L	EPA 200.7	12/11/07		2404
Hardness	230	1	NA	mg/L CaCO3	EPA 200.7			
Iron	Not Detected	0.1	5	mg/L	EPA 200.7	12/11/07		2404
Mercury	Not Detected	0.001	1	mg/L	EPA 245.1	12/06/07	12/5/07	2220
Potassium	1.4	0.5	5	mg/L	EPA 200.7	12/11/07		2404
Magnesium	19	0.2	5	mg/L	EPA 200.7	12/11/07		2404
Sodium	120	0.2	5	mg/L	EPA 200.7	12/11/07		2404
Aluminum	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2564

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Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15400
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
072 201 008 N (Glade)	Kenneth Tab	11/28/07@15:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Antimony	Not Detected	0.006	1	mg/L	EPA 200.8	12/10/07		2363
Arsenic	Not Detected	0.002	1	mg/L	EPA 200.8	12/10/07		2363
Barium	Not Detected	0.1	1	mg/L	EPA 200.8	12/10/07		2363
Beryllium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Cadmium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Chromium	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Copper	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363
Lead	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Manganese	Not Detected	0.02	1	mg/L	EPA 200.8	12/10/07		2363
Nickel	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Selenium	0.008	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Silver	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Thallium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Zinc	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

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WELL #2 PARCEL #072-201-008

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15403
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
072 201 008 S (Gaviota)	Kenneth Tab	11/28/07@15:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Carbonate Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Bicarbonate Alkalinity as CaCO3	150	2	1	mg/L	SM 2320B	12/10/07		2344
Hydroxide Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Total Alkalinity as CaCO3	150	2	1	mg/L	SM 2320B	12/10/07		2344
Chloride	48	1	1	mg/L	EPA 300.0	11/29/07		1998
Total Cyanide	Not Detected	0.005	1	mg/L	SM 4500-CN C,E	12/10/07	12/07/07	2323
Color	10	1	1	units	SM 2120B	11/29/07		1966
Electrical Conductance	830	1	1	umhos/cm	SM 2510 B	11/29/07		1966
Fluoride	1.0	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Langlier Index (Corrosivity)	0.1	---	1	pH units	SM 2330B	12/14/07		2542
MBAS(Anionic Surfactants MW=340)	Not Detected	0.05	1	mg/L	SM 5540 C	11/30/07	11/30/07	2040
Nitrate as N	8.3	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Nitrate as NO3	37	0.4	1	mg/L	EPA 300.0			
Nitrite as N	Not Detected	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Odor	Not Detected	1	1	TON	SM 2150B	11/29/07		1966
pH	7.6	0.1	1	pH units	SM 4500-H B	11/29/07		1966
Sulfate	170	0.5	1	mg/L	EPA 300.0	11/29/07		1998
Total Dissolved Solids	550	10	1	mg/L	SM 2540 C	12/04/07		2209
Turbidity	8.0	0.1	1	NTU	SM 2130 B	11/29/07		1966
Total Coliform Bacteria	Present	---	NA		SM 9223	11/29/07		1990
E. coli	Absent	---	NA		SM 9223	11/29/07		1990
Calcium	69	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Hardness	290	1	NA	mg/L CaCO3	EPA 200.7			
Iron	0.16	0.02	1	mg/L	EPA 200.7	12/13/07		2523
Mercury	Not Detected	0.001	1	mg/L	EPA 245.1	12/06/07	12/5/07	2220
Potassium	1.9	0.1	1	mg/L	EPA 200.7	12/13/07		2523
Magnesium	29	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Sodium	62	0.05	1	mg/L	EPA 200.7	12/13/07		2523
Aluminum	0.17	0.05	1	mg/L	EPA 200.8	12/10/07		2564

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Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15403
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
072 201 008 S (Gaviota)	Kenneth Tab	11/28/07@15:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Antimony	Not Detected	0.006	1	mg/L	EPA 200.8	12/10/07		2363
Arsenic	Not Detected	0.002	1	mg/L	EPA 200.8	12/10/07		2363
Barium	Not Detected	0.1	1	mg/L	EPA 200.8	12/10/07		2363
Beryllium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Cadmium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Chromium	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Copper	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363
Lead	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Manganese	Not Detected	0.02	1	mg/L	EPA 200.8	12/10/07		2363
Nickel	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Selenium	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Silver	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Thallium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Zinc	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

CREEK ENVIRONMENTAL LABORATORIES, INC.
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UNIT 31 LOT 149

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15401
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Unit 31 Lot 149	Kenneth Tab	11/29/07@10:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Carbonate Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Bicarbonate Alkalinity as CaCO3	150	2	1	mg/L	SM 2320B	12/10/07		2344
Hydroxide Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Total Alkalinity as CaCO3	150	2	1	mg/L	SM 2320B	12/10/07		2344
Chloride	81	1	1	mg/L	EPA 300.0	11/29/07		1998
Total Cyanide	Not Detected	0.005	1	mg/L	SM 4500-CN C,E	12/10/07	12/07/07	2323
Color	Not Detected	1	1	units	SM 2120B	11/29/07		1966
Electrical Conductance	2,200	1	1	umhos/cm	SM 2510 B	11/29/07		1966
Fluoride	1.1	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Langlier Index (Corrosivity)	0.4	---	1	pH units	SM 2330B	12/14/07		2542
MBAS(Anionic Surfactants MW=340)	Not Detected	0.05	1	mg/L	SM 5540 C	11/30/07	11/30/07	2040
Nitrate as N	6.6	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Nitrate as NO3	29	0.4	1	mg/L	EPA 300.0			
Nitrite as N	Not Detected	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Odor	Not Detected	1	1	TON	SM 2150B	11/29/07		1966
pH	7.5	0.1	1	pH units	SM 4500-H B	11/29/07		1966
Sulfate	1,000	5	10	mg/L	EPA 300.0	12/03/07		2077
Total Dissolved Solids	1,800	10	1	mg/L	SM 2540 C	12/04/07		2209
Turbidity	0.3	0.1	1	NTU	SM 2130 B	11/29/07		1966
Total Coliform Bacteria	Present	---	NA		SM 9223	11/29/07		1990
E. coli	Absent	---	NA		SM 9223	11/29/07		1990
Calcium	180	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Hardness	760	1	NA	mg/L CaCO3	EPA 200.7			
Iron	Not Detected	0.02	1	mg/L	EPA 200.7	12/13/07		2523
Mercury	Not Detected	0.001	1	mg/L	EPA 245.1	12/06/07	12/5/07	2220
Potassium	1.7	0.1	1	mg/L	EPA 200.7	12/13/07		2523
Magnesium	75	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Sodium	270	0.05	1	mg/L	EPA 200.7	12/13/07		2523
Aluminum	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2564

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Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15401
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Unit 31 Lot 149	Kenneth Tab	11/29/07@10:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Antimony	Not Detected	0.006	1	mg/L	EPA 200.8	12/10/07		2363
Arsenic	0.002	0.002	1	mg/L	EPA 200.8	12/10/07		2363
Barium	Not Detected	0.1	1	mg/L	EPA 200.8	12/10/07		2363
Beryllium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Cadmium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Chromium	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Copper	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363
Lead	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Manganese	0.04	0.02	1	mg/L	EPA 200.8	12/10/07		2363
Nickel	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Selenium	0.015	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Silver	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Thallium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Zinc	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

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UNIT 31 LOT 164

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15402
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Unit 31 Lot 164	Kenneth Tab	11/29/07@10:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Carbonate Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Bicarbonate Alkalinity as CaCO3	170	2	1	mg/L	SM 2320B	12/10/07		2344
Hydroxide Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/10/07		2344
Total Alkalinity as CaCO3	170	2	1	mg/L	SM 2320B	12/10/07		2344
Chloride	34	1	1	mg/L	EPA 300.0	11/29/07		1998
Total Cyanide	Not Detected	0.005	1	mg/L	SM 4500-CN C,E	12/10/07	12/07/07	2323
Color	Not Detected	1	1	units	SM 2120B	11/29/07		1966
Electrical Conductance	1,200	1	1	umhos/cm	SM 2510 B	11/29/07		1966
Fluoride	1.3	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Langlier Index (Corrosivity)	0.3	---	1	pH units	SM 2330B	12/14/07		2542
MBAS(Anionic Surfactants MW=340)	Not Detected	0.05	1	mg/L	SM 5540 C	11/30/07	11/30/07	2040
Nitrate as N	3.4	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Nitrate as NO3	15	0.4	1	mg/L	EPA 300.0			
Nitrite as N	Not Detected	0.1	1	mg/L	EPA 300.0	11/29/07		1998
Odor	Not Detected	1	1	TON	SM 2150B	11/29/07		1966
pH	7.6	0.1	1	pH units	SM 4500-H B	11/29/07		1966
Sulfate	420	5	10	mg/L	EPA 300.0	12/03/07		2077
Total Dissolved Solids	870	10	1	mg/L	SM 2540 C	12/04/07		2209
Turbidity	0.5	0.1	1	NTU	SM 2130 B	11/29/07		1966
Total Coliform Bacteria	Present	---	NA		SM 9223	11/29/07		1990
E. coli	Absent	---	NA		SM 9223	11/29/07		1990
Calcium	92	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Hardness	360	1	NA	mg/L CaCO3	EPA 200.7			
Iron	Not Detected	0.02	1	mg/L	EPA 200.7	12/13/07		2523
Mercury	Not Detected	0.001	1	mg/L	EPA 245.1	12/06/07	12/5/07	2220
Potassium	1.8	0.1	1	mg/L	EPA 200.7	12/13/07		2523
Magnesium	32	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Sodium	150	0.05	1	mg/L	EPA 200.7	12/13/07		2523
Aluminum	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2564

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Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15402
Order: 06253
Project: 12900 Soda Lake Road
Received: 11/29/07
Printed: 12/17/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Unit 31 Lot 164	Kenneth Tab	11/29/07@10:00	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Antimony	Not Detected	0.006	1	mg/L	EPA 200.8	12/10/07		2363
Arsenic	Not Detected	0.002	1	mg/L	EPA 200.8	12/10/07		2363
Barium	Not Detected	0.1	1	mg/L	EPA 200.8	12/10/07		2363
Beryllium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Cadmium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Chromium	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Copper	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363
Lead	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Manganese	Not Detected	0.02	1	mg/L	EPA 200.8	12/10/07		2363
Nickel	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Selenium	0.006	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Silver	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Thallium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Zinc	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

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UNIT 33 LOT 27

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15458
Order: 06279
Received: 11/30/07
Printed: 12/18/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Unit 33 Lot 27	Kenneth Tab	11/29/07@16:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Carbonate Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/11/07		2346
Bicarbonate Alkalinity as CaCO3	160	2	1	mg/L	SM 2320B	12/11/07		2346
Hydroxide Alkalinity as CaCO3	Not Detected	2	1	mg/L	SM 2320B	12/11/07		2346
Total Alkalinity as CaCO3	160	2	1	mg/L	SM 2320B	12/11/07		2346
Chloride	70	1	1	mg/L	EPA 300.0	11/30/07		2030
Total Cyanide	Not Detected	0.005	1	mg/L	SM 4500-CN C,E	12/10/07	12/10/07	2328
Color	Not Detected	1	1	units	SM 2120B	11/30/07		2069
Electrical Conductance	1,800	1	1	umhos/cm	SM 2510 B	11/30/07		2069
Fluoride	1.1	0.1	1	mg/L	EPA 300.0	11/30/07		2030
Langlier Index (Corrosivity)	0.4	---	1	pH units	SM 2330B	12/14/07		2544
MBAS(Anionic Surfactants MW=340)	Not Detected	0.05	1	mg/L	SM 5540 C	11/30/07	11/30/07	2040
Nitrate as N	6.6	0.1	1	mg/L	EPA 300.0	11/30/07		2030
Nitrate as NO3	29	0.4	1	mg/L	EPA 300.0			
Nitrite as N	Not Detected	0.1	1	mg/L	EPA 300.0	11/30/07		2030
Odor	Not Detected	1	1	TON	SM 2150B	11/30/07		2069
pH	7.6	0.1	1	pH units	SM 4500-H B	11/30/07		2069
Sulfate	720	5	10	mg/L	EPA 300.0	12/03/07		2077
Total Dissolved Solids	1,300	10	1	mg/L	SM 2540 C	12/05/07		2343
Turbidity	2.1	0.1	1	NTU	SM 2130 B	11/30/07		2069
Total Coliform Bacteria	Absent	---	NA		SM 9223	11/30/07		2037
Calcium	120	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Hardness	520	1	NA	mg/L CaCO3	EPA 200.7			
Iron	0.02	0.02	1	mg/L	EPA 200.7	12/13/07		2523
Mercury	Not Detected	0.001	1	mg/L	EPA 245.1	12/06/07	12/5/07	2220
Potassium	0.8	0.1	1	mg/L	EPA 200.7	12/13/07		2523
Magnesium	51	0.03	1	mg/L	EPA 200.7	12/13/07		2523
Sodium	220	0.05	1	mg/L	EPA 200.7	12/13/07		2523
Aluminum	Not Detected	0.05	1	mg/L	EPA 200.8	12/17/07		2631
Antimony	Not Detected	0.006	1	mg/L	EPA 200.8	12/10/07		2363
Arsenic	Not Detected	0.002	1	mg/L	EPA 200.8	12/10/07		2363

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Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15458
Order: 06279
Received: 11/30/07
Printed: 12/18/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Unit 33 Lot 29	Kenneth Tab	11/29/07@16:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Barium	Not Detected	0.1	1	mg/L	EPA 200.8	12/10/07		2363
Beryllium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Cadmium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Chromium	0.01	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Copper	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363
Lead	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Manganese	Not Detected	0.02	1	mg/L	EPA 200.8	12/10/07		2363
Nickel	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Selenium	Not Detected	0.005	1	mg/L	EPA 200.8	12/10/07		2363
Silver	Not Detected	0.01	1	mg/L	EPA 200.8	12/10/07		2363
Thallium	Not Detected	0.001	1	mg/L	EPA 200.8	12/10/07		2363
Zinc	Not Detected	0.05	1	mg/L	EPA 200.8	12/10/07		2363

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

CREEK ENVIRONMENTAL LABORATORIES, INC.
A Minority-owned Business Enterprise
141 SUBURBAN ROAD, SUITE C-5 • SAN LUIS OBISPO, CA 93401 • (805) 545-9838 • FAX (805) 545-0107

MOTEL ROOM 14

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15459
Order: 06279
Received: 11/30/07
Printed: 12/18/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Motel Room 14	Kenneth Tab	11/30/07@08:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Total Coliform Bacteria	Absent	---	NA		SM 9223	11/30/07		2037

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

CREEK ENVIRONMENTAL LABORATORIES, INC.
A Minority-owned Business Enterprise
141 SUBURBAN ROAD, SUITE C-5 • SAN LUIS OBISPO, CA 93401 • (805) 545-9838 • FAX (805) 545-0107

RESTAURANT SINK

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15460
Order: 06279
Received: 11/30/07
Printed: 12/18/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Restaurant Sink	Kenneth Tab	11/30/07@08:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Total Coliform Bacteria	Absent	---	NA		SM 9223	11/30/07		2037

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

CREEK ENVIRONMENTAL LABORATORIES, INC.
A Minority-owned Business Enterprise
141 SUBURBAN ROAD, SUITE C-5 • SAN LUIS OBISPO, CA 93401 • (805) 545-9838 • FAX (805) 545-0107

RESTAURANT RESTROOM

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15461
Order: 06279
Received: 11/30/07
Printed: 12/18/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Restaurant Rest Room	Kenneth Tab	11/30/07@08:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Total Coliform Bacteria	Absent	---	NA		SM 9223	11/30/07		2037

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

CREEK ENVIRONMENTAL LABORATORIES, INC.
A Minority-owned Business Enterprise
141 SUBURBAN ROAD, SUITE C-5 • SAN LUIS OBISPO, CA 93401 • (805) 545-9838 • FAX (805) 545-0107

STORE SINK

Kenneth Tab
California Serengetti
P.O. Box 3058
Santa Margarita, CA 93453

Log Number: 07-C15462
Order: 06279
Received: 11/30/07
Printed: 12/18/07

REPORT OF ANALYTICAL RESULTS

Sample Description	Sampled By	Sampled Date @ Time	Matrix
Store Sink	Kenneth Tab	11/30/07@08:30	Drinking Water

Analyte	Result	DLR	Dilution Factor	Units	Method	Date Analyzed	Date Prepared	Batch
Total Coliform Bacteria	Absent	---	NA		SM 9223	11/30/07		2037

DLR = Detection Limit for Reporting. Results of "Not Detected" are below DLR.

CREEK ENVIRONMENTAL LABORATORIES

Lab Director, Michael Ng

Filipponi &
Thompson
Drilling Inc.

STATE LICENSE NO. C57 432680
P.O. Box 845 • ATASCADERO, CA 93423 • PHONE 466-1271

December 4, 2007

Kenny Tab
P.O. Box 3058
Santa Margarita, CA 93453

Re: 13531 Soda Lake Road - CA Valley - APN - 072-201-008 - Glade Trail Site
4.0 Hour Test Pump + 1.0 Hour Recovery

Date	Time	Flow Rate	Water Level
11/28/07	10:40 a.m.		11.9
	10:42	30	23.5
	10:45	30	24.7
	10:50	30	25.2
	11:00	30	25.6
	11:15	30	25.7
	12:40 p.m.	30	26.2
	1:00	30	26.2
	2:00	30	26.7
	2:40	30	26.8

RECOVERY DATA

Date	Time	Water Level
11/28/07	2:40 p.m.	26.8
	2:42	13.3
	2:45	12.9
	2:50	12.8
	3:00	12.6
	3:10	12.4
	3:20	12.3
	3:30	12.3
	3:40	12.2

Please contact our office at (805) 466-1271 with any questions regarding the information provided in this letter.

Thank you,

Ned M. Thompson

Ned M. Thompson
NMT/kf

Filipponi &
Thompson
Drilling Inc.

STATE LICENSE NO. C57 432680
P.O. Box 845 • ATASCADERO, CA 93423 • PHONE 466-1271

December 4, 2007

Kenny Tab
P.O. Box 3058
Santa Margarita, CA 93453

Re: 13531 Soda Lake Road - CA Valley - APN - 072-201-008 - Gaviota Trail Site
4.0 Hour Test Pump + 1.0 Hour Recovery

Date	Time	Flow Rate	Water Level
11/28/07	12:45 p.m.		20.8
	12:47	30	34.6
	12:50	30	35.5
	12:55	30	35.9
	1:05	30	36.1
	1:15	30	36.3
	1:45	30	36.9
	2:15	30	37.3
	3:15	30	37.9
	3:45	30	38.1
	4:45	30	38.3

RECOVERY DATA

Date	Time	Water Level
11/28/07	4:45 p.m.	38.3
	4:47	22.9
	4:50	22.4
	4:55	22.0
	5:05	21.7
	5:15	21.5
	5:25	21.4
	5:35	21.3
	5:45	21.2

Please contact our office at (805) 466-1271 with any questions regarding the information provided in this letter.

Thank you,

Ned M. Thompson
NMT/kf

Filipponi &
Thompson
Drilling Inc.

STATE LICENSE NO. C57 432680
P.O. Box 845 • ATASCADERO, CA 93423 • PHONE 466-1271

December 4, 2007

Margaret Camara
P.O. Box 1072
Seaside, CA 93955

Re: Devil's Den Trail - CA Valley - APN - 082-131-057
4.0 Hour Test Pump + 1.0 Hour Recovery

Date	Time	Flow Rate	Water Level
11/29/07	8:55 a.m.		09.9
	8:57	30	24.7
	9:00	30	29.2
	9:05	30	30.1
	9:10	30	31.8
	9:15	30	32.9
	9:25	30	34.1
	10:25	30	36.7
	10:55	30	37.0
	11:55	30	37.5
	12:55 p.m.	30	37.9

RECOVERY DATA

Date	Time	Water Level
11/29/07	12:55 p.m.	37.9
	12:57	21.4
	1:00	17.2
	1:05	15.2
	1:10	14.4
	1:15	13.7
	1:25	12.8
	1:35	12.3
	1:45	11.9
	1:55	11.6

Please contact our office at (805) 466-1271 with any questions regarding the information provided in this letter.

Thank you,

Ned M. Thompson
NMT/kf

Filipponi &
Thompson
Drilling Inc.

STATE LICENSE NO. C57 432680
P.O. Box 845 • ATASCADERO, CA 93423 • PHONE 466-1271

December 4, 2007

Margaret Camara
P.O. Box 1072
Seaside, CA 93955

Re: Ginger Road - CA Valley - APN - 082-212-015
4.0 Hour Test Pump + 1.0 Hour Recovery

Date	Time	Flow Rate	Water Level
11/29/07	12:15 p.m.		10.2
	12:17	30	23.2
	12:20	30	24.5
	12:25	30	25.9
	12:30	30	26.5
	12:35	30	27.0
	12:45	30	27.4
	1:15	30	27.9
	2:15	30	29.1
	3:15	30	29.3
	4:15	30	29.4

RECOVERY DATA

Date	Time	Water Level
11/29/07	4:15 p.m.	29.4
	4:17	16.5
	4:20	13.7
	4:25	12.8
	4:30	12.3
	4:35	12.1
	4:45	11.5
	4:55	11.2
	5:05	11.0
	5:15	10.9

Please contact our office at (805) 466-1271 with any questions regarding the information provided in this letter.

Thank you,

Ned M. Thompson
NMT/kf

Filipponi & Thompson Drilling Inc.

STATE LICENSE NO. C57 432680
P.O. Box 845 • ATASCADERO, CA 93423 • PHONE 466-1271

December 4, 2007

Margaret Camara
P.O. Box 1072
Seaside, CA 93955

Re: Dos Palos Road - CA Valley - APN - 082-131-019
4.0 Hour Test Pump + 1.0 Hour Recovery

Date	Time	Flow Rate	Water Level
11/29/07	6:50 a.m.		9.9
	6:52	30	18.9
	6:55	30	19.4
	7:00	30	19.7
	7:10	30	20.5
	7:20	30	20.9
	7:35	30	21.4
	7:50	30	21.7
	8:50	30	22.3
	9:50	30	22.7
	10:50	30	23.0

RECOVERY DATA

Date	Time	Water Level
11/29/07	10:50 a.m.	23.0
	10:52	14.3
	10:55	13.5
	11:00	13.0
	11:05	12.6
	11:10	12.3
	11:20	12.0
	11:30	11.8
	11:40	11.6
	11:50	11.4

Please contact our office at (805) 466-1271 with any questions regarding the information provided in this letter.

Thank you,

Ned M. Thompson

Ned M. Thompson
NMT/kf

ORIGINAL
File with DWR
Page 1 of 1

STATE OF CALIFORNIA
_LL COMPLETION REPORT
Refer to Instruction Pamphlet
No. E057368

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. Devil's Den
Date Work Began 11/7/2007, **Ended** 11/7/2007
Local Permit Agency San Luis Obispo County
Permit No. 2007-328 **Permit Date** 9/12/2007

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	3	TOP SOIL
3	30	SANDY BROWN CLAY WITH THIN GRAVEL
		STRINGERS
30	38	SAND & GRAVEL
38	50	SANDY BROWN CLAY & GRAVEL
50	62	SAND & GRAVEL
62	80	SANDY BROWN CLAY & GRAVEL
80	85	SAND & GRAVEL
85	96	BROWN CLAY
96	100	SAND & GRAVEL
100	108	BROWN CLAY
108	115	SAND & GRAVEL
115	120	GREEN CLAY
		The Air Lift Test is only approximate. A Test Pump
		is recommended for an accurate account. (WP)

TOTAL DEPTH OF BORING 120 (Feet)
TOTAL DEPTH OF COMPLETED WELL 120 (Feet)

WELL OWNER

Name Margaret Camara
Mailing Address P.O. Box 1072
Seaside CA 93955
CITY STATE ZIP

WELL LOCATION

Address Devil's Den Trail Site
City California Valley CA
County San Luis Obispo
APN Book 082 Page 131 Parcel 057
Township 30 S Range 18 E Section 24
Latitude 35 18 030 N 119 59 120 W
DEG. MIN. SEC. DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 10 (Ft.) & DATE MEASURED 11/7/2007
ESTIMATED YIELD * 50+ (GPM) & TEST TYPE Air Lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	30	10	✓				F-480 PVC	5	SDR 21	
30	120	10	PERF				F-480 PVC	5	SDR 21	.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	30	✓			
30	120			✓	Monterey Mix

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other ___

ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME FILIPPONI & THOMPSON DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
P.O. BOX 845 ATASCADERO CA 93423
ADDRESS CITY STATE ZIP
Signed [signature] 11/12/07 432680
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. E057367

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. Dos Palos
Date Work Began 11/7/2007, Ended 11/7/2007
Local Permit Agency San Luis Obispo County
Permit No. 2007-329 Permit Date 9/12/2007

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	3	TOP SOIL
3	30	SANDY GREY CLAY
30	38	SAND & GRAVEL
38	50	BROWN CLAY
50	58	SAND & GRAVEL
58	115	BROWN CLAY W/ THIN GRAVEL STRINGERS
115	123	SAND & GRAVEL
123	130	GREEN CLAY
		The Air Lift Test is only approximate. A Test Pump is recommended for an accurate account. (WP)

TOTAL DEPTH OF BORING 130 (Feet)
TOTAL DEPTH OF COMPLETED WELL 120 (Feet)

WELL OWNER

Name Margaret Camara
Mailing Address P.O. Box 1072
Seaside CA 93955
CITY STATE ZIP

WELL LOCATION

Address Dos Palos Road Site
City California Valley CA
County San Luis Obispo
APN Book 082 Page 131 Parcel 019
Township 30 S Range 18 E Section 24
Latitude 35 18 159 N (DEG. MIN. SEC.) Longitude 119 59 119 W (DEG. MIN. SEC.)

LOCATION SKETCH

NORTH
WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify)
— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 10 (Ft.) & DATE MEASURED 11/7/2007
ESTIMATED YIELD * 75 (GPM) & TEST TYPE Air Lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	TYPE: BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	30	10	✓				F-480 PVC	5	SDR 21	
30	120	10		PERF			F-480 PVC	5	SDR 21	.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	30	✓			
30	120			✓	Monterey Mix

ATTACHMENTS (✓)

— Geologic Log
— Well Construction Diagram
— Geophysical Log(s)
— Soil/Water Chemical Analysis
— Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME FILIPPONI & THOMPSON DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS P.O. BOX 845 CITY ATASCADERO STATE CA ZIP 93423
Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
DATE SIGNED 11/12/07
C-57 LICENSE NUMBER 432680

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 1 of 1

STATE OF CALIFORNIA
WELL COMPLETION REPORT
Refer to Instruction Pamphlet
No. 782652

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. #1
Date Work Began 8/30/02, Ended 8/30/02
Local Permit Agency San Luis Obispo
Permit No. 2002-315 Permit Date 8/15/02

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	3	TOP SOIL
3	8	VERY SANDY CLAY
8	25	SAND & GRAVEL
285	31	BROWN CLAY
31	37	SAND & GRAVEL
37	51	BROWN SANDY CLAY
51	55	SAND & GRAVEL
55	124	BROWN CLAY
124	130	SAND & GRAVEL
130	164	BROWN CLAY
164	176	BROWN SAND
176	190	BROWN SANDY CLAY
190	206	BROWN CLAY/SAND STRINGERS/SM GRAVEL
206	240	BROWN SANDY CLAY W/SAND LAYERS
		Air Lift Test is only approximate. A Test Pump is recommended for an accurate account. (WP)

TOTAL DEPTH OF BORING 240 (Feet)
TOTAL DEPTH OF COMPLETED WELL 240 (Feet)

WELL OWNER

Name Kenny Tab
Mailing Address 12900 Soda Lake Road
California Valley CA 93453
CITY STATE ZIP

WELL LOCATION

Address 12900 Soda Lake Road
City California Valley CA
County San Luis Obispo
APN Book 072 Page 141 Parcel 021
Township 30 S Range 18 E Section 12
Latitude 35 19 27 N (DEG. MIN. SEC.) 120 00 16 W (DEG. MIN. SEC.)

LOCATION SKETCH

NORTH
WEST EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

1

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE
DEPTH OF STATIC WATER LEVEL 7 (Ft.) & DATE MEASURED 8/30/02
ESTIMATED YIELD * 53 (GPM) & TEST TYPE Air Lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft	to Ft	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	120	10	✓				PVC	5	SDR 21	
120	240	10	Perf				PVC	5	SDR 21	.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft	to Ft	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	53	✓			
53	240			✓	Monterey Mix

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief
NAME FILIPPONI & THOMPSON DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS P.O. BOX 845 CITY ATASCADERO STATE CA ZIP 93423
Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
DATE SIGNED 09/10/02
C-57 LICENSE NUMBER 432680

DWR 188 REV 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 1 of 1

STATE OF CALIFORNIA
_LL COMPLETION REPORT
Refer to Instruction Pamphlet
No. **E057368**

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. Devil's Den
Date Work Began 11/7/2007, Ended 11/7/2007
Local Permit Agency San Luis Obispo County
Permit No. 2007-328 Permit Date 9/12/2007

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION *Describe material, grain, size, color, etc.*
0	3	TOP SOIL
3	30	SANDY BROWN CLAY WITH THIN GRAVEL
		STRINGERS
30	38	SAND & GRAVEL
38	50	SANDY BROWN CLAY & GRAVEL
50	62	SAND & GRAVEL
62	80	SANDY BROWN CLAY & GRAVEL
80	85	SAND & GRAVEL
85	96	BROWN CLAY
96	100	SAND & GRAVEL
100	108	BROWN CLAY
108	115	SAND & GRAVEL
115	120	GREEN CLAY
		The Air Lift Test is only approximate. A Test Pump
		is recommended for an accurate account. (WP)

TOTAL DEPTH OF BORING 120 (Feet)
TOTAL DEPTH OF COMPLETED WELL 120 (Feet)

WELL OWNER

Name Margaret Camara
Mailing Address P.O. Box 1072
Seaside CA 93955
CITY STATE ZIP

WELL LOCATION

Address Devil's Den Trail Site
City California Valley CA
County San Luis Obispo
APN Book 082 Page 131 Parcel 057
Township 30 S Range 18 E Section 24
Latitude 35 18 030 N (DEG. MIN. SEC.) Longitude 119 59 120 W (DEG. MIN. SEC.)

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 10 (Ft.) & DATE MEASURED 11/7/2007
ESTIMATED YIELD * 50+ (GPM) & TEST TYPE Air Lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	30	10	✓				F-480 PVC	5	SDR 21	
30	120	10	PERF				F-480 PVC	5	SDR 21	.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	30	✓			
30	120			✓	Monterey Mix

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME FILIPPONI & THOMPSON DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS P.O. BOX 845 CITY ATASCADERO STATE CA ZIP 93423
Signed [signature] WELL DRILLER/AUTHORIZED REPRESENTATIVE
DATE SIGNED 11/12/07
C-57 LICENSE NUMBER 432680

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 1 of 1

STATE OF CALIFORNIA

LL COMPLETION REPORT

Refer to Instruction Pamphlet

No. E063575

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./STATION NO.
LATITUDE LONGITUDE
APN/TRS/OTHER

Owner's Well No. Glade
Date Work Began 11/9/2007, **Ended** 11/9/2007
Local Permit Agency San Luis Obispo County
Permit No. 2007-311 **Permit Date** 9/7/2007

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID Bentonite

DEPTH FROM SURFACE Ft. to	Ft.	DESCRIPTION (Describe material, grain, size, color, etc.)
0	3	TOP SOIL
3	30	SANDY BROWN CLAY
30	36	SAND & GRAVEL
36	54	SANDY BROWN CLAY W/ GRAVEL STRINGERS
54	60	SAND & GRAVEL
60	104	SANDY BROWN CLAY W/ GRAVEL STRINGERS
104	112	SAND & GRAVEL
112	120	GREEN CLAY
		The Air Lift Test is only approximate. A Test Pump is recommended for an accurate account. (WP)

TOTAL DEPTH OF BORING 120 (Feet)
TOTAL DEPTH OF COMPLETED WELL 120 (Feet)

WELL OWNER

Name Kenny Tab
Mailing Address P.O. Box 3058
Santa Margarita CA 93453
CITY STATE ZIP

WELL LOCATION

Address 13531 Soda Lake Road - Glade Trail Site
City California Valley CA
County San Luis Obispo
APN Book 072 Page 201 Parcel 008
Township 30 S Range 18 E Section 24
Latitude 35 17 560 N (DEG. MIN. SEC.) Longitude 119 59 215 W (DEG. MIN SEC.)

LOCATION SKETCH

NORTH / WEST / EAST / SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
___ Deepen
___ Other (Specify)
___ DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 10 (Ft.) & DATE MEASURED 11/9/2007
ESTIMATED YIELD * 50 (GPM) & TEST TYPE Air Lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft. to	Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	30	10	✓				F-480 PVC	5	SDR 21	
30	120	10		PERF			F-480 PVC	5	SDR 21	.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft. to	Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	30	✓			
30	120			✓	Monterey Mix

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME FILIPPONI & THOMPSON DRILLING
(PERSON, FIRM, OR CORPORATION) (TYPED OR PRINTED)
ADDRESS P.O. BOX 845 ATASCADERO CA 93423
CITY STATE ZIP
Signed [signature] 11/12/07 432680
WELL DRILLER/AUTHORIZED REPRESENTATIVE DATE SIGNED C-57 LICENSE NUMBER

DWR 188 REV 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

ORIGINAL
File with DWR
Page 1 of 1

STATE OF CALIFORNIA
.LL COMPLETION REPORT
Refer to Instruction Pamphlet
No. E063576

DWR USE ONLY — DO NOT FILL IN
STATE WELL NO./ STATION NO.
LATITUDE | LONGITUDE
APN/TRS/OTHER

Owner's Well No. Gaviota
Date Work Began 11/8/2007, Ended 11/8/2007
Local Permit Agency San Luis Obispo County
Permit No. 2007-312 Permit Date 9/7/2007

GEOLOGIC LOG

ORIENTATION (✓) ✓ VERTICAL ___ HORIZONTAL ___ ANGLE ___ (SPECIFY)
DRILLING METHOD ROTARY FLUID Bentonite

DEPTH FROM SURFACE Ft.	to Ft.	DESCRIPTION Describe material, grain, size, color, etc.
0	3	TOP SOIL
3	30	SANDY BROWN CLAY
30	34	SAND & GRAVEL
34	110	SANDY BROWN CLAY W/ THIN GRAVEL LAYERS
110	135	RED ROCK
		The Air Lift Test is only approximate. A Test Pump is recommended for an accurate account. (WP)

TOTAL DEPTH OF BORING 135 (Feet)
TOTAL DEPTH OF COMPLETED WELL 135 (Feet)

WELL OWNER

Name Kenny Tab
Mailing Address P.O. Box 3058
Santa Margarita CA 93453
CITY STATE ZIP

WELL LOCATION

Address 13531 Soda Lake Road - Gaviota Trail Site
City California Valley CA
County San Luis Obispo
APN Book 072 Page 201 Parcel 008
Township 30 S Range 18 E Section 25
Latitude 35 17 385 N DEG. MIN. SEC. 119 59 205 W DEG. MIN. SEC.

LOCATION SKETCH

NORTH
WEST
EAST
SOUTH

Illustrate or Describe Distance of Well from Roads, Buildings, Fences, Rivers, etc. and attach a map. Use additional paper if necessary. PLEASE BE ACCURATE & COMPLETE.

ACTIVITY (✓)

✓ NEW WELL
MODIFICATION/REPAIR
— Deepen
— Other (Specify)
— DESTROY (Describe Procedures and Materials Under "GEOLOGIC LOG")

PLANNED USES (✓)

WATER SUPPLY
✓ Domestic ___ Public
___ Irrigation ___ Industrial
MONITORING ___
TEST WELL ___
CATHODIC PROTECTION ___
HEAT EXCHANGE ___
DIRECT PUSH ___
INJECTION ___
VAPOR EXTRACTION ___
SPARGING ___
REMEDIATION ___
OTHER (SPECIFY) ___

WATER LEVEL & YIELD OF COMPLETED WELL

DEPTH TO FIRST WATER ___ (Ft.) BELOW SURFACE 1
DEPTH OF STATIC WATER LEVEL 10 (Ft.) & DATE MEASURED 11/8/2007
ESTIMATED YIELD * 50 (GPM) & TEST TYPE Air Lift
TEST LENGTH 1 (Hrs.) TOTAL DRAWDOWN ___ (Ft.)
May not be representative of a well's long-term yield.

CASING (S)

DEPTH FROM SURFACE Ft.	to Ft.	BORE-HOLE DIA. (Inches)	BLANK	SCREEN	CON-DUCTOR	FILL PIPE	MATERIAL / GRADE	INTERNAL DIAMETER (Inches)	GAUGE OR WALL THICKNESS	SLOT SIZE IF ANY (Inches)
0	35	10	✓				F-480 PVC	5	SDR 21	
35	135	10		PERF			F-480 PVC	5	SDR 21	.040

ANNULAR MATERIAL

DEPTH FROM SURFACE Ft.	to Ft.	CE-MENT (✓)	BEN-TONITE (✓)	FILL (✓)	FILTER PACK (TYPE/SIZE)
0	30	✓			
30	135			✓	Monterey Mix

ATTACHMENTS (✓)

___ Geologic Log
___ Well Construction Diagram
___ Geophysical Log(s)
___ Soil/Water Chemical Analysis
___ Other
ATTACH ADDITIONAL INFORMATION, IF IT EXISTS.

CERTIFICATION STATEMENT

I, the undersigned, certify that this report is complete and accurate to the best of my knowledge and belief.
NAME FILIPPONI & THOMPSON DRILLING
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DATE SIGNED 11/12/07
C-57 LICENSE NUMBER 432680

DWR 188 REV. 11-97
IF ADDITIONAL SPACE IS NEEDED, USE NEXT CONSECUTIVELY NUMBERED FORM

TRITON
Environmental Group

CALIFORNIA SPRINGS LODGE & RESORT

GROUNDWATER RESOURCES EVALUATION CALIFORNIA VALLEY

July 3, 2002

Triton Environmental Group, Inc.
4450 California Avenue, Suite K-299
Bakersfield, California 93309
(661) 588-2448

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FIGURES

CALIFORNIA SPRINGS LODGE & RESORT

GROUNDWATER RESOURCES EVALUATION
CALIFORNIA VALLEY

San Luis Obispo County, California
July 3, 2002
Project No. 004

1.0 INTRODUCTION

Mr. Kenneth Tab of California Springs Lodge & Resort (CSLR) authorized Triton Environmental Group, Inc. (Triton) to prepare this Groundwater Resources Evaluation (Evaluation) for Section 12 and part of Section 24, Township 30 South, Range 18 East, Mount Diablo Base and Meridian (MDBM), located in the Carrizo Plain and shown on Figure 1 and 2 (Site). In accordance with a discussion between Mr. Jon Cooper of Triton and Mr. Tab on June 7, 2002, Triton understands that CSLR is planning to develop groundwater resources on the Site by drilling exploratory and production water supply wells for both drinking water and recreational use. The purpose of the Evaluation is to investigate the hydrogeology of the Site vicinity and to provide recommendations for well location and design using data previously generated by others. A summary of the background, records review, findings, conclusions, and recommendations follows.

2.0 BACKGROUND

Formerly part of a grain and cattle ranch, the Site vicinity is included in a subdivision that was approved by San Luis Obispo County in the late 1950s or early 1960s. A group of structures formerly operated as a service station, motel, store, and restaurant is located on the Site near the southwest corner of Section 12 (Figure 2). The purpose of anticipated groundwater resource development is to supply drinking water for use in the structures and for a planned recreational lake in the northward half of Section 12.

3.0 SITE SETTING

The Site consists of two non-contiguous parcels. The northern parcel, Section 12, occupies approximately 640 acres. The southern parcel occupies approximately 114 acres along the eastward side of Section 24. A northwest to southeast-trending intermittent stream channel transects Section 12. Soda Lake Road, a paved county road, also transects Section 12, trending north-northwest to south-southeast from the northwest corner of Section 12. Section 12 slopes toward the intermittent stream channel at an approximate rate of 30 feet per mile, and the southern parcel slopes eastward at the same approximate rate. Site elevation ranges from 1,980 feet above mean sea level (MSL) to 1,950 feet MSL.

4.0 CLIMATIC CONDITIONS

Local rainfall records in the Carrizo Plain for the ten-year average from 1960 to 1970 show annual rainfall of approximately 9.5 inches. In his Rainfall and Temperature Analysis of the Carrizo Plain, Joseph Lima states that:

> Rainfall amounts typically are less in the southern portion of the Carrizo Plain than in the northern portion. The summer days are hot and the nights are cool. A cool wind chill, both night and day, is not uncommon during the summer. The humidity stays fairly low most of the summer and winter. Breezes in the afternoon, from five to ten miles per hour, are also common during the summer months. Fog is very rare and frosts are quite common for at least six to eight months of the year (Lima, 1975).

5.0 HYDROGEOLOGY

The Carrizo Plain is an internally drained basin approximately 56 miles long and eight miles wide, bounded by the Temblor Range to the northeast and the Caliente Range to the southwest. The San Andreas Fault Rift Zone (SAF) is aligned with the southwestward foot of the Temblor range. Northeast of the SAF, Cretaceous to recent sediments rest on Franciscan basement rocks of Jurassic and Cretaceous age. Southwest of the SAF, Cretaceous to Recent sediments overlie Santa Lucia Granodiorite of Late Cretaceous age (Galehouse, 1967). Surface flow within the basin is toward Soda Lake; a desert playa located approximately six miles southwest of the Site that is a sag pond associated with the SAF.

The Site is located on Quaternary-aged alluvium containing alkaline, fine-grained soils that flank the intermittent stream channel conducting stormwater surface flow to Soda Lake (Figure 2). The channel conducts flow to Soda Lake from the northward portion of the Carrizo Plain drainage basin where annual rainfall is greatest.

A review of paired stereoscopic aerial photographs of the Site revealed a soil color pattern suggesting that an ancient channel conducting storm flow to Soda Lake was located approximately 0.4 miles southwest of the current channel and passed near the southwest corner of Section 12.

Most of the fresh groundwater in the Carrizo Plain is found in non-marine formations of post-Pliocene age located southwestward of the SAF. They consist mostly of loosely to well-consolidated sands, gravels, silts and clays, which overlay unconformably older folded and faulted marine and continental deposits. The post-Pliocene formation is wedge-shaped, thinning from approximately 3,000 feet in thickness along the west side of the SAF to zero along the Caliente Range and San Juan Hills that form the westward boundary of the Carrizo Plain.

Groundwater quality generally improves with increasing distance northward and westward from Soda Lake, and is generally poor between Soda Lake and the SAF (Cooper, 1990). Water samples from selected wells have varied in concentration of total dissolved solids (TDS) from 545 parts per million (ppm) in Section 13, T29S, R17E MDBM to 28,740 ppm near Soda Lake in Section 34, T30S, R18E, MDBM (Kemnitzer, 1967).

6.0 WELL DATABASE REVIEW

No local well measurement data were located upon review of the United States Geological Survey's Groundwater Site Information for California. Similarly, no local data were available on the California Department of Water Resources well database website.

A review of Triton's proprietary database yielded a summary of information as discussed below for the wells and test holes located on Figure 2. The summaries provided are Triton's interpretation of data reviewed in Water Well Drillers Reports.

Location 1. Location 1 was drilled to a total depth of 111 feet below ground surface (bgs). Although the water table was measured at a static level of 63.5 feet bgs, the formation encountered was described as yellow clay with very little sand. The well was screened from 63 feet to 111 feet bgs.

Location 2. Location 2 was drilled to a total depth of 50 feet bgs. The formation encountered was described as clay. The water table was measured at a static level of 22.5 feet bgs.

Location 3. Location 3 was drilled to a total depth of 480 feet bgs. The formation was analyzed using geophysical logging techniques. Formation sands encountered were described as poor in porosity and permeability, and the depth interval between 160 and 480 feet bgs is described as clay.

Location 4. Location 4 was drilled to a total depth of 580 feet bgs. The formation was analyzed using geophysical logging techniques. The total formation sand encountered at location 4 was estimated at 205 linear feet.

The sand intervals described as the best aquifer material were 103 feet to 140 feet bgs and 185 feet to 237 feet bgs.

Location 5. Location 5 is the current supply well. The well was constructed using a 10.75-inch diameter casing placed inside a 24-inch diameter boring drilled to a total depth of 520 feet bgs. The 10.75-inch diameter casing is screened from 100 feet to 520 feet bgs. A geophysical log was not available for the well. The total formation sand encountered at location 5 was estimated at 52 linear feet. The well's output capacity was estimated at 500 gallons per minute (Kemnitzer, 1967).

Location 6. Location 6 was drilled to a total depth of 275 feet bgs. The cumulative thickness of sand and gravel encountered at location 6 was estimated at 123 feet and the well was screened from 95 feet to 275 feet bgs. The water table was measured at a static level of 18 feet bgs. The well reportedly yielded 100 gallons per minute (gpm) during preliminary testing.

Location 7. Location 7 was drilled to a total depth of 160 feet bgs. The cumulative thickness of sand and gravel encountered at location 7 was estimated at 48 feet and the well was screened from 80 feet to 145 feet bgs. The depth interval between 145 feet and 160 feet bgs was described as clay. The water table was measured at a static level of 35 feet bgs.

Location 8. Location 8 was drilled to a total depth of 160 feet bgs. The cumulative thickness of sand and gravel encountered at location 8 was estimated at 105 feet and the well was screened from 60 feet to 160 feet bgs. The depth interval between 140 feet and 160 feet bgs was described as the best aquifer material. The water table was measured at a static level of 30 feet bgs.

Location 9. Location 9 was drilled to a total depth of 100 feet bgs. The cumulative thickness of sand, gravel and clay encountered at location 9 was estimated at 45 feet and the well was screened from 50 feet to 100 feet bgs. The water table was measured at a static level of 35 feet bgs.

7.0 FINDINGS

Based on Triton's document review, our findings and the relevance of the findings to the value of groundwater resources at the Site are summarized below.

7.1 Groundwater Well Yields

Well yields vary widely, depending on the details of well construction and design, pump specifications, and aquifer characteristics. Additionally, well yield is controlled by such factors as aquifer porosity, permeability, transmissivity and recharge.

The data relating to groundwater well yields obtained from Triton's record review is limited; however, the data from Locations 5 and 6 suggest that well pumping rates of 100 gpm to 500 gpm can be reasonably expected at selected locations in the Site vicinity.

Locations 1, 2, and 3 are associated with a large fraction of clay and clayey gravel in the subsurface formation, suggesting that well yields would be low beneath the northward portion of the Site. Locations 4, 5, and 6 are associated with formations containing greater fractions of sand and gravel, from which greater groundwater yields are likely.

Locations 7, 8, and 9 also have large fractions of sand and gravel. None of the wells was completed below a depth of 160 feet bgs; therefore, the estimated yield of deeper wells in this area is less certain.

7.2 Groundwater Quality

Well water from location 5 has been analyzed to identify chemical characteristics related to groundwater quality. In 1966, analyses indicated the water was excellent for drinking water uses, with TDS of 404 ppm. Results for nitrate concentration were not available (Kemnitzer, 1967). Detailed chemical data was not available for wells at the other locations listed; however, Triton personnel have previously completed field tests on groundwater from a well in the vicinity of Location 7 and determined the electrical conductivity to be within drinking water limits.

8.0 CONCLUSIONS AND RECOMMENDATIONS

Based on the information presented above, Triton concludes that there are three groundwater resources available on the Site for development by CSLR:

- Rehabilitation of the existing well;
- Completion of a new well in Section 12; and
- Completion of a new well in Section 24.

A brief discussion of each alternative, with recommendations, follows.

8.1 Rehabilitation of Existing Well

A pumping test of the existing well should be conducted for a minimum duration of 24 hours. A detailed record of drawdown with pumping time should be completed under the direction of a Certified Hydrogeologist (C HG). Following the pumping test, the pump should be removed and the well casing logged with a video logger to evaluate casing condition. Based on the results of the pumping test and the video log, a well rehabilitation plan, if appropriate, should be prepared by a qualified hydrogeologist in consultation with a qualified well rehabilitation contractor.

8.2 Section 12 Exploratory Boring

An exploratory boring should be drilled in or near the portion of Section 12 west of Soda Lake Road and south of the former motel. Triton is available to assist CSLR and its drilling contractor in the selection of a specific drilling site. A test boring should be completed to a minimum depth of 600 feet bgs using mud rotary techniques. A lithologic log should be completed during completion of the test boring. A C HG or a geologist working under the direct supervision of a C HG should complete the log in the field. The geologist will observe and describe samples of cuttings returned by the drill rig and will record related data on the lithologic log such as drill penetration rates and drilling fluid circulation problems. The test boring should then be analyzed using a geophysical electric logging tool (E-log) to determine the appropriate screening interval and to evaluate the quantity and quality of water available in the water-bearing portions of the formation.

Well design, if appropriate, will be based on an analysis of the lithologic log and the E-log by a C HG. All work should be completed under the direction of a C HG.

8.3 Section 24 Exploratory Boring

An exploratory boring should be drilled in the northern half of Section 24 to assess the deeper aquifer in that vicinity. The test boring should be completed to a minimum depth of 600 feet bgs using mud rotary techniques. Protocol for monitoring and logging the exploratory boring should be the same as discussed in Section 8.2. Triton is available to assist CSLR and its drilling contractor in the selection of a specific drilling site.

Well design, if appropriate, will be based on an analysis of the lithologic log and the E-log by a C HG. All work should be completed under the direction of a C HG.

9.0 REFERENCES

Arrowsmith, J.R., 1995, The San Andreas Fault Zone in the Carrizo Plain, California: Review of Quaternary Geologic Investigations, Landforms, and Fault Activity.

Cooper, Jon W., 1990, A Geophysical Study of the Hydrogeology of the Carrizo Plain Area, San Luis Obispo County, California.

Dibblee, T.W., Jr., 1973, Regional Geologic Map of San Andreas and Related Faults in Carrizo Plain, Temblor, Caliente, and La Panza Ranges and Vicinity, California, U.S. Geological Survey (USGS) Map I-757.

Eigenbrode, J.L., 1999, Sedimentological, Carbon-Isotopic, and Molecular Records of Late Holocene Climate in the Sediments of Soda Lake, Carrizo Plain, California.

Galehouse, 1967, Provenance and Paleocurrents of the Paso Robles Formation, California, Geological Society of America Bulletin, v. 68, p. 951-978.

Kemnitzer, W.J., 1967, Groundwater in the Carrizo Plain, San Luis Obispo County, California.

Lima, J.M., 1975, Rainfall and Temperature Analysis of the Carrizo Plain, San Luis Obispo County, California, Senior Project report submitted to California Polytechnic State University.

United States Geological Survey (USGS), 1982, Simmler, Calif. 7 ½-minute topographic map.

10.0 LIMITATIONS

This Evaluation represents Triton's professional opinion and judgement, which are dependent upon information obtained during the Evaluation. Conclusions or recommendations are based in part on information supplied by others; the accuracy or sufficiency of which was not independently reviewed.

11.0 SIGNATURE PAGE

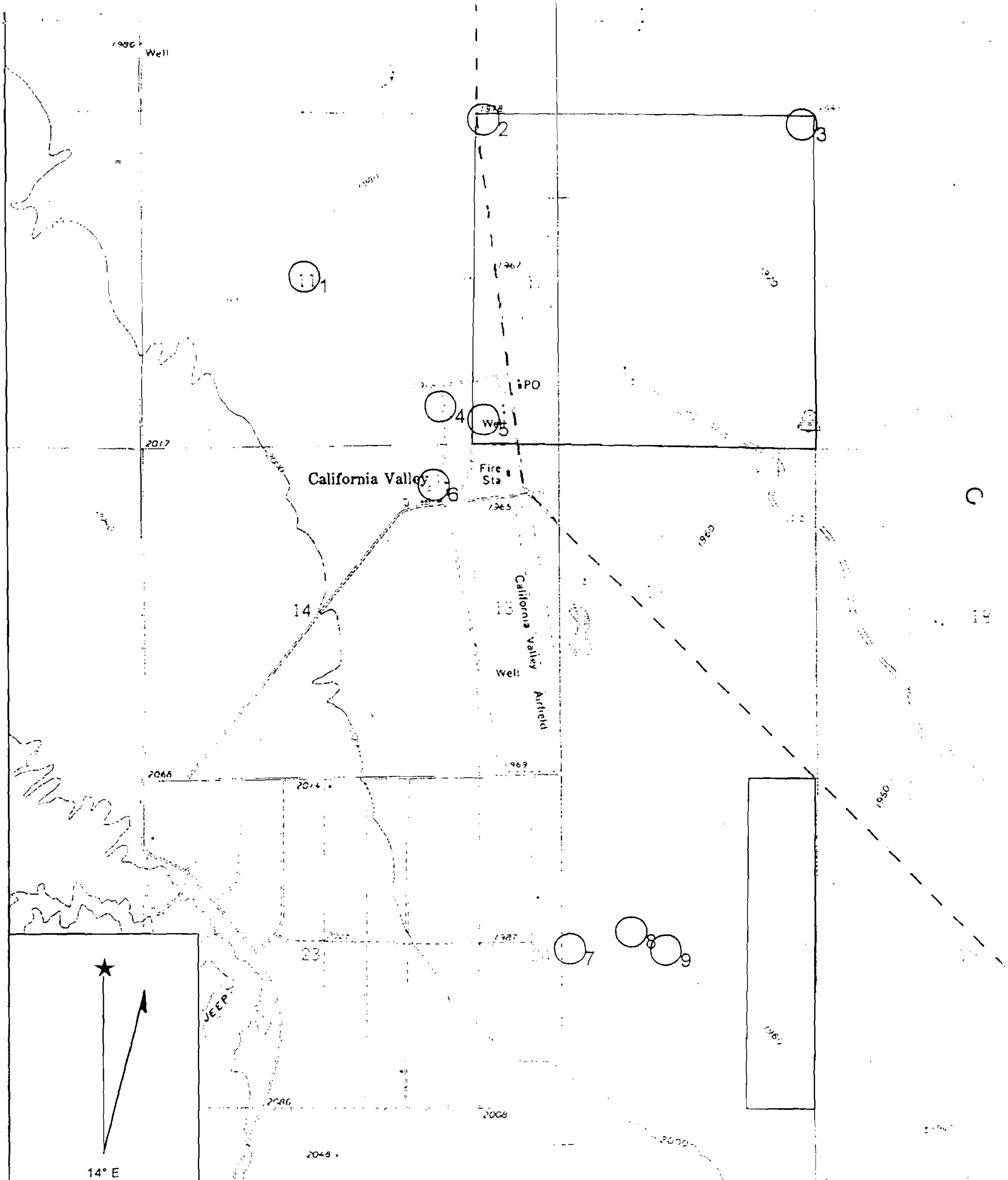
This Groundwater Resources Evaluation for California Springs Lodge & Resort, dated July 3, 2002, was prepared by Triton Environmental Group, Inc. under the responsible charge of the following professionals:

REPORT PREPARED BY:

Jon W. Cooper, CHG
Certified Hydrogeologist

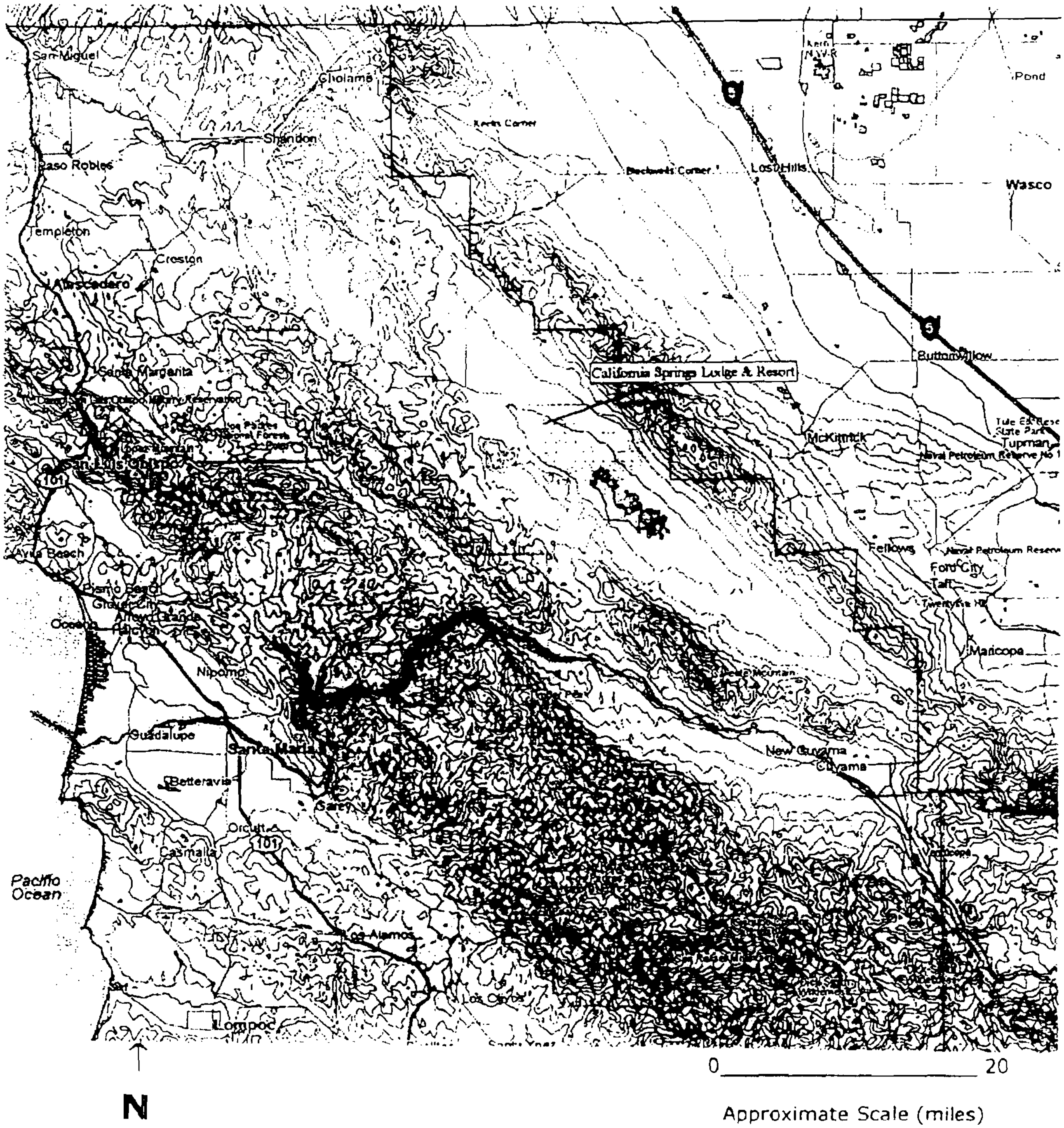
REPORT REVIEWED BY:

Mark J. Pishinsky, REA
Environmental Engineer



Name: CALIFORNIA VALLEY
Date: 7/2/2002
Scale: 1 inch equals 2000 feet

Location: 035° 18' 58.3" N 120° 00' 09.6" W
Caption: FIGURE 2



PROJECT NO. 004	SITE LOCATION MAP	Triton Environmental Group, Inc.
California Springs Lodge & Resort California Valley, California	FIGURE 1	4450 California Avenue, Suite K-299 Bakersfield, CA 93309

CARRIZO PLAIN STRATIGRAPHIC UNITS CHART

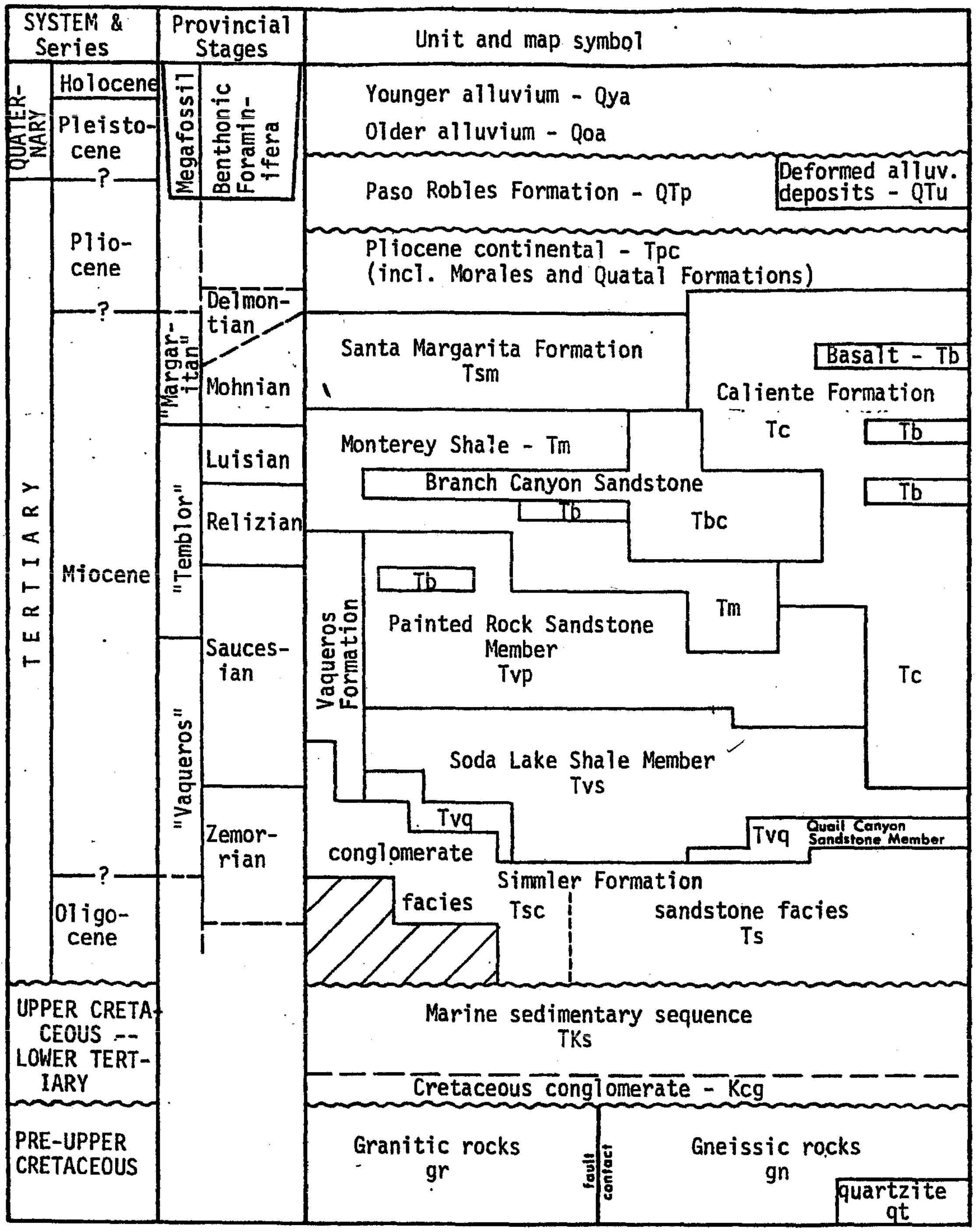


Figure 1.--Generalized chart of stratigraphic units in Caliente Range-Carrizo Plain area. Correlation of provincial megafaunal and foraminiferal stages after Addicott (1972) and Vedder (1973). Letter symbols same as symbols on plate 1 (geologic map). From Bartow, 1974.

EXISTING CESF PROJECT SITE GROUNDWATER WELL DRILLER'S REPORT

QUADRUPLICATE
RETAIN THIS COPY

WATER WELL DRILLERS REPORT

(Sections 7076, 7077, 7078, Water Code)

5

THE RESOURCES AGENCY OF CALIFORNIA

Do Not Fill In
Nº 106487

State Well No.
Other Well No. 29S/18E 28

(1) OWNER:
Name Nelson Lewis (Louis ... / Rob't Stern)
Address P.O.Box 126
Buttonwillow, California

(2) LOCATION OF WELL:
County San Luis Obispo Owner's number, if any—
R. F. D. or Street No.
Section 28, Township 29 S, Range 18 E MD
Center of Section 28

(3) TYPE OF WORK (check):
New well ☒ Deepening ☐ Reconditioning ☐ Abandon ☐
If abandonment, describe material and procedure in Item 11.

(4) PROPOSED USE (check):
Domestic ☐ Industrial ☐ Municipal ☐
Irrigation ☒ Test Well ☐ Other ☐

(5) EQUIPMENT:
Rotary ☒
Cable ☐
Dug Well ☐

(6) CASING INSTALLED:
SINGLE ☒ DOUBLE ☐

From ft.	to ft.	Diam.	Gage or Wall	Diameter of Bore	from ft.	to ft.
0	630	16"	1/4"	27½"	0	630

If gravel packed
Type and size of shoe or well ring: point
Size of gravel: 3/8 & under
Describe joint: welded

(7) PERFORATIONS:
Type of perforator used: Louver
Size of perforations 2½ in., length, by 5/32 in.

From ft.	to ft.	Perf. per row	Rows per ft.
205	630	10	6
(75	205	6	1)
(mills Perforator 3/16 x 1)			

(8) CONSTRUCTION:
Was a surface sanitary seal provided? ☐ Yes ☒ No To what depth ft.
Were any strata sealed against pollution? ☐ Yes ☒ No If yes, note depth of strata
From ft. to ft.
Method of Sealing

(9) WATER LEVELS:
Depth at which water was first found 30 ft.
Standing level before perforating ft.
Standing level after perforating ft.

(10) WELL TESTS:
Was a pump test made? ☒ Yes ☐ No If yes, by whom Bakersfield Pump
Yield: 500 gal./min. with 370 ft. draw down after 8 hrs.
Temperature of water Was a chemical analysis made? ☐ Yes ☐ No
Was electric log made of well? ☐ Yes ☒ No

(11) WELL LOG:
Total depth 630 ft. Depth of completed well 630 ft.
Formation: *Describe by color, character, size of material, and structure.*

From ft.	to ft.	Formation
0	4	soil & sandy clay
4	10	clay
10	40	sandy clay
40	55	fine sand
55	63	clay
63	86	sandy clay
86	98	fine sand
98	146	shale & clay
146	158	sandy clay
158	168	clay
168	179	sandy clay
179	198	shale & clay
198	222	clay
222	238	medium sand
238	252	clay
252	265	medium sand
265	278	sandy clay
278	289	medium sand
289	298	sandy clay
298	309	clay
309	322	medium sand
322	346	sandy clay
346	361	clay
361	374	medium sand
374	393	clay
393	406	sandy clay
406	423	coarse sand
423	439	clay
439	449	medium sand
449	462	sandy clay
462	479	clay
479	492	sandy clay
492	508	medium sand
508	522	clay
522	541	sandy clay
541	558	medium sand
558	574	clay
574	589	medium sand
589	608	sand
608	618	sandy clay
618	630	clay

Work started 6/23/65 19 , Completed 7/7/65 19

WELL DRILLER'S STATEMENT:
This well was drilled under my jurisdiction and this report is true to the best of my knowledge and belief.

NAME SLOCUM WATER WELL DRILLING
(Person, firm, or corporation) (Typed or printed)
Address 1900 Ming Road
Bakersfield, California 93304

(Signed) (Charles A. Bowker, mgr.) Well Driller
License No. 198639 C 57 Dated 7/20/65, 19

87649 8-63 25M QUIN ① △ SPO

DWR 188 (REV. 3-54)

CALIFORNIA DEPARTMENT OF WATER RESOURCES
MONITORING WELL DATA

DATA FOR DWR MONITORING WELLS 28G, 28K, AND 28L

WELL NUMBER	TOWNSHIP	RANGE	SECTION	Basin Number	DATE	GROUND SURFACE ELEVATION	GROUND SURFACE TO WATER LEVEL	WATER SURFACE ELEVATION	NO MEASUREMENT COLLECTED
29S18E28G01M	29S	18E	28	3-19	15-Apr-69	2022	54.5	1967.5	
29S18E28G01M	29S	18E	28	3-19	13-Apr-70	2022	125.5	1896.5	
29S18E28G01M	29S	18E	28	3-19	18-Nov-70	2022	67.2	1954.8	
29S18E28G01M	29S	18E	28	3-19	27-Apr-71	2022	63.1	1958.9	
29S18E28G01M	29S	18E	28	3-19	20-Oct-71	2022	75.5	1946.5	
29S18E28G01M	29S	18E	28	3-19	10-Apr-72	2022	225	1797	
29S18E28G01M	29S	18E	28	3-19	20-Apr-72	2022	135	1887	
29S18E28G01M	29S	18E	28	3-19	09-Nov-72	2022	64	1958	
29S18E28G01M	29S	18E	28	3-19	16-Apr-73	2022	58.7	1963.3	
29S18E28G01M	29S	18E	28	3-19	15-Nov-73	2022	62	1960	
29S18E28G01M	29S	18E	28	3-19	04-Nov-74	2022	59.6	1962.4	
29S18E28G01M	29S	18E	28	3-19	28-Apr-75	-999	0	-999	7
29S18E28G01M	29S	18E	28	3-19	16-Oct-75	2022	59.7	1962.3	
29S18E28G01M	29S	18E	28	3-19	27-Apr-76	2022	93.6	1928.4	
29S18E28G01M	29S	18E	28	3-19	25-Oct-76	2022	67	1955	
29S18E28G01M	29S	18E	28	3-19	03-May-77	2022	89.5	1932.5	
29S18E28G01M	29S	18E	28	3-19	31-Oct-77	2022	63.8	1958.2	
29S18E28G01M	29S	18E	28	3-19	08-May-78	2022	53.8	1968.2	
29S18E28G01M	29S	18E	28	3-19	07-Dec-78	2022	50.9	1971.1	
29S18E28K01M	29S	18E	28	3-19	10-Oct-63	2020	31.8	1988.2	
29S18E28K01M	29S	18E	28	3-19	02-Apr-64	2020	32	1988	
29S18E28K01M	29S	18E	28	3-19	07-Oct-64	2020	33.9	1986.1	
29S18E28K01M	29S	18E	28	3-19	14-Apr-65	2020	38.9	1981.1	
29S18E28K01M	29S	18E	28	3-19	22-Oct-65	2020	31.5	1988.5	
29S18E28K01M	29S	18E	28	3-19	22-Apr-66	2020	31.7	1988.3	
29S18E28K01M	29S	18E	28	3-19	11-Oct-66	2020	31.9	1988.1	
29S18E28K01M	29S	18E	28	3-19	11-May-67	2020	32.2	1987.8	
29S18E28K01M	29S	18E	28	3-19	28-Oct-67	2020	32	1988	
29S18E28K01M	29S	18E	28	3-19	19-Apr-68	2020	32.3	1987.7	
29S18E28K01M	29S	18E	28	3-19	22-Oct-68	2020	34.3	1985.7	
29S18E28K01M	29S	18E	28	3-19	15-Apr-69	2020	25	1995	
29S18E28K01M	29S	18E	28	3-19	13-Apr-70	2020	27.8	1992.2	
29S18E28K01M	29S	18E	28	3-19	18-Nov-70	2020	28.8	1991.2	
29S18E28K01M	29S	18E	28	3-19	27-Apr-71	2020	28.2	1991.8	
29S18E28K01M	29S	18E	28	3-19	20-Apr-72	2020	28.9	1991.1	
29S18E28K01M	29S	18E	28	3-19	09-Nov-72	2020	30.2	1989.8	
29S18E28K01M	29S	18E	28	3-19	16-Apr-73	2020	28.9	1991.1	
29S18E28K01M	29S	18E	28	3-19	15-Nov-73	2020	29.2	1990.8	
29S18E28K01M	29S	18E	28	3-19	24-Apr-74	2020	30.8	1989.2	
29S18E28K01M	29S	18E	28	3-19	04-Nov-74	2020	29.5	1990.5	
29S18E28K01M	29S	18E	28	3-19	28-Apr-75	2020	30.3	1989.7	W
29S18E28K01M	29S	18E	28	3-19	16-Oct-75	2020	30.2	1989.8	
29S18E28K01M	29S	18E	28	3-19	26-Apr-76	2020	32	1988	
29S18E28K01M	29S	18E	28	3-19	25-Oct-76	2020	30.9	1989.1	
29S18E28K01M	29S	18E	28	3-19	03-May-77	2020	31.7	1988.3	

DATA FOR DWR MONITORING WELLS 28G, 28K, AND 28L

29S18E28K01M	29S	18E	28	3-19	31-Oct-77	2020	31	1989		
29S18E28K01M	29S	18E	28	3-19	08-May-78	2020	19.2	2000.8		
29S18E28K01M	29S	18E	28	3-19	07-Dec-78	2020	23.7	1996.3		
29S18E28L01M	29S	18E	28	3-19	10-Oct-63	2020	27.2	1992.8		
29S18E28L01M	29S	18E	28	3-19	02-Apr-64	2020	31.9	1988.1		
29S18E28L01M	29S	18E	28	3-19	07-Oct-64	2020	33.9	1986.1		
29S18E28L01M	29S	18E	28	3-19	14-Apr-65	2020	27.7	1992.3		
29S18E28L01M	29S	18E	28	3-19	22-Oct-65	2020	26	1994		
29S18E28L01M	29S	18E	28	3-19	22-Apr-66	2020	33.7	1986.3		
29S18E28L01M	29S	18E	28	3-19	11-Oct-66	2020	32	1988		
29S18E28L01M	29S	18E	28	3-19	11-May-67	-999	0	-999	8	
29S18E28L01M	29S	18E	28	3-19	19-Apr-68	2020	31.1	1988.9		
29S18E28L01M	29S	18E	28	3-19	22-Oct-68	2020	33	1987		
29S18E28L01M	29S	18E	28	3-19	15-Apr-69	2020	19.9	2000.1		
29S18E28L01M	29S	18E	28	3-19	13-Apr-70	2020	24	1996		
29S18E28L01M	29S	18E	28	3-19	18-Nov-70	2020	29.3	1990.7		
29S18E28L01M	29S	18E	28	3-19	27-Apr-71	2020	24.9	1995.1		
29S18E28L01M	29S	18E	28	3-19	20-Oct-71	2020	29	1991		
29S18E28L01M	29S	18E	28	3-19	20-Apr-72	2020	22.8	1997.2		
29S18E28L01M	29S	18E	28	3-19	09-Nov-72	2020	26.3	1993.7		
29S18E28L01M	29S	18E	28	3-19	16-Apr-73	2020	24.8	1995.2		
29S18E28L01M	29S	18E	28	3-19	15-Nov-73	2020	25.1	1994.9		
29S18E28L01M	29S	18E	28	3-19	24-Apr-74	2020	26.8	1993.2		
29S18E28L01M	29S	18E	28	3-19	04-Nov-74	2020	26.1	1993.9		
29S18E28L01M	29S	18E	28	3-19	28-Apr-75	2020	27.2	1992.8		
29S18E28L01M	29S	18E	28	3-19	16-Oct-75	2020	26.8	1993.2		
29S18E28L01M	29S	18E	28	3-19	27-Apr-76	2020	29.4	1990.6		
29S18E28L01M	29S	18E	28	3-19	25-Oct-76	2020	28.6	1991.4		
29S18E28L01M	29S	18E	28	3-19	03-May-77	2020	39.8	1980.2		
29S18E28L01M	29S	18E	28	3-19	31-Oct-77	2020	29.5	1990.5		
29S18E28L01M	29S	18E	28	3-19	08-May-78	2020	16.6	2003.4		
29S18E28L01M	29S	18E	28	3-19	07-Dec-78	2020	20.4	1999.6		

CARRISA PLAIN SOLAR PROJECT (ARCO SITE)
GROUNDWATER INVESTIGATION AND ANALYSIS

Bechtel Civil & Minerals, Inc.

Interoffice Memorandum

To	T. A. McCormick	File No.	
Subject	Carrisa Plains Test Well Job 16413	Date	June 15, 1984
		From	C. R. Farrell
		Of	H&CF/Geology
Copies to	M. J. Adair L. R. West	At	45/31 Ext.

Attached is a summary of the work done to construct and test a production well at the Carrisa Plain Solar Project site.

I contacted Don's Drilling Co. on Friday, June 14, 1984 concerning the sealing of the first well drilled. Mr. D. Redfairn said that he filled the casing to near surface with drill cuttings, mud and the broken up pieces from the concrete pump base. He cut off the well casing about three feet below ground surface, filled the balance of casing with a grout plug, and welded a metal cap on the casing top. He reported this to the county regulatory agency.

C R Farrell

C. R. Farrell

CRF:as
Attachment

PRODUCTION TEST WELL

CARRISA PLAINS SOLAR PROJECT

JUNE 1984

Bechtel National, Inc. requested Bechtel Civil and Minerals, Inc. to investigate the possibility of developing a water supply from ground water for the Solar Energy Plant at Carrisa Plains, California. The water supply requirement is estimated to be about 115 gpm (gallons per minute). A preliminary literature review followed by discussions with local farmers indicated that the ground water resources at the proposed site should be sufficient to meet the water requirements. Near-surface ground water (to a depth of approximately 100 feet) is reported to be poor quality but sands and gravels below that depth yield good quality to wells. A program for well construction and aquifer testing was developed and approved. The drilling contract was awarded to Don's Drilling Co., Bakersfield, Calif. in March, 1984. The contractor mobilized on March 5 and the test/production well was completed on May 5. The following paragraphs describe briefly the drilling, construction, and testing of the test well.

Exploration

Three 5-1/4-inch diameter exploratory pilot holes were drilled before a sufficiently thick interval of coarse-grained and apparently permeable materials was encountered to justify construction of a well. The first pilot hole, W-1, located about 1000 feet north of the southern section line and approximately half way between the east and west section lines, was first drilled to a depth of 500 feet. An E-log, which measures the SP (self potential) and apparent electrical resistivity of the materials was run in the hole. A review of the E-log and the drill cuttings indicated that very little sand or gravel was present except in the bottom portion of the hole. It was decided to drill an additional 100 feet (to 600 feet) to determine if additional sand or gravel might be encountered. The hole was drilled to a total depth of 620 feet, and a second E-log was run. The E-log verified the indications of the drill cuttings that little to no permeable material was present at this site. The pilot hole was backfilled and a second exploratory site was selected.

The second pilot hole, W-2, was located about 120 feet south and 120 feet east of the north-west corner of the section. This hole was drilled to 600 feet and E-logged. The hole encountered only clay and silt below about 120 feet. Based on the E-log and the drill cuttings this hole was also backfilled and abandoned.

The third pilot hole, W-3, was located about 120 feet north and 120 feet east of the south-west corner of the section. It was drilled to 620 feet and an E-log was run. The E-log, as well as the drill cuttings, were favorable, indicating lenses of sand and gravel from 460 to 610 feet. Based on these results it was decided to ream the pilot hole and construct the 12-inch diameter test well.

<u>Construction of well</u>

The well is a gravel-packed well, consisting of a 19-inch diameter hole in which a 12-inch diameter casing and screen assembly is installed. A filter gravel was placed below a depth of 190 feet in the annular space between the wall of the drilled hole and the casing/screen assembly. A bentonite seal was installed from 185 to 190 feet. The annulus was backfilled with gravel above that seal to 50 feet below the land surface and a cement-grout surface seal was installed from 50 feet to land surface. A concrete pump base, 6 feet by 6 feet and 1-foot thick was installed at the ground surface.

The well casing and screen assembly consists of 60 feet of galvinized low carbon steel screen and 560 feet carbon steel casing. The screen is a continous wire wrap type, manufactured by U.O.P. Johnson Co. with .020-inch openings. The screen was installed in three sections located at depths of 490-500 feet, 530-555 feet, and 575-600 feet below the land surface.

The well was developed by jetting the screen, and by washing and surging with air. After nine days of cleaning and development by these means it was determined that the well was clean enough for final development with the test pump.

The test pump was installed and final development began on April 10. At 11:20 a.m. April 11, while developing, the pump discharge rate suddenly increased from about 80 gpm to almost 200 gpm and the water level in the well rose about 120 feet. In less than 5 minutes the pump locked-up and ceased pumping. The contractor then removed the pump. It was found that the well had filled in to a depth of 460 feet below land surface with sand and gravel. The caved material was washed out to a depth of 585 ft with a 9-7/8-inch bit where an obstruction was encountered, preventing further clearing of the well. It was concluded that the well screen was broken at that depth.

The cause of the break in the screen, based on the events that occurred, was apparently the bridging of gravel filter during installation, leaving a void in the annular space at some point above the break. During development with the pump, the bridge collapsed, and the impact of falling gravel from above caused the screen to break at a depth of 585 feet. Because the casing/screen assembly could not be pulled to repair the screen, the contractor elected to drill a new well. He backfilled and sealed the initial well in accordance with state and county regulations.

The drill rig was moved about 36 feet north of well W-3 and a second 19-inch diameter hole (W-3A) was drilled to a depth of 620 feet. The casing and screen assembly in well W-3A includes 500 feet of 10-inch diameter carbon steel casing, 50 feet of 8-inch diameter galvinized low carbon steel wire wrapped screen, and 67 feet of 8-inch diameter carbon steel casing. The 10-inch casing is joined to the 8-inch casing/screen assembly by a 10x8-inch reducer. The screen has .030-inch openings and was installed in two sections located at depths of 530-550 feet and

570-600 feet below the land surface. A washdown valve seals the bottom of the casing/screen assembly. Gravel filter material was placed in the annular space between drill hole and the well assembly with considerable care to avoid bridging. The filter is from 620 feet to 220 feet below the land surface. A grout plug was installed from 220 feet to 215 feet. The annulus above the plug is filled with gravel to a depth of 50 feet below the land surface. The well was completed by installation of a grout surface seal from 50 feet to ground surface and construction of the pump base.

Development of Well 3A proceeded in a similar manner to that of Well 3. Installation of the test pump and final development was accomplished without difficulty. Removal of fines and sand from the well was realized.

Well Test and Methods of Analysis

After the completion of development an aquifer pumping test was performed. The pumping test provides an in-situ measurement of the transmissivity of the aquifer, which is important in determining the long term yield of the well. The test was performed in accordance with recognized methods for conducting a constant-discharge type test.

The aquifer pumping test data were analyzed by methods based on the Theis solution of non-steady ground water flow to a well in response to a constant pumping rate. The Theis solution can be written in the following form (Freeze & Cherry, "Groundwater", Prentice Hall, Inc., 1979:

$$s = \frac{Q}{4\pi T} W(u)$$

where:

s = drawdown in the well (feet),

Q = discharge from well (ft^3/day),

T = transmissivity (ft^2/day),

$W(u)$ = well function of u,

$$u = \frac{r^2 S}{4Tt}$$

r = distance from well, feet,

S = storativity, dimensionless, and

t = time, days.

The Jacob approximation of the Theis solution was applied in the analyses. Semilog graphical plotting of the data is used in this method. Both drawdown in response to pumping and recovery of the water level following cessation of pumping provide data with which to analyze aquifer capacity.

Drawdown data obtained during pumping is plotted against the log of time since pumping began. A straight line is developed, the slope of which is related to the transmissivity. The recovery semilog plots are similar to the time-drawdown solution. Residual drawdown (s') data are plotted against the logarithm of the ratio of time since pumping started (t) and time since pumping stopped (t'). With these data a straight line is also developed, the slope of which is related to the transmissivity.

The test commenced at 9:45 a.m. May 2, 1984 pumping continued for 72 hours. Initially the pumping rate was set at 305 gpm. After 90 minutes, the rate had to be reduced to approximately 265 gpm because of mechanical problems with the diesel engine that operated the pump. The water level in the well was measured during the test with an air line. The pumping rate was measured with an orifice plate on the discharge pipe.

The depth to water below ground surface before commencing the aquifer test (static level) was 40 feet. After 90 minutes of pumping at a rate of 305 gpm the water level in the well was drawn down to a depth of 373 feet (drawdown of 333 feet). Because of mechanical problems with the diesel power source, the pumping rate was decreased at that time, and for the balance of the pumping period (total pumping duration of 4335 minutes, or 3 days) the pumping rate varied from 254 to 268 gpm. WIth the drop in pumping rate, the water level in the well quickly recovered to 340 feet depth, and then began dropping again, slowly, as pumping continued at the lower rate. The water level depth in the well at the end of the pumping period was 368 feet.

Evaluation of Aquifer Capacity

The analyses of the pumping test data indicate that the transmissivity of the aquifer (the sands and gravels encountered between 460 and 610 feet) is approximately 2800 gallons per day per foot (375 ft^2/d) and the estimated well efficiency during the test was 0.60. It is not possible to measure the aquifer storativity accurately with the data collected from the pumping well. However, the occurrence of the sands and gravels within thick clay/silt layers, and the potentiometric level (represented by the water level in the well) above the aquifer indicate it is confined to semiconfined. A storativity of 0.001 can be applied for estimating aquifer capacity. These aquifer characteristics, the measured responses of the test well, and assuming no recharge occurs to replenish the aquifer, provide a conservative basis for estimating the capacity of the aquifer to provide the long-term design water requirement (115 gpm).

Adjusting the well performance to a rate of 115 gpm, and projecting the drawdown interference after 20 years of continuous pumping indicates that it would be less than 200 feet at the well, and less than 50 feet at a distance of 1000 feet from the well. The aquifer is capable of providing the water requirement and the extraction would not interfere with existing users.

Bechtel Civil & Minerals, Inc.

Interoffice Memorandum

To T. A. McCormick

File No.

Subject Capacity of the Test Well
Carrisa Plain Solar Project
job #16413

Date June 25, 1984

From C. R. Farrell

Of H&CF/Geology

Copies to M. J. Adair(w/o enc.)
L. R. West (w/o enc.)

At 45/31 Ext.

In the meeting Thursday, June 21, 1984 you asked that I evaluate the capability of the test well at the Carrisa Plain site to meet a maximum seasonal water requirement of 190 gpm for 4 months (June - September) and a 24-hour peak demand of 250 gpm. These maximum demands are for the design long-term mean of 115 gpm. In addition, you asked that I provide an estimate of the long-term maximum capacity of the well. Long-term is assumed to be represented by a 20-year operational period. The following summarizes those estimates. Copies of the pumping test data and calculations on which the estimates are based are enclosed.

Review of the data and analyses of the pumping test conducted at the well (well 3A) in May indicates that it is capable of yielding the design water requirement (115 gpm) and could meet the seasonal and peak maximum demands.

The maximum long-term capacity of the well is estimated based on several assumptions, or conditions. These include:

1. Pump set at 490 feet depth.

2. Potentiometric surface of the ground-water basin declines at a rate of 1 foot per year (storage depletion by others).

3. Initial efficiency of well is maintained.

4. Seasonal and peak demands are proportional to those demands determined for design water requirements (115 gpm).

Based on these conditions, the maximum long-term mean capacity of the well is calculated to be 170 gpm.

CR Farrell

CRF/jt

C. R. Farrell

CALCULATION COVER SHEET

BECHTEL

PROJECT Carrisa Plain Solar Power JOB NO. 16413 DISCIPLINE Geology

SUBJECT Ground water supply - test well analysis FILE NO.

CALC.NO.

ORIGINATOR J. C. Isham DATE 5/10/84

CHECKER C. R. Farrell DATE 6/10/84 NO. OF SHEETS 10

RECORD OF ISSUES

NO.	DESCRIPTION	BY	DATE	CHKD	DATE	APPRD	DATE	DATE FILMED
0	Analysis of well test	JCI	5/10/84	CRF	6/13/84	CRF	6/22/84	

PRELIMINARY CALC. ☐ COMMITED PRELIMINARY DESIGN CALC. ☒

SUPERSEDED CALC. ☐ FINAL CALC. ☐

STATEMENT OF PROBLEMS:

1. Analyze pumping test to determine aquifer characteristics
2. Determine capacity of aquifer to provide design water requirements and estimate of maximum yield of well

SOURCES OF DESIGN CRITERIA:

Project: average water requirement of 150 AcFt/yr or approximately 115 gpm, and maximum seasonal demand of 190 gpm during summer period: June - September (4 months)

SOURCES OF FORMULA & REFERENCES:

"Ground Water and Wells", Johnson Division, UOP Inc., 1980

0510 (11-74)

BECHTEL

CALCULATION SHEET

DATE 6/10/84

DESIGN BY J.C. Isham DATE 5/10/84 CHECKED BY CRFarrell SHEET NO. 1 of ~~8~~ ~~9~~ 10

PROJECT Carrisa Plains Solar JOB NO. 16413

SUBJECT Analysis of W3A pumping Test. CALCULATION NO. FILE NO.

Analyses the drawdown & recovery data by the Jacob method from Johnson's Ground Water & Wells, UOP INC, 1980

Drawdown data

$$T = \frac{264 \times Q}{\Delta s}$$

Recovery data

$$T = \frac{264 \times Q}{\Delta s'}$$

where:
- T = Transmissivity (gal/day/ft)
- Q = Pumping rate (gal/min)
- Δs = Drawdown over one log cycle of time since pumping started (ft)
- $\Delta s'$ = Residual drawdown over one log cycle of the ratio of t/t' (ft)
- t = Time since pumping started (MIN)
- t' = Time since pumping stopped (MIN)

BECHTEL

CALCULATION SHEET 0510 (11-74)

DESIGN BY J. C. Isham DATE 5/10/84 CHECKED BY CRFarrell DATE 6/10/84 SHEET NO. 2 of ~~8~~ 18

PROJECT Carrisa Plains Solar JOB NO. 16413

SUBJECT W3A Pumping Test CALCULATION NO. FILE NO.

1) Analysis of Drawdown data (See Page 3)

The test started at 0945 on 5/2/84 at a rate of 305 gpm. After 90 mins. of pumping at 305 gpm the rate had to decreased due to mechanical problem with the diesel engine that drives the pump.

The analysis of the early data 0-90 mins. indicates a T of 1300 gpd/ft (curve "a")

From 90 to 4335 mins. the pumping rate varied from 254 to 268 gpm. The average pumping rate through out the entire test was approx. 265 gpm.

The analysis of the later data 1550 - 4335 mins. indicates a T of 2000 gpd/ft (curve "b")

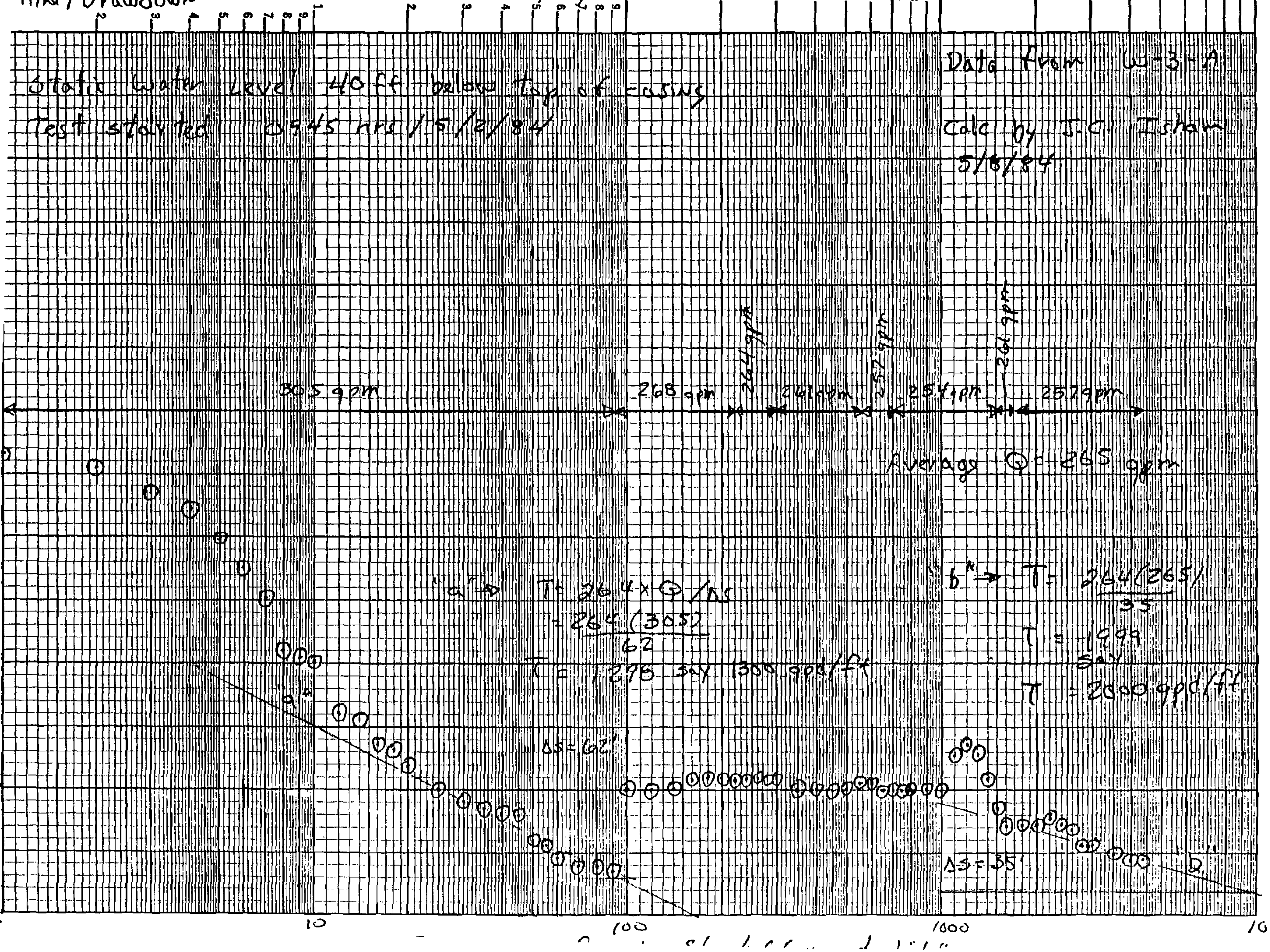
An average T from the drawdown data is 1650 gpd/ft

K+E SEMI-LOGARITHMIC 46 6012
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Job # 16413

Pumping Test on Well W-3-A

Time/Drawdown Plot



0510 (11-74)

BECHTEL

CALCULATION SHEET

DESIGN BY J.C. Isham DATE 5/10/84 CHECKED BY CRFarrell DATE 6/10/84 SHEET NO. 4 of 8 10

PROJECT Carrisa Plains Solar JOB NO. 16413

SUBJECT W3A Pumping Test CALCULATION NO. ____ FILE NO. ____

2) Analysis of Recovery Data (See Page 5

The pump was stopped at 1000 on 5/5/84 after 4335 mins. of operation. The average pumping rate was approx. 265 gpm.

Two curves are drawn through the recovery data

Curve "c" is a fit of the early and late time recovery data. This curve indicates a T of 2400 gpd/ft.

Curve "d" is a fit of only the early time recovery data. This curve indicates a T of 3200 gpd/ft.

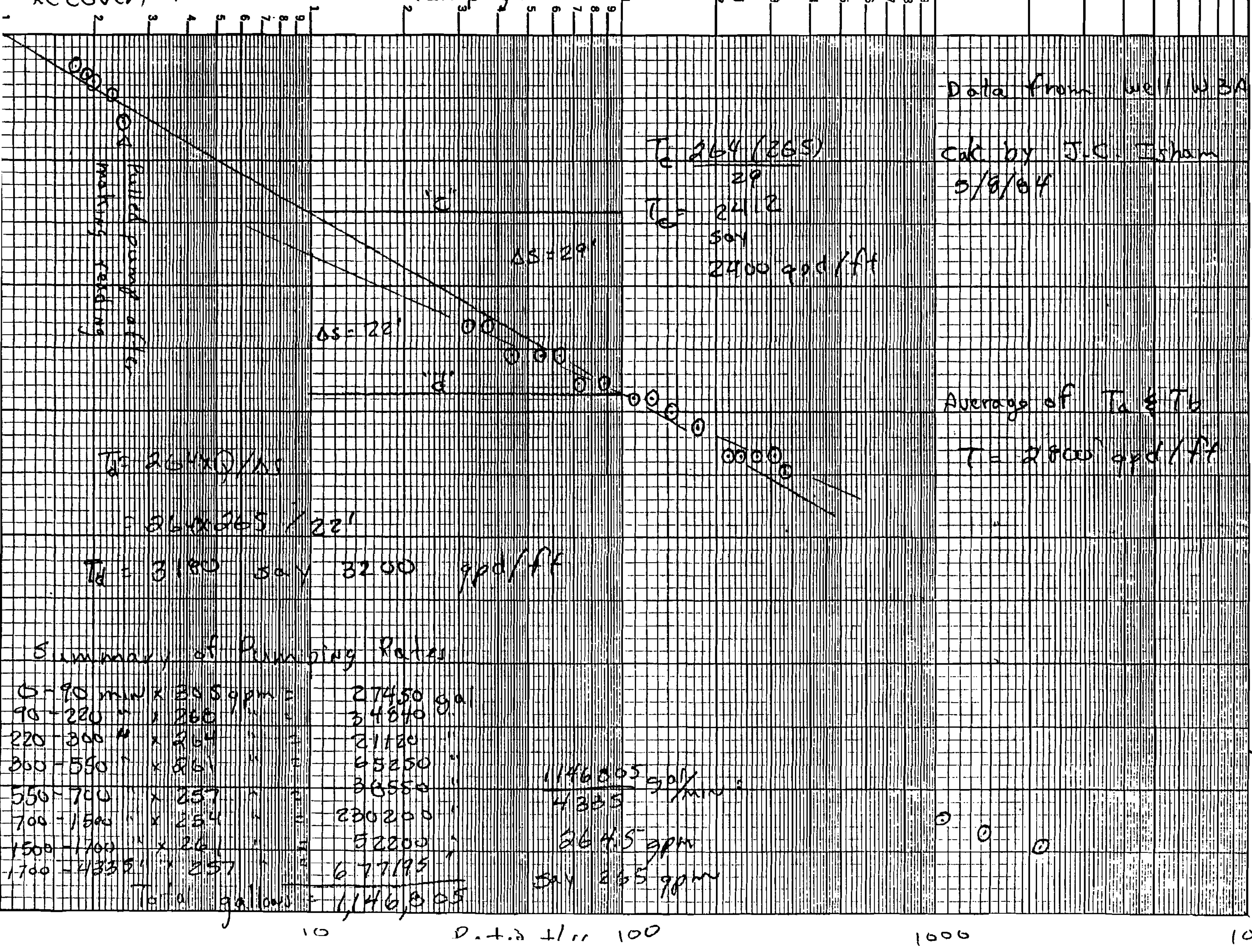
An average T from the recovery data is 2800 gpd/ft

KΣ SEMI-LOGARITHMIC 46 6012
4 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Carrisa, 110]W
Job # 16413

Recovery Plot

Pumping test in Well W-3-A



0510 (11-74)

CALCULATION SHEET

BECHTEL

DATE 6/10/84

DESIGN BY J.C. Isham DATE 5/10/84 CHECKED BY CRK SHEET NO. 6 of ~~8~~ 10

PROJECT Carrisa Plains Solar JOB NO. 164B

SUBJECT W3A Pumping Test CALCULATION NO. FILE NO.

Because problems involved in the intreprotion of all of the drawdown data:

1) change in pumping rate
2) early curve to short for a good analysis of T.
3) what caused the relatively sharp rise & fall of water Level between 1000 & 1500 mins.

it is believed that the recovery data gives a better measurement of Transmissivity of the aquifer. T= 2800 gpd/ft

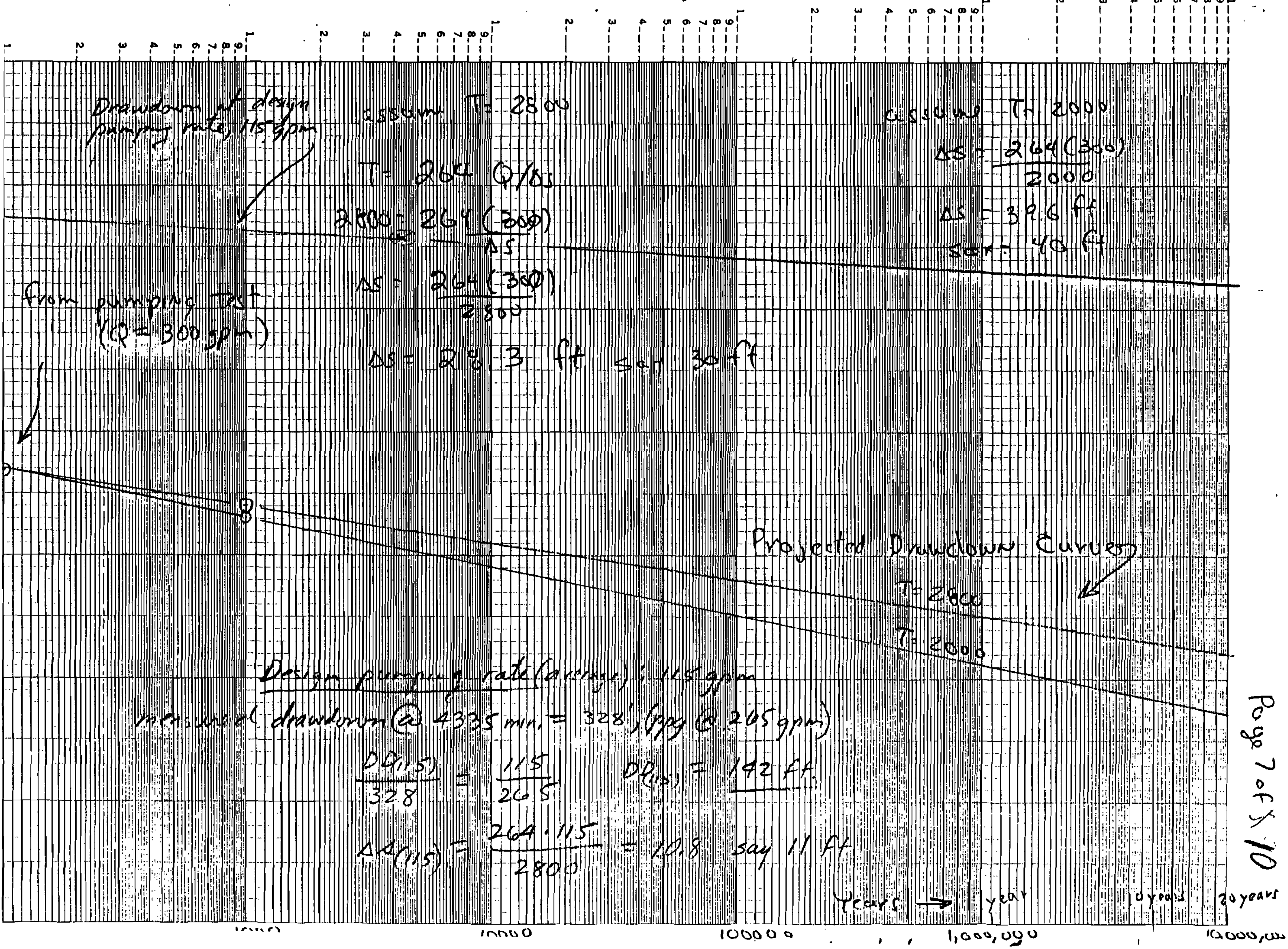
Using the data from the pumping test ie: 330' of drawdown after 90 mins. & a T of 2000 gpd/ft The projected drawdown after 20 years of pumping is shown on page 7

Assu[illegible]

1) [illegible]

2) Coeffi[illegible] ([illegible])

Job # 16413



assume T = 2800

$T = 264\,Q/\Delta s$

$2800 = \frac{264\,(300)}{\Delta s}$

$\Delta s = \frac{264\,(300)}{2800}$

$\Delta s = 28.3$ ft say 30 ft

assume T = 2000

$\Delta s = \frac{264\,(300)}{2000}$

$\Delta s = 39.6$ ft

say 40 ft

<u>Design pumping rate (average): 115 gpm</u>

measured drawdown @ 4335 min. = 328', pmpg @ 265 gpm

$\frac{DD_{(115)}}{328} = \frac{115}{265}$ $DD_{(115)} =$ <u>142 ft.</u>

$\Delta A_{(115)} = \frac{264 \cdot 115}{2800} = 10.8$ say 11 ft

KE SEMI-LOGARITHMIC
3 CYCLES X 70 DIVISIONS MADE IN U.S.A.
KEUFFEL & ESSER CO.

Carrisa Plain Project
Job # 16413 June 14/84

$s = \frac{Q}{4\pi T} \ln\left(\frac{2.25\, Tt}{r^2 S}\right)$

$T = 335\ ft^2/d$
$S = 0.001$
$r = 0.5'$
$t = 3$ days
$Q = 265$ gpm $= 5.10E^4\ ft^3/d$

$s = \frac{5.10E^4}{4\pi\, 335} \ln\left(\frac{2.25 \cdot 335 \cdot 3}{(0.5)^2\, 0.001}\right)$

$= 194'$ (theoretical)

$= 328'$ (measured in well)

efficiency: $\frac{\text{theoretical DD}}{\text{measured DD}} = \frac{194}{328}$

$= 60\%$

$\Delta s = \frac{528\ Q}{T} = \frac{528 \cdot 115}{2800}$

$= 21.7$ say $22'$

theoretical DD after 20 years @ distance of 100 ft from well: (pumping 115 gpm)

$s = \frac{2.214E^4}{4\pi\, 335} \ln\left(\frac{2.25 \cdot 335 \cdot 7300}{(100)^2\, 0.001}\right)$

$= 69.5$ say $70'$

at well ($r = 0.5$)

$s = 125'$

$s_{60} = 125/_{0.6} = 208'$

1 10 100 1000 10,000

Distance from well (feet)

0510 (11-74)

BECHTEL

CALCULATION SHEET

DATE ______

DESIGN BY ______ DATE 6/30/84 CHECKED BY ______ SHEET NO. ______

PROJECT Carrisa Plain Solar Power JOB NO. 16413

SUBJECT Ground Water Supply CALCULATION NO. ______ FILE NO. ______

Determine maximum probable yield (long-term = 20 years) of test well:

Assumed conditions:

1. Pump set at depth of 490' (10 feet above reducer to 8-inch ϕ casing)
2. Initial depth to water is 40'
3. No recharge to ground water basin
4. Decline of potentiometric surface in basin (depletion of storage by others) is 1'/yr, or 20' in 20 years
5. Well efficiency maintained @ initial level (60%)
6. Maximum seasonal demand is $\frac{190}{115}$ of the long-term mean and is for 4 months duration (based on project calculation of 190 gpm during June – Sept for mean of 115 gpm).

Then: Available drawdown is 490 - 40 - 20 = 430' (at 20 yr)

Approach:

1. Calculate additional drawdown of maximum season for design long-term mean (115 gpm) and add to drawdown at 20 years of 115 gpm (180 feet, from p. 7 of calc).
2. Solve for maximum long-term mean as proportional to drawdown of 115 gpm with maximum seasonal correction

Added drawdown @ 20 years:

$$s = \frac{Q}{0.6 \cdot 4\pi T} \ln\left(\frac{2.25\,Tt}{r^2 S}\right)$$

0510 (11-74)

BECHTEL

CALCULATION SHEET

DATE

DESIGN BY C Farrell DATE 6/22/84 CHECKED BY SHEET NO. 10 of 10

PROJECT Carrisa Plain Solar Power JOB NO. 16413

SUBJECT Ground Water Supply CALCULATION NO. FILE NO.

$T = 2800\ gpd/ft = 335\ ft^2/d$

$S = 0.001$

$r = 0.5'$

$t = 4\ months = 120\ days$

$Q = 190 - 115 = 75\ gpm$

$= 1.444E^4\ ft^3/d$

$$s = \frac{1.444E^4}{0.6 \cdot 4 \cdot \pi \cdot 335} \ln\left(\frac{2.25 \cdot 335 \cdot 120}{(0.5)^2 \cdot 10^{-3}}\right)$$

$= \underline{112\ ft}$

Then:

$$\frac{\text{Maximum (long-term mean)}}{115\ gpm\ \text{(long-term mean)}} = \frac{430'\ \text{(available drawdown)}}{150 + 112}$$

$$Max = \frac{115 \cdot 430}{292} = 169.35\ gpm$$

say 170 gpm

BECHTEL AQUIFER PUMPING TEST

OBSERVATION WELL W-3A

PROJECT Carrisa Plains JOB No. 16413

TEST TYPE CONSTANT DISCHARGE DATE TEST BEGUN 5-2-84

PUMPING WELL W-3A DIST. TO PPG WELL same (____)

SCREEN DEPTH (____): PPG WELL 530-550-570-600 OBS. WELL ____

FLOW MEAS. METHOD 6X4 ORIFICE PUMP Johnson #4137 8"dia - 17 stage

PUMPING RATE / HISTORY ____

PUMPING PERIOD ____

REFERENCE POINT AIRLINE 3' ABOVE L.S. ELEVATION ____

LOCATION (approx. top of casing) OBSERVER Layne Western, West & Isham

STATIC W.L. 15.16 FT PH 5.51 COND 1500 WATER TEMP 74°

	TIME (24 HR) DAY	TIME-AFTER PUMP ON (MIN)	DEPTH TO WATER (FT)	DRAW DOWN (FT)	DISCHARGE (____)	TIME (24 HR) DAY	TIME-AFTER PUMP ON (____)	DEPTH TO WATER (____)	DRAW DOWN (____)	DISCHARGE (____)
	9:45 AM	0	40'	0'	START PUMP	12:05PM	140	340'	300'	268
	9:46	1	206'	166'	305	12:25	160	336'	296'	268
	9:47	2	213'	173'	305	12:45	180	336'	296'	268
	9:48	3	222'	182'	305	1:05	200	336'	296'	268
	9:49	4	229'	189'	305	1:25	220	336'	296'	268
	9:50	5	241'	201'	305	1:45	240	336'	296'	264
	9:51	6	252'	212'	305	2:05	260	336'	296'	264
	9:52	7	264'	224'	305	2:25	280	336'	296'	264
	9:53	8	285'	245'	305	2:45	300	336'	296'	264
	9:54	9	287'	247'	305	3:30	350	340'	300'	261
WD TEST	9:55	10	289'	249'	305	4:20	400	340'	300'	261
0.10 cc	9:57	12	310'	270'	305	5:10	450	340'	300'	261
	9:58	14	313'	273'	305	6:00	500	340'	300'	261
	10:01	16	322'	282'	305	6:50	550	338'	298'	261
	10:03	18	324'	284'	305	7:45	600	338'	298'	257
0.20 cc	10:05	20	331'	291'	305	8:30	650	340'	300'	257
	10:10	25	340'	300'	305	9:20	700	340'	300'	257
0.30 cc	10:15	30	345	305'	305	10:10	750	340'	300'	254
	10:20	35	347'	307'	307	11:00	800	340'	300'	254
	10:25	40	350'	310'	305	11:50	850	340'	300'	254
0.40 cc	10:30	45	350'	310'	305	5-3-84 12:40AM	900	340'	300'	254
	10:35	50	361'	321	305	1:30	950	340'	300'	254
	10:40	55	363'	323'	305	2:20	1000	340'	300'	254
	10:45	60	368'	328'	305	4:00	1100	326'	286'	254
	10:55	70	370'	330'	305	5:40	1200	322'	282'	254
	11:05	80	370'	330'	302	7:20	1300	326'	286'	254
	11:15	90	373'	333'	302	9:00	1400	336'	296'	254
	11:25	100	340'	300'	268	10:40	1500	347'	307'	254
0.40 cc	11:45	120	340'	300'	268	12:20PM	1600	354'	314'	261

AQUIFER PUMPING TEST

OBSERVATION WELL W-3A

PROJECT Carrisa Plains JOB No. 16413

TEST TYPE CONSTANT DISCHARGE DATE TEST BEGUN 5-2-84

PUMPING WELL W-3A DIST. TO PPG WELL same ( )

	TIME (24 HR) DAY	TIME-AFTER PUMP ON ( )	DEPTH TO WATER ( )	DRAW DOWN ( )	DISCHARGE ( )	TIME (24 HR) DAY	TIME-AFTER PUMP ON ( )	DEPTH TO WATER ( )	DRAW DOWN ( )	DISCHARGE ( )
	12:20PM	1600	354'	314'	261					
	2:00	1700	354'	314'	261					
	3:40	1800	354'	314'	257					
	5:20	1900	354'	314'	257					
	7:00	2000	354'	314'	257					
	8:40	2100	354'	314'	257					
	10:20	2200	352'	312'	257					
5-4-84	12:00AM	2300	354'	314'	257					
	1:40	2400	354'	314'	257					
	3:20	2500	354'	314'	257					
	5:00	2600	356'	316'	261					
	6:40	2700	363'	323'	257					
	8:20	2800	363'	323'	257					
	10:00	2900	363'	323'	257					
	11:40	3000	363'	323'	257					
	1:20PM	3100	363'	323'	257					
	3:00	3200	363'	323'	257					
	4:40	3300	363'	323'	257					
	6:20	3400	363'	323'	257					
	8:00	3500	366'	326'	257					
	9:40	3600	366'	326'	257					
	11:20	3700	366'	326'	257					
5-5-84	1:00AM	3800	366'	326'	257					
	2:40	3900	368'	328'	257					
	4:20	4000	368'	328'	257					
	6:00	4100	368'	328'	257					
	7:40	4200	368'	328'	257					
	9:20	~~4300~~ 4295	368'	328'	257					
	10:00	~~4400~~	368'	328'	257	Pump off				
		4335								

PAGE 1 OF 1

AQUIFER PUMPING TEST

OBSERVATION WELL W3A

PROJECT Carrisa Plains JOB No. 16413

TEST TYPE Recovery Data DATE TEST BEGUN 5-2-84

PUMPING WELL W3A DIST. TO PPG WELL Same (____)

SCREEN DEPTH (____): PPG WELL ____ OBS. WELL ____

FLOW MEAS. METHOD ____ PUMP ____

PUMPING RATE / HISTORY Average Pumping Rate 265 gpm

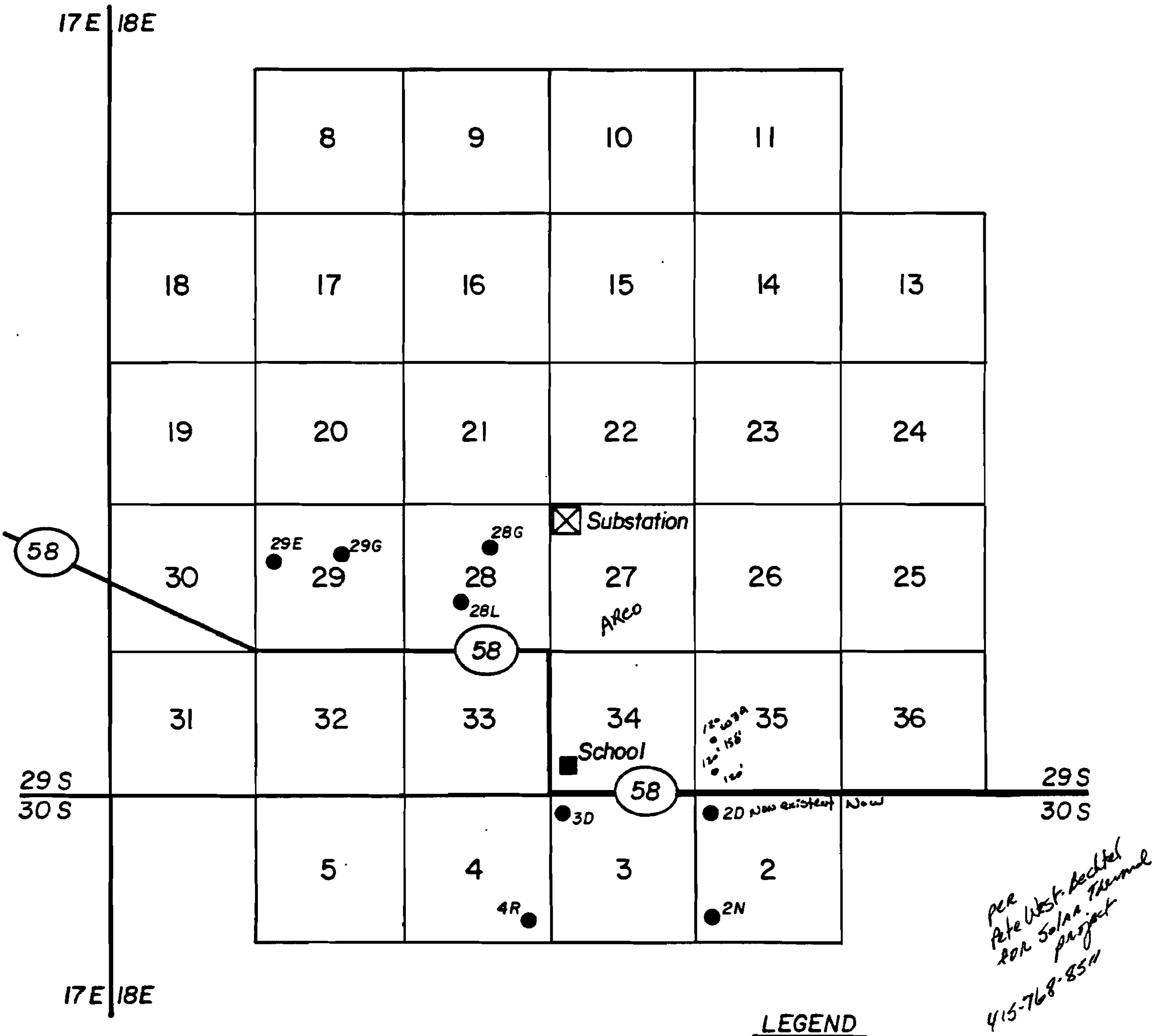
PUMPING PERIOD 4335 mins

REFERENCE POINT air line 3' above G.S. ELEVATION ____

LOCATION ____ OBSERVER J.C. Isham

Static Water Level 39.5

	TIME (24 HR DAY)	TIME-AFTER PUMP ~~ON~~ off	DEPTH TO WATER (ft)	DRAW DOWN (ft)	DISCHARGE (t/t')	TIME (24 HR DAY)	TIME-AFTER PUMP ON off	DEPTH TO WATER (ft)	DRAW DOWN (ft)	DISCHARGE (t/t')
5-5-84	1000	0	368	328.5		Reading adjusted to old R.P.				
		1	208.1	168.6	4335	1700	3300	49.2	9.7	2.31
		2	168.9	129.4	2169	1900	3420	48.9	9.4	2.27
		3	166.6	127.1	1446	5-8-84 0025	3745	48.2	8.7	2.16
		4	164.2	124.7	1085	0800	4200	47.0	7.5	2.03
		5	changed			1000	4320	46.9	7.4	2.0
		6	air	bottle		1430	4590	46.3	6.8	1.94
		7	No readings			1800	4800	45.8	6.3	1.9
		8				2300	5100	45.5	6.0	1.85
		9				5-9-84				
	1010	10				1120	5840	44.3	4.8	1.74
		12	108.8	69.3	362	1320	5960	43.9	4.4	1.73
		14	106.5	67.0	311					
		16	106.5	67.0	272					
		18	106.5	67.0	242					
	1020	20	106.5	67.0	218					
		25	101.9	62.4	174					
	1030	30	99.6	60.1	146					
		35	97.3	57.8	125					
	1040	40	97.3	57.8	109					
		50	94.9	55.4	88					
	1100	60	94.9	55.4	73					
		70	90.3	50.8	63					
	1120	80	90.3	50.8	55					
		100	90.3	50.8	44					
	1200	120	85.7	46.2	37					
		140	85.7	46.2	32					
5/7/84	1000	2880	53.4	13.9	2.5					
	Pulled	Pump	/New	R.P.						



LEGEND

18 *Section Number*

18G ● *Surveyed State-Numbered Wells*

CARRIZO PLAIN

LOCATIONS OF SURVEYED WELLS

1" = 1 mile

Engineering Research
005.41

Carrizo Plain Groundwater Quality
Solar Thermal Project

September 23, 1982

MR. R. E. PRICE:

Here is a copy of the April 19, 1982, letter to Mr. H. M. Howe: Attention Mr. D. A. Deniston, describing Carrizo Plain water availability and quality. Also, included is a rewrite of a portion of the above letter which includes a table of ranges and averages for the important parameters listed in Table 1 of the April 19 letter.

Because well depths are variable or unknown and we have no well logs to accompany this data, I cannot recommend these values for a design basis. I will pursue obtaining the appropriate well logs as soon as the project is authorized and well owners can be contacted. This will provide additional information to interpret water quality data. However, in the event that the logs that can be obtained do not provide sufficient information to give us confidence in existing water quality data, installation of an onsite monitoring well will be necessary.

This well will be designed specifically for groundwater quality monitoring. It will intersect all water bearing strata down to bedrock. This could be up to 600 feet for this area. Separate water quality sampling of each water bearing aquifer as well as a composite of the entire water column will be possible.

A conservative cost per foot for such a well would be $30. This includes drilling operating costs, and direct and nondirect costs for two operators, and one geologist. It also assumes an average drilling rate of 40 feet per day. Any drilling logs we receive will provide additional information on expected drilling rates and, subsequently, estimated costs.

ORIGINAL SIGNED

D. P. GRIFFIN

DPG

DPG(551-305):bav

Attachment

cc w/attach.: TAJenckes

cc w/o attach.: KABeede
DADeniston
RCKarfiol
TMTurner

TMT

+ 62-6218 (REV. 6/79)

PG and E

FOR INTRA—COMPANY USES

From Division or Department	Engineering Research
File No.	005.41
Re Letter of	
Subject	Solar Thermal Carrizo Plain and Cuyama Valley Water Availability
To Division or Department	

April 19, 1982

MR. H. M. HOWE:

Attention Mr. D. A. Deniston

This letter describes the availability of groundwater to supply a proposed solar thermal power plant which is to be located near one of two existing Company substations. One of the substations is in the northern portion of the Carrizo Plain (San Luis Obispo County), and the second is near the City of Cuyama in the south central portion of the Cuyama Valley (San Luis Obispo and Santa Barbara Counties). Figure 1 shows the approximate locations of these substations.

The Carrizo Plain and Cuyama Valley Groundwater Basins are part of the Department of Water Resources (DWR) Central Coastal Hydrologic Study Area. The Cuyama Basin is listed by DWR as subject to critical conditions of overdraft. The DWR definition of overdraft is: "A basin is subject to critical conditions of overdraft when continuation of present water management practices would probably result in significant adverse overdraft-related environmental, social, or economic impacts."

The Carrizo Basin does not have an overdraft problem; DWR believes that it "has a potential for limited to moderate additional development." In addition, the basin is considered to be an undeveloped groundwater reservoir by the U.S. Geological Survey (USGS).

Carrizo Plain Basin

This basin's groundwater storage capacity, as listed by DWR in 1975, is 400,000 acre-ft. The usable capacity is one-fourth of the storage capacity or 100,000 acre-ft. The basin's estimated safe seasonal yield is 600 acre-ft per year which is equal to the natural recharge of the basin.

Groundwater wells in the Carrizo Basin yield instantaneous average flows of 500 gallons per minute (gpm) with maximum flows of 1000 gpm. 500 gpm flowing for a year's time is equivalent to over 800 acre-ft per year, greater than the amount of water required (500 to 600 acre-ft) to supply the proposed solar power plant.

Wells in the area of the substation have depths ranging from 175 to 600 feet. A well located approximately two miles south of the substation was pump tested by PGandE in 1966. The well had a standing water depth (water table) of 138 feet. During the pump test, a 60 hp motor pumped 2.68 acre-ft of groundwater in 24 hours. The pumping lowered the water table to approximately 235 feet at the well.

We have requested DWR to transmit to us well log information of state-numbered wells in the area of the substation. This information will provide us with more complete data as to the depth of the wells, depths to water, and well pumping yields. The state-numbered wells within a 32 square area (approximately three-mile radius) about the Company substation located north of Highway 58 are shown by Figure 2. There are other groundwater wells in the area; however, only the eight wells shown have state well-numbers and consequently have DWR well data.

Available groundwater quality data for each of the eight wells, for selected sampling dates, were tabulated. These are shown by Table 1. Data summarized by sections (one square mile) and for the total area are shown by Table 2.

The hardness of the groundwater in mg/l varied from 154 to 363 with an overall average of 240 as $CaCO_3$. The calcium ion concentration in mg/l varied from 34 to 71 with an overall average of 58. The overall water quality of the groundwater was better in Township 30 South, Range 18 East-Sections 3 and 4 and Township 29 south, Range 18 east-Section 29. These sections are located in the south and west portions of the area and one to over two miles from the substation.

In general, the presently available data indicate adequate, easily accessible, and good quality groundwater is available near the proposed Carrizo Plain site.

Cuyama Valley Basin

The Cuyama Basin groundwater storage capacity, as listed by DWR in 1975, is 2,100,000 acre-ft. The usable capacity is one-fifth of the storage capacity or 400,000 acre-ft. The basin's safe seasonal yield is 6,600 acre-ft per year. In the late seventies, use of the basin's groundwater was 54,000 acre-ft per year which is eight times the safe seasonal yield. Groundwater levels have declined 60 to 200 feet in the central and western portions of the basin between 1950 and the late seventies. As discussed earlier, the Cuyama Valley Basin is subject to critical overdraft with resulting continual decline of groundwater levels. The DWR reports, "No sound alternatives for stemming this declining trend short of adjudication are apparent. Importation of water from distant sources for agricultural use appears to be beyond the payment capacity of crops currently raised or suitable to the area."

In 1975, well depths ranged from 100 to 300 feet and the instantaneous pumping yields of typical basin wells were high, averaging 1,100 gpm with a maximum of 1,440 gpm.

The known state-numbered groundwater wells within a 29 square mile area around the Company substation near Cuyama are shown by Figure 3. There are other groundwater wells in the area; however, only the wells shown have state well-numbers and consequently have DWR well data. We have requested DWR to transmit to us well log information of the state-numbered wells. This information will provide us with more complete data as to the depth of the wells, depths to water, and well pumping yields.

Available groundwater quality data for 21 state-numbered wells, for selected sampling dates, were tabulated. These are shown by Table 3. Data summarized by sections and for the total 29 square mile area are shown by Table 4.

Total hardness in mg/l varied from 253 to 1917 with an average of 1188 as $CaCO_3$. Calcium ion concentration in mg/l varied from 75 to 465 with an average of 252. The best quality water is found in Sections 21 of Township 10 North, Range 26 West, and all of the sections shown of Township 10 North, Range 25 West. The poorest quality groundwater is found in Sections 22 and 24 of Township 10 North, Range 26 West. The Company substation is located in Section 24.

The present available data indicate the groundwater of the Cuyama Valley Basin near the proposed site is only of fair quality. Groundwater is presently available in quantity, but the basin's overdraft problem may interfere with the long-term availability of groundwater for power plant use.

Hydrologic data for this letter was obtained from the California Department of Water Resources (DWR) Water Data Information System, DWR's Bulletins 18 and 118, Ground Water Basins in California; the State Water Resources Control Board's Central Coastal Basin Water Quality Control Plan; and the U.S. Geological Surveys' Professional Paper 813-E, Summary Appraisals of the Nation's Ground-Water Resources - California Region. The DWR's Fresno and Los Angeles offices were also contacted for additional information.

To assist in locating groundwater wells, an index to the Township and Range System of California is attached as Figure, 4 and the State Well-Numbering System is attached as Figure 5.

T. M. Turner
T. M. TURNER

TMT(551-459):sm
Attachment
cc w/attach: THillesland RCKarfiol/DPGriffin
TAJenckes

Table 1

Northern Carrizo Plain Groundwater Quality
(Quality of well waters located within three miles of Company substation)

	Well Location (Township/Range-Section + Well No.)					
	29S/18E-28G01	29S/18E-28L01	29S/18E-28L01	29S/18E-28L01	29S/18E-28L01	29S/18E-28L01
Date	10/22/68	10/22/65	10/11/66	11/04/67	10/22/68	11/18/70
Temperature, °F/°C	-/-	69/21	66/19	62/17	-/-	56/13
pH, Field	-	-	-	-	-	-
pH, Lab	7.4	7.9	8.0	8.2	8.1	8.0
Electrical Conductivity Field, mhos/cm	-	-	-	-	-	-
Lab, mhos/cm	1387	1143	1150	1123	875	1191
Calcium Ion, mg/l	75	71	-	72	39	81
Magnesium Ion, mg/l	27	20	-	16	15	18
Sodium Ion, mg/l	180	145	-	148	125	143
Potassium Ion, mg/l	2.0	1.0	-	1.0	1.0	.0
Alkalinity as $CaCO_3$, mg/l	4	136	131	137	127	147
Sulfate Ion, mg/l	533	260	-	239	119	223
Chloride Ion, mg/l	98	74	70	74	81	65
Nitrate Ion, mg/l	2.3	80.0	70.0	87.0	70.0	130
Boron, mg/l	.54	.68	-	.59	.57	.75
Fluoride Ion, mg/l	.7	.6	-	.6	.8	.6
Silica, mg/l	-	-	-	-	-	-
Total Dissolved Solids, mg/l	957	750	-	727	564	805
Total Hardness, mg/l	298	259	-	246	151	276
Noncarbonate Hardness, mg/l	294	121	-	109	24	129
Sodium Absorption Ratio	4.5	3.9	-	4.1	4.4	3.7

Table 1 - contd.

	Well Location (Township/Range-Section + Well No.)					
	29S/18E-28L01	29S/18E-28L01	29S/18E-28L01	29S/18E-29E01	29S/18E-29G01	30S/18E-02D01
Date	11/04/74	10/25/76	10/31/77	10/21/53	10/04/72	10/22/68
Temperature, °F/°C	62/16.7	59/15	60/16	-/-	-/-	-/-
pH, Field	-	-	-	-	-	-
pH, Lab	8.3	8.0	8.2	8.1	8.3	7.4
Electrical Conductivity Field, mhos/cm	-	-	-	-	-	-
Lab, mhos/cm	1111	1156	1040	885	1053	1478
Calcium Ion, mg/l	71	78	80	47	49	118
Magnesium Ion, mg/l	17	20	19	15	16	28
Sodium Ion, mg/l	148	142	150	135	147	187
Potassium Ion, mg/l	1.2	.8	.2	0	1.6	1.0
Alkalinity as CaCO3, mg/l	148	155	167	153	142	136
Sulfate Ion, mg/l	215	236	239	166	197	515
Chloride Ion, mg/l	75	80	77	57	69	83
Nitrate Ion, mg/l	104	97.0	88.2	34.3	33.0	38.3
Boron, mg/l	.67	.69	.65	.60	.64	.75
Fluoride Ion, mg/l	.6	.5	.6	.7	.8	.7
Silica, mg/l	-	-	-	-	-	-
Total Dissolved Solids, mg/l	727	797	847	635	691	1102
Total Hardness, mg/l	247	274	278	179	169	410
Noncarbonate Hardness, mg/l	90	122	111	26	47	274
Sodium Absorption Ratio	3.9	3.7	3.9	4.6	4.7	4.0

Table 1 - contd.

	Well Location (Township/Range-Section + Well No.)					
	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01
Date	03/12/54	10/02/58	07/30/59	10/04/60	04/19/61	10/31/61
Temperature, °F/°C	-/-	-/-	68/20	68/20	70/21	58/14
pH, Field	-	-	-	-	-	-
pH, Lab	7.7	7.2	7.2	7.7	7.7	8.0
Electrical Conductivity Field, mhos/cm	-	-	-	-	-	-
Lab, mhos/cm	602	792	685	875	810	836
Calcium Ion, mg/l	52	60	58	74	69	66
Magnesium Ion, mg/l	16	25	22	24	21	24
Sodium Ion, mg/l	60	33	58	70	71	81
Potassium Ion, mg/l	1.0	3.0	2.0	1.0	1.0	2.0
Alkalinity as CaCO3, mg/l	152	194	158	191	184	180
Sulfate Ion, mg/l	73	69	110	149	30	151
Chloride Ion, mg/l	39	64	45	52	48	57
Nitrate Ion, mg/l	43.0	6.0	31.0	30.0	45.0	31.0
Boron, mg/l	.18	.20	.20	.40	.19	.16
Fluoride Ion, mg/l	.6	.4	.1	.5	.3	.3
Silica, mg/l	-	20.0	30.0	33.0	35.0	32.0
Total Dissolved Solids, mg/l	396	505	500	384	691	541
Total Hardness, mg/l	187	255	235	285	259	263
Noncarbonate Hardness, mg/l	35	59	77	92	75	63
Sodium Absorption Ratio	1.9	2.3	1.0	1.8	2.9	2.3

Table 1 - contd.

	Well Location (Township/Range-Section + Well No.)					
	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01	30S/18E-02N01
Date	10/22/62	10/10/63	10/07/64	10/22/65	11/04/67	10/22/68
Temperature, °F/°C	67/19	66/19	-/-	69/19	62/17	-/-
pH, Field	-	-	-	-	-	-
pH, Lab	7.9	8.0	7.8	7.9	8.2	8.0
Electrical Conductivity Field, mhos/cm	-	-	-	-	-	-
Lab, mhos/cm	720	670	765	884	866	909
Calcium Ion, mg/l	61	48	62	77	77	76
Magnesium Ion, mg/l	20	28	20	22	19	24
Sodium Ion, mg/l	60	62	63	60	83	86
Potassium Ion, mg/l	1.0	1.0	1.0	1.0	2.0	1.0
Alkalinity as CaCO3, mg/l	162	166	166	180	175	167
Sulfate Ion, mg/l	15	125	117	158	150	176
Chloride Ion, mg/l	39	41	36	34	62	62
Nitrate Ion, mg/l	36.0	36.0	40.0	39.0	40.0	45.0
Boron, mg/l	.20	.32	.24	.26	.20	.29
Fluoride Ion, mg/l	.4	.1	.4	.3	.4	.3
Silica, mg/l	40.0	31.0	38.0	-	-	-
Total Dissolved Solids, mg/l	430	494	440	600	570	625
Total Hardness, mg/l	234	235	237	293	270	289
Noncarbonate Hardness, mg/l	72	69	71	95	95	121
Sodium Absorption Ratio	1.7	1.8	1.8	2.1	2.2	2.5

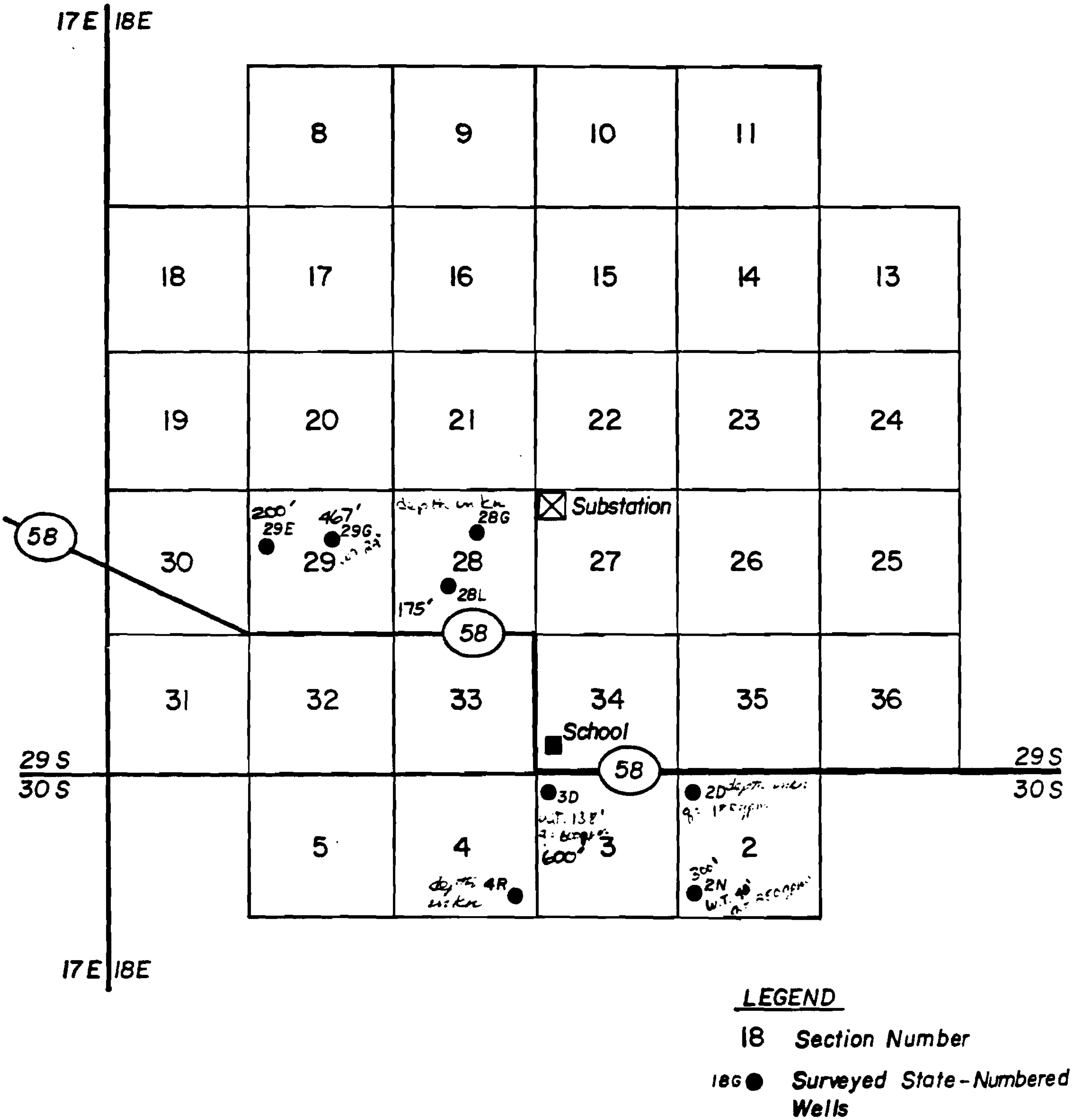
Table 1 - contd.

	Well Location (Township/Range-Section + Well No.)		
	30S/18E-02N01	30S/18E-03D01	30S/18E-04R01
Date	11/18/70	11/09/72	10/22/68
Temperature, °F/°C	62/17	68/20	-/-
pH, Field	-	-	-
pH, Lab	7.8	7.9	7.9
Electrical Conductivity Field, mhos/cm	-	-	-
Lab, mhos/cm	1030	513	514
Calcium Ion, mg/l	94	43	34
Magnesium Ion, mg/l	20	15	12
Sodium Ion, mg/l	101	38	52
Potassium Ion, mg/l	.0	1.5	1.0
Alkalinity as CaCO3, mg/l	180	136	136
Sulfate Ion, mg/l	205	85	83
Chloride Ion, mg/l	74	32	32
Nitrate Ion, mg/l	55.0	36.3	56.3
Boron, mg/l	.26	.07	.07
Fluoride Ion, mg/l	.3	.3	.3
Silica, mg/l	-	-	-
Total Dissolved Solids, mg/l	706	356	346
Total Hardness, mg/l	317	169	154
Noncarbonate Hardness, mg/l	131	31	23
Sodium Absorption Ratio	2.5	1.9	2.0

Table 2

Northern Carrizo Plan
Average Well Water Quality Within Three Miles of Substation
(Averaged by Sections and by Total Area)

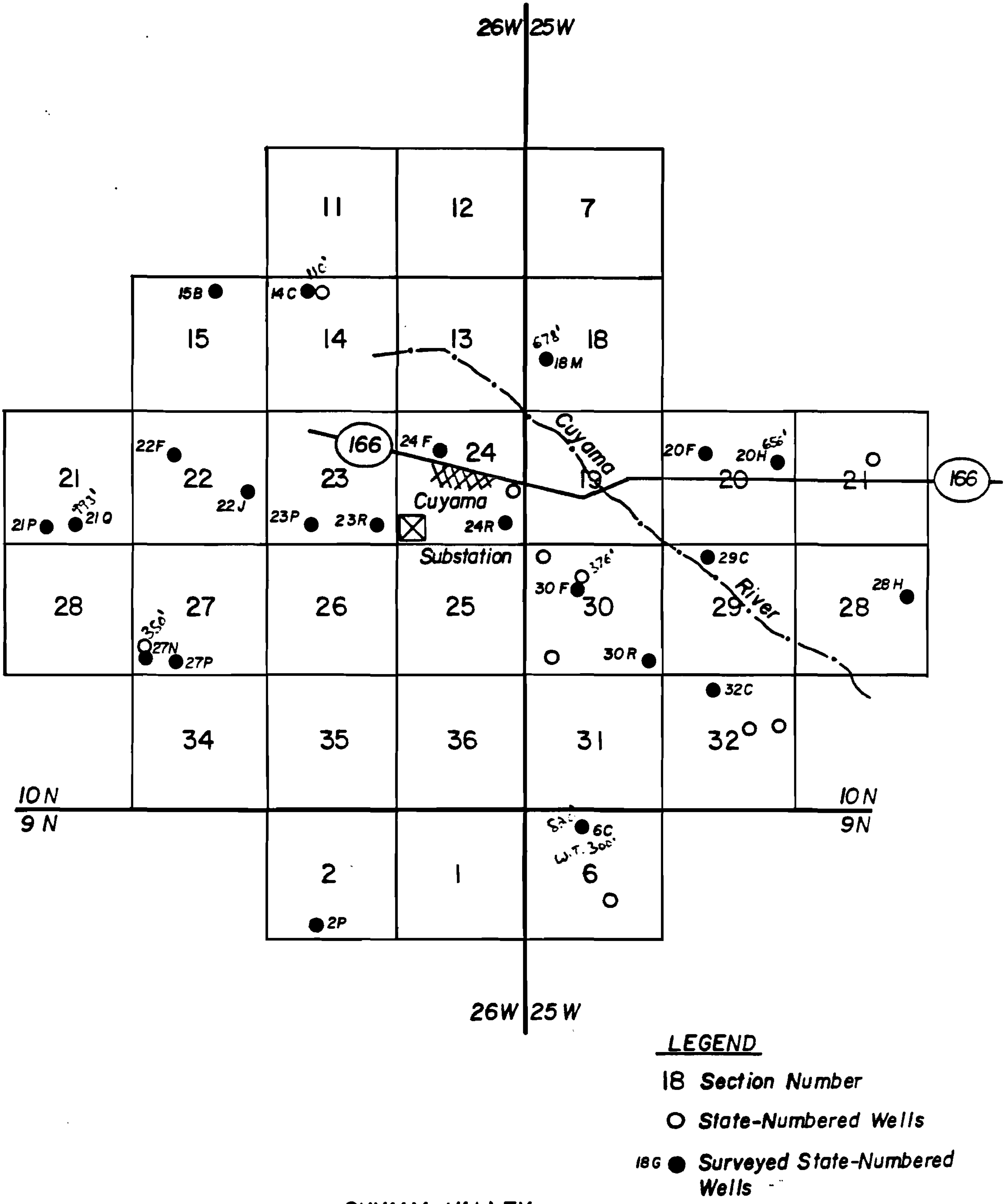
	Section Summary Well Location (Township/Range-Section)					Total Area Summary
	29S/18E-28	29S/18E-29	30S/18E-02	30S/18E-03	30S/18E-04	
No. of Wells Surveyed	2	2	2	1	1	8
Dates Sampled	10/65-10/77	10/53-10/72	3/54-10/77	11/72	10/68	10/53-10/77
Temperature, °F	62	-	65	68	-	65
pH	8.0	8.2	7.8	7.9	7.9	8.0
Electrical Conductivity, mhos/cm	1131	969	844	513	514	864
Calcium Ion, mg/l	71	48	69	43	34	58
Magnesium Ion, mg/l	19	15	22	15	12	18
Sodium Ion, mg/l	148	141	77	38	52	101
Potassium Ion, mg/l	.9	.8	1.2	1.5	1.0	1.1
Alkalinity as CaCO3, mg/l	142	148	173	136	136	150
Sulfate Ion, mg/l	258	182	161	85	83	171
Chloride Ion, mg/l	77	63	51	32	32	56
Nitrate Ion, mg/l	81	34	37	36	56	47
Boron, mg/l	.64	.62	.27	.07	.07	.4
Fluoride Ion, mg/l	.6	.8	.4	.3	.3	.5
Silica, mg/l	-	-	32	-	-	32
Total Hardness, mg/l	254	174	363	169	154	240
Noncarbonate Hardness, mg/l	125	37	95	31	23	72
Sodium Absorption Ratio	4	4.7	2.1	1.9	2.0	3.2
Total Dissolved Solids, mg/l	772	663	563	356	346	583



CARRIZO PLAIN

LOCATIONS OF SURVEYED WELLS

1" = 1 mile



CUYAMA VALLEY

LOCATIONS OF SURVEYED WELLS

1" = 1 mile

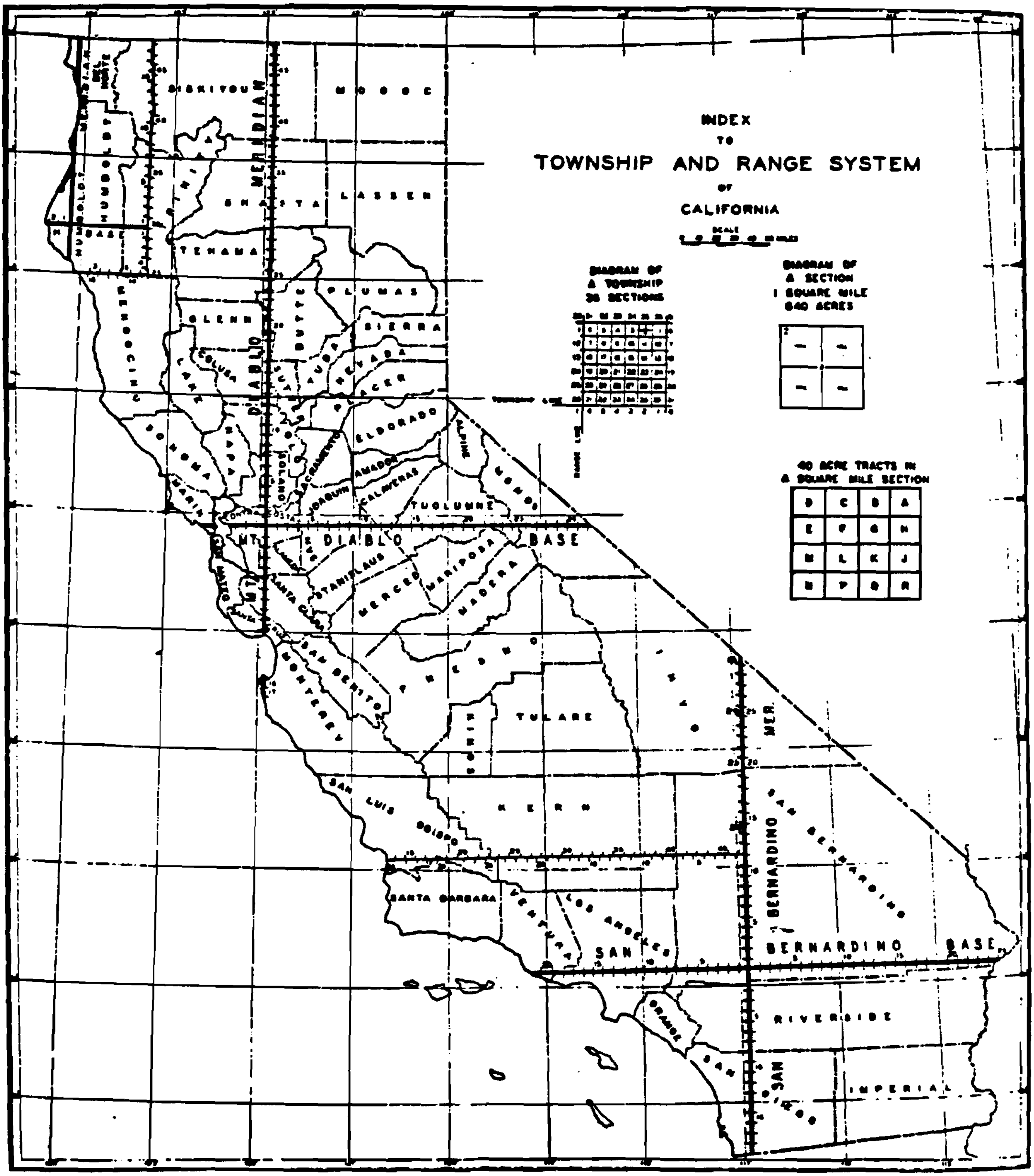
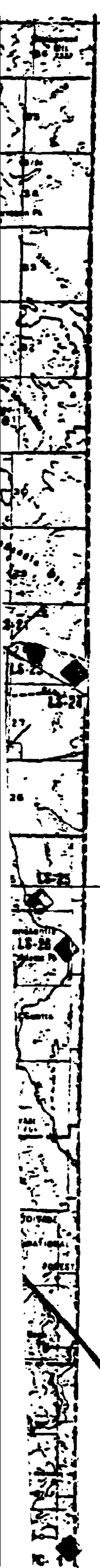

INDEX
TO
TOWNSHIP AND RANGE SYSTEM
OF
CALIFORNIA
DIAGRAM OF
A TOWNSHIP
36 SECTIONS
DIAGRAM OF
A SECTION
1 SQUARE MILE
640 ACRES
40 ACRE TRACTS IN
A SQUARE MILE SECTION
MT. DIABLO BASE
SAN BERNARDINO BASE
HUMBOLDT BASE
MT. DIABLO MERIDIAN
SAN BERNARDINO MER.
SISKIYOU
MODOC
SHASTA
LASSEN
TEHAMA
PLUMAS
GLENN
BUTTE
SIERRA
NEVADA
PLACER
MENDOCINO
LAKE
COLUSA
SONOMA
NAPA
MARIN
ELDORADO
ALPINE
AMADOR
CALAVERAS
TUOLUMNE
MONO
STANISLAUS
MERCED
MARIPOSA
MADERA
SANTA CLARA
SAN BENITO
MONTEREY
FRESNO
INYO
TULARE
KINGS
KERN
SAN LUIS OBISPO
SANTA BARBARA
VENTURA
LOS ANGELES
SAN BERNARDINO
ORANGE
RIVERSIDE
SAN DIEGO
IMPERIAL

Figure 4

... 1416 Ninth Street, Room 1310, Sacramento, California, 95814.

Information on how geothermal resources can be used may be obtained from the Geothermal Energy Office, California Energy Commission, 1111 Howe Avenue, Sacramento, California, 95825.

Persons who desire or can provide additional information on thermal springs and wells in California are encouraged to contact the Geothermal Resources Officer, California Division of Mines and Geology, Sacramento District Office, 2815 O Street, Sacramento, California, 95816 in order that we may update this map and related files.



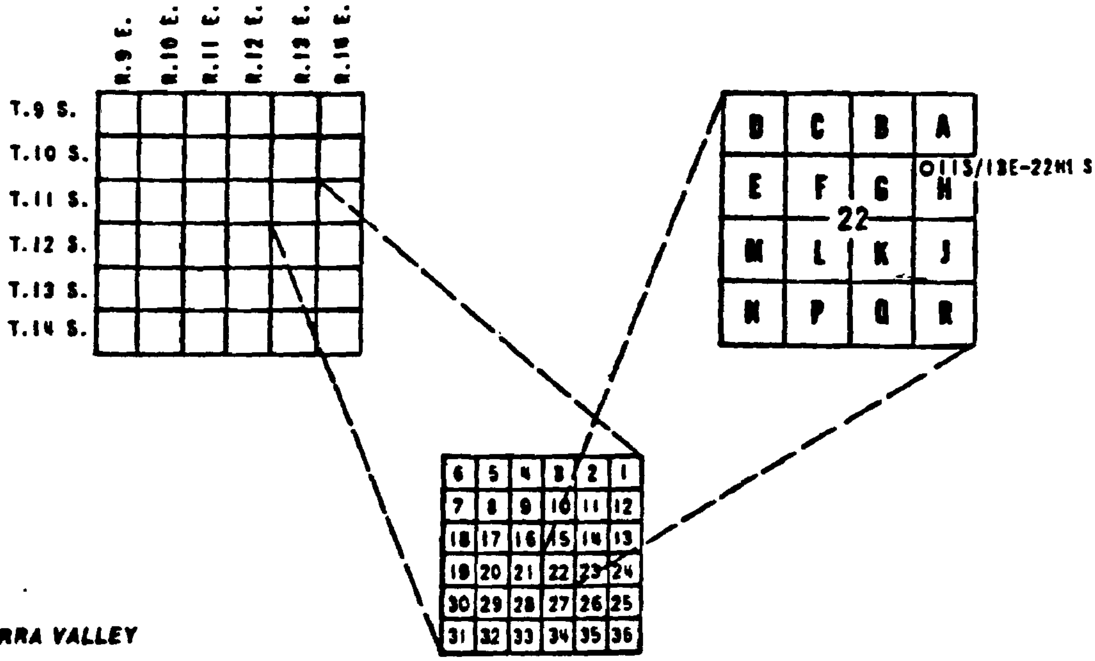
KEY TO TABLE OF THERMAL SPRINGS AND WELLS

COUNTY CODE NUMBER	NAME	LATITUDE NORTH	LONGITUDE WEST	TEMPERATURE, °CELSIUS (W = WARM, H = HOT)	FLOW, LITERS PER MINUTE	TOTAL DISSOLVED SOLIDS, MILLIGRAMS PER LITER	DEPTH, METERS
IN- 8	UNNAMED SPRINGS	X36 29.70	117 53.80	90°	57	2150*	—
IN- 9	DIRTY SOCKS HOT SPRING (WELL)	36 19.75	117 58.90	34°	380	8630	183
IN-10	DEVIL'S KITCHEN FUMAROLE	36 02.08	117 47.82	97°		2500	—

The majority of column headings in the above key are self-explanatory. Position information is given in degrees, minutes, and decimal parts of minutes of latitude and longitude. An X preceding the position indicates an approximate position. An asterisk indicates a computed estimate of total dissolved solids. A bar (—) symbol in the depth column indicates a spring orifice discharging at the surface. As numerous wells are named by the California well-numbering system, a brief description of that system follows.

WELL-NUMBERING SYSTEM USED IN CALIFORNIA

The well-numbering system used in California is in accordance with the township-section system of the U.S. Bureau of Land Management. As shown by the example (well number 11S/13E-22H1 S) in the accompanying diagram, that part of the number preceding the slash indicates the township (T. 11 S.); the number following the slash indicates the range (R. 13 E.); the number following the hyphen indicates the section (sec. 22); the letter following the section number indicates the 40-acre subdivision (H) of the section. The last number is a serial number for wells in that 40-acre subdivision; in this case, it indicates the first well to be listed in the SE 1/4 NE 1/4 sec. 22, T. 11 S., R. 13 E. The final letter, separated from the rest of the number by a space, indicates the base line and meridian. Base line and meridian designations are as follows: M, Mount Diablo; S, San Bernardino; H, Humboldt.



SIERRA VALLEY

At least two dozen thermal water wells ranging from 25° to 93°C occur in this large valley. Many of them are artesian. The hot water probably rises along large buried faults that cross the valley. Although a few small towns lie on the edge of the valley, it is largely rural and supports several large cattle ranches. Possible applications include agricultural pro-

Figure 5

Suggested Rewrite - Water Availability Section of The Siting Summary for the Carrizo Plain Area - T. Turner 6/23

Groundwater is the only source of water supply to the Carrizo Plain Basin. The basin groundwater storage capacity, as listed by the California Department of Water Resources (DWR) in 1978 is 400,000 acre ft. One fourth of this storage capacity or 100,000 acre ft is listed by DWR as useable and available for limited to moderate additional development. Groundwater wells yield flows of 500 to 1000 gal/min. Well depths range from 175 to 600 feet.

The water quality of the study area groundwater for six selected parameters is shown by the following table:

Parameter	minimum	maximum	average
Total Dissolved Solids, (mg/l)	346	1100	583
Total Hardness, (mg/l)	151	410	240
Alkalinity as $CaCO_3$, (mg/l)	4	194	150
Sulfate Ion, (mg/l)	15	533	171
Calcium Ion, (mg/l)	34	118	58
Magnesium Ion, (mg/l)	12	28	18

APPENDIX F

Laboratory Report and Chain-of-Custody Form - Proposed Pumping Well

FIELD DOCUMENTATION

FIELD REPORT

PROJECT NO. 22239472.01701

DATE OF WORK 2/14/08

REPORT NO. 1

PROJECT AUSRA CESF - Pumping ~~IR~~ W-1 Well PAGE 1 OF 2

0400 - Arrived @ Joe's house. Packed up truck.

0430 - Left for site.

0810 - Arrived on site. Started set up. Called well ID "IRW-1" ("Irrigation Well 1").

0847 - H_2O level @ 37.49' bgs.

1040 - Finished pump set up & YSI calibration: pH @ 6.97 (7.00 standard), conductivity @ 1326 µS/cm (1,000 standard), ORP @ 251.5 (250.5 standard).

1042 - Pump started. Took photos of operation on Stavro's camera phone.

1204 - Joe measured ferrous iron (Fe^{2+}) @ <0.2 mg/L (not detected)

1418 - Stopped pumping. Collected samples @ 1410. Fe^{2+} not detected @ <0.2 mg/L. Break down & clean up.

1610 - Packed up & left site.

2015 - Arrived @ Joe's house. Unpacked truck.

2045 - Left Joe's house.

THIS FIELD REPORT ONLY PROVIDES THE RESULTS OF OBSERVATION AND TESTS BY URS CORPORATION PERSONNEL. THIS REPORT SHOULD NO BE CONSTRUED AS SUPERVISION, DIRECTION, OR A RECOMMENDATION.

TIME

CC

CC

CC

BY: Stavro Pilafas

RECEIVED DATE

URS
2020 EAST FIRST STREET, SUITE 400
SANTA ANA, CALIFORNIA 92705
(714) 835-6886
FAX (714) 667-7147

FIELD REPORT

PROJECT NO. 22239472.01701

DATE OF WORK 2/14/08

REPORT NO. 1

PROJECT AUSRA-CESF – Pumping IRW-1 Well PAGE 2 OF 2

Recovery Measurements on IRW-1:

Time, seconds	H_2O level (feet)
1419	73.6
1420	72.0
1421.20	71.5
1421.38	71.0
1421.47	70.5
1421.56	70.0
1422.06	69.5
1422.15	69.0
1422.23	68.5
1422.31	68.0
1422.41	67.5
1422.50	67.0
1423.01	66.5
1423.13	66.0
1423.24	65.5
1423.33	65.0
1425.41	60.0
1429.47	55.0
1440.19	50.0
1448.51	48.0
1459.26	46.71

TIME ______

CC ______

CC ______

CC ______

BY: Stavro Pilafas

RECEIVED ______ DATE ______

URS

2020 EAST FIRST STREET, SUITE 400
SANTA ANA, CALIFORNIA 92705
(714) 835-6886
FAX (714) 667-7147

Calscience Environmental Laboratories, Inc.

☐ SoCal Laboratory
7440 Lincoln Way
Garden Grove, CA 92841-1427
(714) 895-5494

☐ NorCal Service Center
5063 Commercial Circle, Suite H
Concord, CA 94520-8577
(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 2/14/08

Page 1 of 1

LABORATORY CLIENT: URS Corp.

ADDRESS: 2020 E. First St. Suite 400

CITY: Santa Ana STATE: CA ZIP: 92705

TEL: 714-835-6886 E-MAIL: robert.scott@urscorp.com

CLIENT PROJECT NAME / NUMBER: 22239472.01701

P.O. NO.:

PROJECT CONTACT: robert_scott@urscorp.com Bob Scott 619.294.9400

LAB USE ONLY: ☐☐-☐☐☐☐

SAMPLER(S): (PRINT) Stavro Pilafas

COELT LOG CODE: ☐☐☐☐

COOLER RECEIPT TEMP= 0.9 °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☐ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY): ☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐ ____

SPECIAL INSTRUCTIONS:
24-Hr TAT: All remaining analyses.
Standard TAT: CN, VOCs, SVOCs, radioactivity analyses.

REQUESTED ANALYSES

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.
	IRW-1		2/14/08	1410	W	20

SAMPLE ID	EPA 300.0 Anions - Fluoride	EPA 6010B Diss. metals including Sb, Ba, Be, Se, Tl	EPA 6010B/7470A - Total Metals	SM 2130B - Turbidity	SM 2320B - Alkalinity	SM 2510 B - Specific Conductance	SM 2540C - TDS	SM 2540D - TSS	SM 4500 H+B - pH	SM 4500 P B/E - Total Phosphorus
IRW-1	X	X	X	X	X	X	X	X	X	X

SAMPLE ID	SM 4500-CO2 D CO2	Total CN	Radium 226 and 228	Tritium	Strontium 90 & Uranium	Gross Alpha and Gross Beta	EPA 8260B - VOCs	EPA 8270 - SVOCs	Asbestos
IRW-1	X	X	X	X	X	X	X	X	X

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature] 2/15/08 0930	[signature] CEL	2/15/08	928

DISTRIBUTION: White with final report, Green and Yellow to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the green and Yellow copies respectively.

05/01/07 Revision

Q&Q Graphic 714-898-9702

URS

Groundwater Monitoring Program
Gauging Log & Development / Sampling Log

Well Number: IRW-1	Date: 2/14/08	Project: AUSRA-CESF	Project No. 22239472.01701

Gauging Data from Top of Casing (Reference Point)

Initial Depth to Water: 37.49'	Total Well Depth: 630'	Water Column Height (H): 592.51'	Top of Casing Elevation: —
Gauging Time and initials: 0847 SP	Casing diameter (D)= 16 in.	1 casing volume= $(D^2)(H)(0.0408)$= 6,189 gal	3 casing volumes= 18,567 gal.

Groundwater Purge Data

Purge Method: (Standard Purge) Low-Flow/Micro-Purge | Purge Equipment: Schafer 5hp Pump | Pump Id:

Depth to Water	Time	Purge Rate (GPM)	Hz	Vol. Removed	pH (Units)	Specific Conductivity (μS/cm)	Turbidity (NTU)	Temp. (°C)	DO (mg/L)	ORP (mV)	Remarks
37.45	1015	—	—	—	—	—	—	—	—	—	
49.00	1042	108	—	∅	6.93	1,501	25.7	17.91	5.92	196.8	
55.10	1045	—	—	—	—	—	—	—	—	—	
62.85	1048	105	—	648	7.03	1,483	14.64	17.95	5.48	147.9	
71.30	1054	100	—	1,278	7.03	1,481	10.98	17.41	5.08	146.7	
72.95	1100	100	—	1,878	7.03	1,503	8.86	17.33	5.23	144.3	
74.63	1106	99	—	2,472	7.02	1,549	7.42	16.94	5.09	142.4	
75.60	1112	100	—	3,072	6.99	2,260	7.09	16.36	4.99	138.9	
76.25	1118	100	—	3,672	6.99	2,294	8.51	16.19	4.41	136.2	
76.85	1124	100	—	4,272	6.97	2,286	6.77	16.10	4.58	134.9	
77.31	1130	100	—	4,872	6.97	2,279	6.56	15.53	4.54	131.5	
77.72	1136	100	—	5,472	6.95	2,280	6.57	15.25	4.62	128.4	
78.07	1142	98	—	6,060	6.94	2,263	6.04	15.76	4.66	125.9	
78.36	1148	98	—	6,648	6.96	2,280	6.18	15.30	4.67	123.6	Gallons = ml's/3781
78.52	1154	98	—	7,236	6.96	2,263	5.44	15.67	4.70	120.5	Sample Rate: ______
78.81	1200	98	—	7,824	6.95	2,263	5.12	14.71	4.87	122.3	Total Casing Volumes Removed: ______
78.75	1206	98	—	8,412	6.94	2,253	4.85	14.64	4.62	121.5	Total Gallons Removed: ______

– Joe measured iron content: No ferrous iron (Fe^{2+}) detected @ <0.2 mg/L.

Sample ID.(time): IRW-1 (1410) Dup ID.: —— (——) Rinsate ID.: —— (——)

Analytical Methods: (See Chain-of-Custody) Sampler: SP/JL

URS

Groundwater Monitoring Program
Gauging Log & Development / Sampling Log

Well Number: IRW-1	Date: 2/14/08	Project: AUSRA-CESF	Project No. 22239472.01701

Gauging Data from Top of Casing (Reference Point)

Initial Depth to Water: 37.49'	Total Well Depth: 630'	Water Column Height (H): 592.51'	Top of Casing Elevation: —
Gauging Time and initials: 0847 SP	Casing diameter (D)= 16 in.	1 casing volume= $(D^2)(H)(0.0408)$= 6,189 gal	3 casing volumes= 18,567 gal.

Groundwater Purge Data

Purge Method: Standard Purge Low-Flow/Micro-Purge | Purge Equipment: | Pump Id:

Depth to Water	Time	Purge Rate (GPM)	Hz	Vol. Removed	pH (Units)	Specific Conductivity (µS/cm)	Turbidity (NTU)	Temp. (°C)	DO (mg/L)	ORP (mV)	Remarks
79.00	1212	97	—	8,994	6.94	2,250	4.57	14.59	4.64	118.6	
79.41	1218	98	—	9,582	6.95	2,246	4.10	14.48	4.65	117.7	
79.69	1224	98	—	10,170	6.95	2,243	4.01	14.41	4.64	116.4	
79.86	1230	98	—	10,758	6.95	2,244	4.23	14.25	4.64	115.7	
79.91	1236	97	—	11,340	6.94	2,244	3.77	16.86	4.38	113.8	Stagnant H_2O in flow-through cell-adjusted flow.
79.76	1242	97	—	11,922	6.94	2,243	7.29	18.38	4.85	108.1	
79.80	1248	97	—	12,504	6.95	2,236	8.74	18.37	4.92	102.3	
79.87	1254	96	—	13,080	6.96	2,228	7.33	18.38	4.96	101.6	
79.86	1300	97	—	13,662	6.97	2,229	6.68	18.43	4.95	98.7	
80.13	1306	97	—	14,244	6.98	2,221	5.16	18.38	4.94	97.3	
80.18	1312	97	—	14,826	6.96	2,219	4.92	18.42	4.63	95.3	
80.33	1318	96	—	15,402	6.98	2,222	4.01	18.43	4.86	92.7	
80.41	1324	97	—	15,984	6.98	2,219	3.82	18.44	4.98	92.0	
80.42	1330	97	—	16,566	6.98	2,222	3.83	18.42	4.99	90.6	Gallons = ml's/3781
80.50	1336	96	—	17,142	6.97	2,218	4.21	18.46	5.00	89.8	Sample Rate: ______
80.55	1342	96	—	17,718	6.97	2,209	4.50	18.42	5.00	89.6	Total Casing Volumes Removed: ______
80.52	1348	95	—	18,288	6.96	2,211	4.63	18.45	5.09	88.3	Total Gallons Removed: ______

Sample ID.(time): IRW-1 (1410) Dup ID.: — (—) Rinsate ID.: — (—)

Analytical Methods: (See Chain-of-Custody) Sampler: SP/JL

URS

Groundwater Monitoring Program
Gauging Log & Development / Sampling Log

Well Number: IRW-1	Date: 2/14/08	Project: AUSRA-CESF	Project No. 22239472.01701

Gauging Data from Top of Casing (Reference Point)

Initial Depth to Water: 37.49'	Total Well Depth: 630'	Water Column Height (H): 592.51'	Top of Casing Elevation: —
Gauging Time and initials: 0847 SP	Casing diameter (D)= 16 in.	1 casing volume= $(D^2)(H)(0.0408)$= 6,189 gal	3 casing volumes= 18,567 gal.

Groundwater Purge Data

Purge Method: Standard Purge Low-Flow/Micro-Purge | Purge Equipment: | Pump Id:

Depth to Water	Time	Purge Rate	Hz	Vol. Removed	pH (Units)	Specific Conductivity (µS/cm)	Turbidity (NTU)	Temp. (°C)	DO (mg/L)	ORP (mV)	Remarks
80.71	1354	96	—	18,864	6.98	2,224	4.18	18.50	4.79	90.1	
—	1401	97	—	19,446	6.98	2,285	4.95	18.45	4.76	92.7	
80.10	1414	96	—	20,022	6.96	2,190	5.78	18.58	4.77	94.3	
	1410	Sampled Well.									Joe measured iron content: No ferrous iron (Fe^{2+}) detected @ <0.2 mg/L.
	1418	Stopped Pump.									
											Gallons = ml's/3781
											Sample Rate: ______
											Total Casing Volumes Removed: ______
											Total Gallons Removed: ______

Sample ID.(time): IRW-1 (1410) Dup ID.: — (—) Rinsate ID.: — (—)

Analytical Methods: (See Chain-of Custody) Sampler: SP/JL

LABORATORY ANALYSIS REPORT

Calscience Environmental Laboratories, Inc.

March 10, 2008

Bob Scott
URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Subject: **Calscience Work Order No.: 08-02-1151**
Client Reference: Ausra / 2239472.01701

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 2/15/2008 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Systems Manual, applicable standard operating procedures, and other related documentation. The original report of subcontracted analysis, if any, is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

Vikas Patel

Calscience Environmental
Laboratories, Inc.
Vikas Patel
Project Manager

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation		Date Received:	02/15/08
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319		Preparation:	EPA 3005A Filt.
		Method:	EPA 6010B
		Units:	mg/L
Project: Ausra / 2239472.01701			Page 1 of 2

Client Sample Number	Lab Sample Number	Date /Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
IRW-1	**08-02-1151-1-F**	**02/14/08 14:10**	**Aqueous**	**ICP 5300**	**02/15/08**	**02/15/08 17:38**	**080215L05**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Antimony	0.0262	0.0150	1		Barium	0.0190	0.0100	1	
Beryllium	ND	0.00100	1		Selenium	ND	0.0150	1	
Thallium	0.0278	0.0150	1		Aluminum	ND	0.0500	1	
Iron	ND	0.100	1		Manganese	0.00776	0.00500	1	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation	Date Received: 02/15/08
1615 Murray Canyon Road, Suite 1000	Work Order No: 08-02-1151
San Diego, CA 92108-4319	Preparation: EPA 3010A Total / EPA 7470A Total
	Method: EPA 6010B / EPA 7470A
	Units: mg/L
Project: Ausra / 2239472.01701	Page 2 of 2

Client Sample Number	Lab Sample Number	Date /Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
IRW-1	**08-02-1151-1-E**	**02/14/08 14:10**	**Aqueous**	**ICP 5300**	**02/15/08**	**02/15/08 17:30**	**080215L05**

Comment(s): -Mercury was analyzed on 2/15/2008 5:39:06 PM with batch 080215L04

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Arsenic	ND	0.0100	1		Manganese	0.0616	0.00500	1	
Cadmium	ND	0.00500	1		Potassium	0.900	0.500	1	
Chromium	0.0181	0.00500	1		Sodium	183	0.500	1	
Copper	ND	0.00500	1		Silicon	19.8	0.0500	1	
Lead	ND	0.0100	1		Zinc	0.0194	0.0100	1	
Mercury	ND	0.000500	1		Nickel	ND	0.00500	1	
Aluminum	ND	0.0500	1		Calcium	107	0.100	1	
Iron	0.733	0.100	1		Magnesium	23.7	0.100	1	

Client Sample Number	Lab Sample Number	Date /Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-04-008-3,364**	**N/A**	**Aqueous**	**Mercury**	**02/15/08**	**02/15/08 17:07**	**080215L04**

Parameter	Result	RL	DF	Qual
Mercury	ND	0.000500	1	

Client Sample Number	Lab Sample Number	Date /Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**097-01-003-8,022**	**N/A**	**Aqueous**	**ICP 5300**	**02/15/08**	**02/15/08 17:22**	**080215L05**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Arsenic	ND	0.0100	1		Iron	ND	0.100	1	
Cadmium	ND	0.00500	1		Magnesium	ND	0.100	1	
Chromium	ND	0.00500	1		Manganese	ND	0.00500	1	
Copper	ND	0.00500	1		Potassium	ND	0.500	1	
Lead	ND	0.0100	1		Sodium	ND	0.500	1	
Nickel	ND	0.00500	1		Silicon	ND	0.0500	1	
Aluminum	ND	0.0500	1		Zinc	ND	0.0100	1	
Calcium	ND	0.100	1						

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

ANALYTICAL REPORT

URS Corporation		Date Sampled:	02/14/08
1615 Murray Canyon Road, Suite 1000		Date Received:	02/15/08
San Diego, CA 92108-4319		Date Analyzed:	02/15/08
		Work Order No.:	08-02-1151
Attn: Bob Scott		Method:	EPA 6010B
RE: Ausra / 2239472.01701			Page 1 of 1

All concentrations are reported in mg/L (ppm).

Sample Number	SiO_2 Concentration	Reporting Limit
IRW-1	42.4	0.107
Method Blank	ND	0.107

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation		Date Received:	02/15/08
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319		Preparation:	EPA 3510B
		Method:	EPA 8270C
		Units:	ug/L

Project: Ausra / 2239472.01701

Page 1 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
IRW-1	**08-02-1151-1-G**	**02/14/08 14:10**	**Aqueous**	**GC/MS MM**	**02/18/08**	**02/21/08 23:08**	**080218L01**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
N-Nitrosodimethylamine	ND	10	1		4-Nitrophenol	ND	10	1	
Aniline	ND	10	1		Dibenzofuran	ND	10	1	
Phenol	ND	10	1		2,4-Dinitrotoluene	ND	10	1	
Bis(2-Chloroethyl) Ether	ND	25	1		2,6-Dinitrotoluene	ND	10	1	
2-Chlorophenol	ND	10	1		Diethyl Phthalate	ND	10	1	
1,3-Dichlorobenzene	ND	10	1		4-Chlorophenyl-Phenyl Ether	ND	10	1	
1,4-Dichlorobenzene	ND	10	1		Fluorene	ND	10	1	
Benzyl Alcohol	ND	10	1		4-Nitroaniline	ND	10	1	
1,2-Dichlorobenzene	ND	10	1		Azobenzene	ND	10	1	
2-Methylphenol	ND	10	1		4,6-Dinitro-2-Methylphenol	ND	50	1	
Bis(2-Chloroisopropyl) Ether	ND	10	1		N-Nitrosodiphenylamine	ND	10	1	
3/4-Methylphenol	ND	10	1		4-Bromophenyl-Phenyl Ether	ND	10	1	
N-Nitroso-di-n-propylamine	ND	10	1		Hexachlorobenzene	ND	10	1	
Hexachloroethane	ND	10	1		Pentachlorophenol	ND	10	1	
Nitrobenzene	ND	25	1		Phenanthrene	ND	10	1	
Isophorone	ND	10	1		Anthracene	ND	10	1	
2-Nitrophenol	ND	10	1		Di-n-Butyl Phthalate	ND	10	1	
2,4-Dimethylphenol	ND	10	1		Fluoranthene	ND	10	1	
Benzoic Acid	ND	50	1		Benzidine	ND	50	1	
Bis(2-Chloroethoxy) Methane	ND	10	1		Pyrene	ND	10	1	
2,4-Dichlorophenol	ND	10	1		Pyridine	ND	10	1	
Naphthalene	ND	10	1		Butyl Benzyl Phthalate	ND	10	1	
4-Chloroaniline	ND	10	1		3,3'-Dichlorobenzidine	ND	25	1	
Hexachloro-1,3-Butadiene	ND	10	1		Benzo (a) Anthracene	ND	10	1	
4-Chloro-3-Methylphenol	ND	10	1		Bis(2-Ethylhexyl) Phthalate	ND	10	1	
2-Methylnaphthalene	ND	10	1		Chrysene	ND	10	1	
Hexachlorocyclopentadiene	ND	25	1		Di-n-Octyl Phthalate	ND	10	1	
2,4,6-Trichlorophenol	ND	10	1		Benzo (k) Fluoranthene	ND	10	1	
2,4,5-Trichlorophenol	ND	10	1		Benzo (b) Fluoranthene	ND	10	1	
2-Chloronaphthalene	ND	10	1		Benzo (a) Pyrene	ND	10	1	
2-Nitroaniline	ND	10	1		Benzo (g,h,i) Perylene	ND	10	1	
Dimethyl Phthalate	ND	10	1		Indeno (1,2,3-c,d) Pyrene	ND	10	1	
Acenaphthylene	ND	10	1		Dibenz (a,h) Anthracene	ND	10	1	
3-Nitroaniline	ND	10	1		1-Methylnaphthalene	ND	10	1	
Acenaphthene	ND	10	1		1,2,4-Trichlorobenzene	ND	10	1	
2,4-Dinitrophenol	ND	50	1						

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2-Fluorophenol	54	7-121		Phenol-d6	35	1-127	
Nitrobenzene-d5	90	50-146		2-Fluorobiphenyl	98	42-138	
2,4,6-Tribromophenol	92	41-137		p-Terphenyl-d14	127	47-173	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation		Date Received:	02/15/08
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319		Preparation:	EPA 3510B
		Method:	EPA 8270C
		Units:	ug/L

Project: Ausra / 2239472.01701 Page 2 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**095-01-003-2,344**	**N/A**	**Aqueous**	**GC/MS MM**	**02/18/08**	**02/19/08 13:46**	**080218L01**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
N-Nitrosodimethylamine	ND	10	1		4-Nitrophenol	ND	10	1	
Aniline	ND	10	1		Dibenzofuran	ND	10	1	
Phenol	ND	10	1		2,4-Dinitrotoluene	ND	10	1	
Bis(2-Chloroethyl) Ether	ND	25	1		2,6-Dinitrotoluene	ND	10	1	
2-Chlorophenol	ND	10	1		Diethyl Phthalate	ND	10	1	
1,3-Dichlorobenzene	ND	10	1		4-Chlorophenyl-Phenyl Ether	ND	10	1	
1,4-Dichlorobenzene	ND	10	1		Fluorene	ND	10	1	
Benzyl Alcohol	ND	10	1		4-Nitroaniline	ND	10	1	
1,2-Dichlorobenzene	ND	10	1		Azobenzene	ND	10	1	
2-Methylphenol	ND	10	1		4,6-Dinitro-2-Methylphenol	ND	50	1	
Bis(2-Chloroisopropyl) Ether	ND	10	1		N-Nitrosodiphenylamine	ND	10	1	
3/4-Methylphenol	ND	10	1		4-Bromophenyl-Phenyl Ether	ND	10	1	
N-Nitroso-di-n-propylamine	ND	10	1		Hexachlorobenzene	ND	10	1	
Hexachloroethane	ND	10	1		Pentachlorophenol	ND	10	1	
Nitrobenzene	ND	25	1		Phenanthrene	ND	10	1	
Isophorone	ND	10	1		Anthracene	ND	10	1	
2-Nitrophenol	ND	10	1		Di-n-Butyl Phthalate	ND	10	1	
2,4-Dimethylphenol	ND	10	1		Fluoranthene	ND	10	1	
Benzoic Acid	ND	50	1		Benzidine	ND	50	1	
Bis(2-Chloroethoxy) Methane	ND	10	1		Pyrene	ND	10	1	
2,4-Dichlorophenol	ND	10	1		Pyridine	ND	10	1	
Naphthalene	ND	10	1		Butyl Benzyl Phthalate	ND	10	1	
4-Chloroaniline	ND	10	1		3,3'-Dichlorobenzidine	ND	25	1	
Hexachloro-1,3-Butadiene	ND	10	1		Benzo (a) Anthracene	ND	10	1	
4-Chloro-3-Methylphenol	ND	10	1		Bis(2-Ethylhexyl) Phthalate	ND	10	1	
2-Methylnaphthalene	ND	10	1		Chrysene	ND	10	1	
Hexachlorocyclopentadiene	ND	25	1		Di-n-Octyl Phthalate	ND	10	1	
2,4,6-Trichlorophenol	ND	10	1		Benzo (k) Fluoranthene	ND	10	1	
2,4,5-Trichlorophenol	ND	10	1		Benzo (b) Fluoranthene	ND	10	1	
2-Chloronaphthalene	ND	10	1		Benzo (a) Pyrene	ND	10	1	
2-Nitroaniline	ND	10	1		Benzo (g,h,i) Perylene	ND	10	1	
Dimethyl Phthalate	ND	10	1		Indeno (1,2,3-c,d) Pyrene	ND	10	1	
Acenaphthylene	ND	10	1		Dibenz (a,h) Anthracene	ND	10	1	
3-Nitroaniline	ND	10	1		1-Methylnaphthalene	ND	10	1	
Acenaphthene	ND	10	1		1,2,4-Trichlorobenzene	ND	10	1	
2,4-Dinitrophenol	ND	50	1						

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
2-Fluorophenol	64	7-121		Phenol-d6	44	1-127	
Nitrobenzene-d5	93	50-146		2-Fluorobiphenyl	77	42-138	
2,4,6-Tribromophenol	103	41-137		p-Terphenyl-d14	140	47-173	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation		Date Received:	02/15/08
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319		Preparation:	EPA 5030B
		Method:	EPA 8260B
		Units:	ug/L

Project: Ausra / 2239472.01701

Page 1 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
IRW-1	**08-02-1151-1-K**	**02/14/08 14:10**	**Aqueous**	**GC/MS CC**	**02/21/08**	**02/21/08 17:51**	**080221L01**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Acetone	ND	50	1		c-1,3-Dichloropropene	ND	0.50	1	
Benzene	ND	0.50	1		t-1,3-Dichloropropene	ND	0.50	1	
Bromobenzene	ND	1.0	1		Ethylbenzene	ND	1.0	1	
Bromochloromethane	ND	1.0	1		2-Hexanone	ND	10	1	
Bromodichloromethane	ND	1.0	1		Isopropylbenzene	ND	1.0	1	
Bromoform	ND	1.0	1		p-Isopropyltoluene	ND	1.0	1	
Bromomethane	ND	10	1		Methylene Chloride	ND	10	1	
2-Butanone	ND	10	1		4-Methyl-2-Pentanone	ND	10	1	
n-Butylbenzene	ND	1.0	1		Naphthalene	ND	10	1	
sec-Butylbenzene	ND	1.0	1		n-Propylbenzene	ND	1.0	1	
tert-Butylbenzene	ND	1.0	1		Styrene	ND	1.0	1	
Carbon Disulfide	ND	10	1		1,1,1,2-Tetrachloroethane	ND	1.0	1	
Carbon Tetrachloride	ND	0.50	1		1,1,2,2-Tetrachloroethane	ND	1.0	1	
Chlorobenzene	ND	1.0	1		Tetrachloroethene	ND	1.0	1	
Chloroethane	ND	1.0	1		Toluene	ND	1.0	1	
Chloroform	ND	1.0	1		1,2,3-Trichlorobenzene	ND	1.0	1	
Chloromethane	ND	10	1		1,2,4-Trichlorobenzene	ND	1.0	1	
2-Chlorotoluene	ND	1.0	1		1,1,1-Trichloroethane	ND	1.0	1	
4-Chlorotoluene	ND	1.0	1		1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	10	1	
Dibromochloromethane	ND	1.0	1		1,1,2-Trichloroethane	ND	1.0	1	
1,2-Dibromo-3-Chloropropane	ND	5.0	1		Trichloroethene	ND	1.0	1	
1,2-Dibromoethane	ND	1.0	1		Trichlorofluoromethane	ND	10	1	
Dibromomethane	ND	1.0	1		1,2,3-Trichloropropane	ND	5.0	1	
1,2-Dichlorobenzene	ND	1.0	1		1,2,4-Trimethylbenzene	ND	1.0	1	
1,3-Dichlorobenzene	ND	1.0	1		1,3,5-Trimethylbenzene	ND	1.0	1	
1,4-Dichlorobenzene	ND	1.0	1		Vinyl Acetate	ND	10	1	
Dichlorodifluoromethane	ND	1.0	1		Vinyl Chloride	ND	0.50	1	
1,1-Dichloroethane	ND	1.0	1		p/m-Xylene	ND	1.0	1	
1,2-Dichloroethane	ND	0.50	1		o-Xylene	ND	1.0	1	
1,1-Dichloroethene	ND	1.0	1		Methyl-t-Butyl Ether (MTBE)	ND	1.0	1	
c-1,2-Dichloroethene	ND	1.0	1		Tert-Butyl Alcohol (TBA)	ND	10	1	
t-1,2-Dichloroethene	ND	1.0	1		Diisopropyl Ether (DIPE)	ND	2.0	1	
1,2-Dichloropropane	ND	1.0	1		Ethyl-t-Butyl Ether (ETBE)	ND	2.0	1	
1,3-Dichloropropane	ND	1.0	1		Tert-Amyl-Methyl Ether (TAME)	ND	2.0	1	
2,2-Dichloropropane	ND	1.0	1		Ethanol	ND	100	1	
1,1-Dichloropropene	ND	1.0	1						
Surrogates:	REC (%)	Control Limits		Qual	Surrogates:	REC (%)	Control Limits		Qual
Dibromofluoromethane	115	74-140			1,2-Dichloroethane-d4	127	74-146		
Toluene-d8	101	88-112			1,4-Bromofluorobenzene	88	74-110		

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation		Date Received:	02/15/08
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319		Preparation:	EPA 5030B
		Method:	EPA 8260B
		Units:	ug/L
Project: Ausra / 2239472.01701			Page 2 of 2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Method Blank	**099-10-006-24,504**	**N/A**	**Aqueous**	**GC/MS CC**	**02/21/08**	**02/21/08 12:36**	**080221L01**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
Acetone	ND	50	1		c-1,3-Dichloropropene	ND	0.50	1	
Benzene	ND	0.50	1		t-1,3-Dichloropropene	ND	0.50	1	
Bromobenzene	ND	1.0	1		Ethylbenzene	ND	1.0	1	
Bromochloromethane	ND	1.0	1		2-Hexanone	ND	10	1	
Bromodichloromethane	ND	1.0	1		Isopropylbenzene	ND	1.0	1	
Bromoform	ND	1.0	1		p-Isopropyltoluene	ND	1.0	1	
Bromomethane	ND	10	1		Methylene Chloride	ND	10	1	
2-Butanone	ND	10	1		4-Methyl-2-Pentanone	ND	10	1	
n-Butylbenzene	ND	1.0	1		Naphthalene	ND	10	1	
sec-Butylbenzene	ND	1.0	1		n-Propylbenzene	ND	1.0	1	
tert-Butylbenzene	ND	1.0	1		Styrene	ND	1.0	1	
Carbon Disulfide	ND	10	1		1,1,1,2-Tetrachloroethane	ND	1.0	1	
Carbon Tetrachloride	ND	0.50	1		1,1,2,2-Tetrachloroethane	ND	1.0	1	
Chlorobenzene	ND	1.0	1		Tetrachloroethene	ND	1.0	1	
Chloroethane	ND	1.0	1		Toluene	ND	1.0	1	
Chloroform	ND	1.0	1		1,2,3-Trichlorobenzene	ND	1.0	1	
Chloromethane	ND	10	1		1,2,4-Trichlorobenzene	ND	1.0	1	
2-Chlorotoluene	ND	1.0	1		1,1,1-Trichloroethane	ND	1.0	1	
4-Chlorotoluene	ND	1.0	1		1,1,2-Trichloro-1,2,2-Trifluoroethane	ND	10	1	
Dibromochloromethane	ND	1.0	1		1,1,2-Trichloroethane	ND	1.0	1	
1,2-Dibromo-3-Chloropropane	ND	5.0	1		Trichloroethene	ND	1.0	1	
1,2-Dibromoethane	ND	1.0	1		Trichlorofluoromethane	ND	10	1	
Dibromomethane	ND	1.0	1		1,2,3-Trichloropropane	ND	5.0	1	
1,2-Dichlorobenzene	ND	1.0	1		1,2,4-Trimethylbenzene	ND	1.0	1	
1,3-Dichlorobenzene	ND	1.0	1		1,3,5-Trimethylbenzene	ND	1.0	1	
1,4-Dichlorobenzene	ND	1.0	1		Vinyl Acetate	ND	10	1	
Dichlorodifluoromethane	ND	1.0	1		Vinyl Chloride	ND	0.50	1	
1,1-Dichloroethane	ND	1.0	1		p/m-Xylene	ND	1.0	1	
1,2-Dichloroethane	ND	0.50	1		o-Xylene	ND	1.0	1	
1,1-Dichloroethene	ND	1.0	1		Methyl-t-Butyl Ether (MTBE)	ND	1.0	1	
c-1,2-Dichloroethene	ND	1.0	1		Tert-Butyl Alcohol (TBA)	ND	10	1	
t-1,2-Dichloroethene	ND	1.0	1		Diisopropyl Ether (DIPE)	ND	2.0	1	
1,2-Dichloropropane	ND	1.0	1		Ethyl-t-Butyl Ether (ETBE)	ND	2.0	1	
1,3-Dichloropropane	ND	1.0	1		Tert-Amyl-Methyl Ether (TAME)	ND	2.0	1	
2,2-Dichloropropane	ND	1.0	1		Ethanol	ND	100	1	
1,1-Dichloropropene	ND	1.0	1						

Surrogates:	REC (%)	Control Limits	Qual	Surrogates:	REC (%)	Control Limits	Qual
Dibromofluoromethane	114	74-140		1,2-Dichloroethane-d4	123	74-146	
Toluene-d8	103	88-112		1,4-Bromofluorobenzene	88	74-110	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

URS Corporation		Date Received:	02/15/08
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319			

Project: Ausra / 2239472.01701

Page 1 of 1

Client Sample Number	Lab Sample Number	Date Collected	Matrix
IRW-1	**08-02-1151-1**	**02/14/08**	**Aqueous**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
Fluoride	1.4	0.10	1		mg/L	N/A	02/15/08	EPA 300.0
Chloride	66	10	10		mg/L	N/A	02/15/08	EPA 300.0
Nitrate (as N)	13	1.0	10		mg/L	N/A	02/15/08	EPA 300.0
o-Phosphate (as P)	ND	0.10	1		mg/L	N/A	02/15/08	EPA 300.0
Sulfate	560	100	100		mg/L	N/A	02/15/08	EPA 300.0
Turbidity	3.1	0.10	1		NTU	N/A	02/16/08	SM 2130 B
Alkalinity, Total (as CaCO3)	114	5.0	1		mg/L	N/A	02/15/08	SM 2320B
Bicarbonate (as CaCO3)	114	5.0	1		mg/L	N/A	02/15/08	SM 2320B
Carbonate (as CaCO3)	ND	1.0	1		mg/L	N/A	02/15/08	SM 2320B
Hydroxide (as CaCO3)	ND	1.0	1		mg/L	N/A	02/15/08	SM 2320B
Specific Conductance	1600	10	1		umhos/cm	N/A	02/15/08	SM 2510 B
Solids, Total Dissolved	1140	10	1		mg/L	N/A	02/15/08	SM 2540 C
Solids, Total Suspended	1.5	1.0	1		mg/L	N/A	02/15/08	SM 2540 D
pH	6.88	0.01	1		pH units	N/A	02/15/08	SM 4500 H+ B
Phosphorus, Total	0.40	0.10	1		mg/L	02/18/08	02/18/08	SM 4500 P B/E
Cyanide, Total	ND	0.050	1		mg/L	02/15/08	02/15/08	SM 4500-CN E
Carbon Dioxide	6.3	1.0	1		mg/L	N/A	02/15/08	SM4500-CO2D

Client Sample Number	Lab Sample Number	Date Collected	Matrix
Method Blank		**N/A**	**Aqueous**

Parameter	Result	RL	DF	Qual	Units	Date Prepared	Date Analyzed	Method
Fluoride	ND	0.10	1		mg/L	N/A	02/15/08	EPA 300.0
Chloride	ND	1.0	1		mg/L	N/A	02/15/08	EPA 300.0
Nitrate (as N)	ND	0.10	1		mg/L	N/A	02/15/08	EPA 300.0
o-Phosphate (as P)	ND	0.10	1		mg/L	N/A	02/15/08	EPA 300.0
Sulfate	ND	1.0	1		mg/L	N/A	02/15/08	EPA 300.0
Alkalinity, Total (as CaCO3)	ND	1.0	1		mg/L	N/A	02/15/08	SM 2320B
Bicarbonate (as CaCO3)	ND	1.0	1		mg/L	N/A	02/15/08	SM 2320B
Carbonate (as CaCO3)	ND	1.0	1		mg/L	N/A	02/15/08	SM 2320B
Hydroxide (as CaCO3)	ND	1.0	1		mg/L	N/A	02/15/08	SM 2320B
Solids, Total Dissolved	ND	1.0	1		mg/L	N/A	02/15/08	SM 2540 C
Solids, Total Suspended	ND	1.0	1		mg/L	N/A	02/15/08	SM 2540 D
Phosphorus, Total	ND	0.10	1		mg/L	02/18/08	02/18/08	SM 4500 P B/E
Cyanide, Total	ND	0.050	1		mg/L	02/15/08	02/15/08	SM 4500-CN E

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: 02/15/08
Work Order No: 08-02-1151
Preparation: EPA 3010A Total
Method: EPA 6010B

Project Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
IRW-1	**Aqueous**	**ICP 5300**	**02/15/08**	**02/15/08**	**080215S05**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Antimony	99	102	72-132	2	0-10	
Arsenic	102	102	80-140	0	0-11	
Barium	101	102	87-123	1	0-6	
Beryllium	105	104	89-119	1	0-8	
Cadmium	102	101	82-124	1	0-7	
Chromium	104	105	86-122	1	0-8	
Copper	97	99	78-126	2	0-7	
Lead	91	90	84-120	1	0-7	
Nickel	103	103	84-120	1	0-7	
Selenium	91	92	79-127	0	0-9	
Thallium	96	95	79-121	1	0-8	
Aluminum	116	117	73-145	1	0-16	
Calcium	4X	4X	77-113	4X	0-11	Q
Iron	91	93	65-149	1	0-21	
Magnesium	4X	4X	56-140	4X	0-11	Q
Manganese	96	97	86-116	1	0-7	
Potassium	101	103	83-131	2	0-7	
Sodium	4X	4X	73-127	4X	0-9	Q
Silicon	4X	4X	24-180	4X	0-15	Q
Zinc	109	110	89-131	1	0-8	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: 02/15/08
Work Order No: 08-02-1151
Preparation: EPA 7470A Total
Method: EPA 7470A

Project Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
08-02-1135-1	**Aqueous**	**Mercury**	**02/15/08**	**02/15/08**	**080215S04**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	96	97	66-126	1	0-7	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: 02/15/08
Work Order No: 08-02-1151
Preparation: EPA 5030B
Method: EPA 8260B

Project Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
08-02-1028-1	**Aqueous**	**GC/MS CC**	**02/21/08**	**02/21/08**	**080221S01**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Benzene	101	100	88-118	1	0-7	
Carbon Tetrachloride	104	100	67-145	4	0-11	
Chlorobenzene	104	102	88-118	2	0-7	
1,2-Dibromoethane	106	103	70-130	2	0-30	
1,2-Dichlorobenzene	107	105	86-116	2	0-8	
1,1-Dichloroethene	95	93	70-130	3	0-25	
Ethylbenzene	108	106	70-130	2	0-30	
Toluene	110	107	87-123	3	0-8	
Trichloroethene	102	100	79-127	2	0-10	
Vinyl Chloride	112	111	69-129	1	0-13	
Methyl-t-Butyl Ether (MTBE)	102	101	71-131	2	0-13	
Tert-Butyl Alcohol (TBA)	110	104	36-168	6	0-45	
Diisopropyl Ether (DIPE)	95	94	81-123	0	0-9	
Ethyl-t-Butyl Ether (ETBE)	100	101	72-126	1	0-12	
Tert-Amyl-Methyl Ether (TAME)	101	101	72-126	0	0-12	
Ethanol	109	100	53-149	8	0-31	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: N/A
Work Order No: 08-02-1151

Project: Ausra / 2239472.01701

Matrix: Aqueous

Parameter	Method	Quality Control Sample ID	Date Analyzed	Date Extracted	MS% REC	MSD % REC	%REC CL	RPD	RPD CL	Qualifiers
Phosphorus, Total	SM 4500 P B/E	IRW-1	02/18/08	2/18/08	106	102	70-130	2	0-25	
Fluoride	EPA 300.0	IRW-1	02/15/08	N/A	102	101	64-142	0	0-9	
Chloride	EPA 300.0	IRW-1	02/15/08	N/A	99	100	56-134	0	0-3	
Nitrate (as N)	EPA 300.0	IRW-1	02/15/08	N/A	104	104	58-142	0	0-6	
o-Phosphate (as P)	EPA 300.0	IRW-1	02/15/08	N/A	108	109	63-141	1	0-12	
Sulfate	EPA 300.0	IRW-1	02/15/08	N/A	111	113	49-133	1	0-3	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Duplicate

URS Corporation		Date Received:	N/A
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319			

Project: Ausra / 2239472.01701

Matrix: Aqueous

Parameter	Method	QC Sample ID	Date Analyzed	Sample Conc	DUP Conc	RPD	RPD CL	Qualifiers
pH	SM 4500 H+ B	IRW-1	02/15/08	6.88	6.91	0	0-25	
Specific Conductance	SM 2510 B	IRW-1	02/15/08	1600	1600	0	0-25	
Turbidity	SM 2130 B	IRW-1	02/16/08	3.1	3.1	0	0-25	
Carbon Dioxide	SM4500-CO2D	IRW-1	02/15/08	6.3	6.1	3	0-25	
Alkalinity, Total (as CaCO3)	SM 2320B	IRW-1	02/15/08	114	114	0	0-25	
Bicarbonate (as CaCO3)	SM 2320B	IRW-1	02/15/08	114	114	0	0-25	
Carbonate (as CaCO3)	SM 2320B	IRW-1	02/15/08	ND	ND	NA	0-25	
Hydroxide (as CaCO3)	SM 2320B	IRW-1	02/15/08	ND	ND	NA	0-25	
Solids, Total Suspended	SM 2540 D	08-02-1082-5	02/15/08	6100	6060	1	0-20	
Solids, Total Dissolved	SM 2540 C	08-02-0943-9	02/15/08	1710	1520	12	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

ACCREDITED IN ACCORDANCE WITH nelac

URS Corporation	Date Received: N/A
1615 Murray Canyon Road, Suite 1000	Work Order No: 08-02-1151
San Diego, CA 92108-4319	Preparation: EPA 3010A Total
	Method: EPA 6010B

Project: Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
097-01-003-8,022	**Aqueous**	**ICP 5300**	**02/15/08**	**02/15/08**	**080215L05**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Antimony	82	95	80-120	15	0-20	
Arsenic	82	96	80-120	15	0-20	
Barium	100	101	80-120	2	0-20	
Beryllium	95	98	80-120	4	0-20	
Cadmium	102	102	80-120	0	0-20	
Chromium	99	104	80-120	4	0-20	
Copper	100	96	80-120	4	0-20	
Lead	98	100	80-120	2	0-20	
Nickel	105	105	80-120	0	0-20	
Selenium	91	91	80-120	0	0-20	
Thallium	98	98	80-120	0	0-20	
Aluminum	94	101	80-120	8	0-20	
Calcium	95	109	80-120	14	0-20	
Iron	102	104	80-120	2	0-20	
Magnesium	98	99	80-120	1	0-20	
Manganese	94	99	80-120	5	0-20	
Potassium	90	95	80-120	6	0-20	
Sodium	92	98	80-120	7	0-20	
Silicon	107	107	80-120	0	0-20	
Zinc	102	105	80-120	2	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: N/A
Work Order No: 08-02-1151
Preparation: EPA 7470A Total
Method: EPA 7470A

Project: Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-04-008-3,364	**Aqueous**	**Mercury**	**02/15/08**	**02/15/08**	**080215L04**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Mercury	96	97	85-121	1	0-4	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: N/A
Work Order No: 08-02-1151
Preparation: EPA 3510B
Method: EPA 8270C

Project: Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
095-01-003-2,344	**Aqueous**	**GC/MS MM**	**02/18/08**	**02/19/08**	**080218L01**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Phenol	35	35	4-142	0	0-24	
2-Chlorophenol	80	80	53-113	0	0-17	
1,4-Dichlorobenzene	70	70	50-122	0	0-19	
N-Nitroso-di-n-propylamine	78	78	56-146	0	0-22	
4-Chloro-3-Methylphenol	78	78	55-121	0	0-18	
Acenaphthene	85	86	55-139	1	0-17	
4-Nitrophenol	30	30	1-145	2	0-29	
2,4-Dinitrotoluene	76	77	41-161	1	0-22	
Pentachlorophenol	61	63	34-130	4	0-23	
Pyrene	106	106	38-170	1	0-27	
1,2,4-Trichlorobenzene	73	73	49-121	0	0-19	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

URS Corporation		Date Received:	N/A
1615 Murray Canyon Road, Suite 1000		Work Order No:	08-02-1151
San Diego, CA 92108-4319		Preparation:	EPA 5030B
		Method:	EPA 8260B

Project: Ausra / 2239472.01701

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-10-006-24,504	**Aqueous**	**GC/MS CC**	**02/21/08**	**02/21/08**	**080221L01**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
Benzene	102	101	84-120	1	0-8	
Carbon Tetrachloride	99	102	63-147	3	0-10	
Chlorobenzene	102	103	89-119	1	0-7	
1,2-Dibromoethane	101	105	80-120	4	0-20	
1,2-Dichlorobenzene	104	106	89-119	1	0-9	
1,1-Dichloroethene	93	94	77-125	1	0-16	
Ethylbenzene	108	107	80-120	1	0-20	
Toluene	109	108	83-125	1	0-9	
Trichloroethene	102	100	89-119	2	0-8	
Vinyl Chloride	111	112	63-135	2	0-13	
Methyl-t-Butyl Ether (MTBE)	97	102	82-118	5	0-13	
Tert-Butyl Alcohol (TBA)	102	107	46-154	5	0-32	
Diisopropyl Ether (DIPE)	92	95	81-123	3	0-11	
Ethyl-t-Butyl Ether (ETBE)	98	101	74-122	3	0-12	
Tert-Amyl-Methyl Ether (TAME)	98	100	76-124	2	0-10	
Ethanol	93	103	60-138	10	0-32	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: N/A
Work Order No: 08-02-1151

Project: Ausra / 2239472.01701

Matrix: Aqueous

Parameter	Method	Quality Control Sample ID	Date Extracted	Date Analyzed	LCS % REC	LCSD % REC	%REC CL	RPD	RPD CL	Qual
Fluoride	EPA 300.0	099-05-118-4,347	N/A	02/15/08	100	101	80-122	1	0-7	
Chloride	EPA 300.0	099-05-118-4,347	N/A	02/15/08	97	97	81-111	0	0-5	
Nitrate (as N)	EPA 300.0	099-05-118-4,347	N/A	02/15/08	102	102	87-111	0	0-12	
o-Phosphate (as P)	EPA 300.0	099-05-118-4,347	N/A	02/15/08	101	101	78-126	0	0-22	
Sulfate	EPA 300.0	099-05-118-4,347	N/A	02/15/08	104	104	89-107	0	0-13	
Cyanide, Total	SM 4500-CN E	099-05-061-2,225	02/15/08	02/15/08	84	84	80-120	1	0-20	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - Laboratory Control Sample

URS Corporation
1615 Murray Canyon Road, Suite 1000
San Diego, CA 92108-4319

Date Received: N/A
Work Order No: 08-02-1151

Project: Ausra / 2239472.01701

Matrix : Aqueous

Parameter	Method	Quality Control Sample ID	Date Analyzed	Date Extracted	Conc Added	Conc Recovered	LCS %Rec	%Rec CL	Qualifiers
Phosphorus, Total	SM 4500 P B/E	099-05-098-1,897	02/18/08	02/18/08	0.400	0.411	103	80-120	

RPD - Relative Percent Difference , CL - Control Limit

Calscience
Environmental
Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 08-02-1151

Qualifier	Definition
*	See applicable analysis comment.
1	Surrogate compound recovery was out of control due to a required sample dilution, therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported with no further corrective action required.
A	Result is the average of all dilutions, as defined by the method.
B	Analyte was present in the associated method blank.
C	Analyte presence was not confirmed on primary column.
E	Concentration exceeds the calibration range.
H	Sample received and/or analyzed past the recommended holding time.
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
N	Nontarget Analyte.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
U	Undetected at the laboratory method detection limit.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Calscience Environmental Laboratories, Inc.

☐ SoCal Laboratory
7440 Lincoln Way
Garden Grove, CA 92841-1427
(714) 895-5494

☐ NorCal Service Center
5063 Commercial Circle, Suite H
Concord, CA 94520-8577
(925) 689-9022

CHAIN OF CUSTODY RECORD

Date 2/14/08

Page 1 of 1

LABORATORY CLIENT: URS Corp.	CLIENT PROJECT NAME / NUMBER: 22239472.01701
ADDRESS: 2020 E. First St. Suite 400	P.O. NO.:
CITY: Santa Ana — STATE: CA — ZIP: 92705	PROJECT CONTACT: robert_scott@urscorp.com Bob Scott 619-294-9400
TEL: 714-835-6886 — E-MAIL: robert.scott@urscorp.com	LAB USE ONLY: 02-1151
	SAMPLER(S): (PRINT) Stavro Pilafas — COELT LOG CODE: ☐☐☐☐
	COOLER RECEIPT TEMP= 0.9 °C

TURNAROUND TIME: ☐ SAME DAY ☐ 24 HR ☐ 48 HR ☐ 72 HR ☐ 5 DAYS ☐ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING FORMS ☐ COELT EDF ☐ ____________

SPECIAL INSTRUCTIONS:
24-Hr TAT: All remaming analyses.
Standard TAT: CN, vocs, svocs, radioactivity analyses.

LAB USE ONLY	SAMPLE ID	FIELD POINT NAME (FOR COELT EDF)	SAMPLING DATE	SAMPLING TIME	MATRIX	NO. OF CONT.
	IRW-1		2/14/08	1410	W	20

REQUESTED ANALYSES

Sample ID	EPA 300.0 Anions - Fluoride including	EPA 6010B Diss. Metals - A including Sb, Ba, Be, Se, Tl	EPA 6010B/7470A Total Metals	SM 2130B - Turbidity	SM 2320B - Alkalinity	SM 2510 B - Specific Conductance	SM 2540C - TDS	SM 2540D - TSS	SM 4500H+B - pH	SM 4500 P B/E - Total Phosphorus	SM 4500 - CO2D CO2	Total CN	Radium 226 and 228	Tritium	Strontium 90 & Uranium	Gross Alpha and Gross Beta	EPA 8260B - VOCs	EPA 8270 - SVOCs	Asbestos
IRW-1	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X

Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
[signature] 2/15/08 0930	[signature] CEL	2/15/08	930
Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:
Relinquished by: (Signature)	Received by: (Signature/Affiliation)	Date:	Time:

DISTRIBUTION: White with final report, Green and Yellow to Client.
Please note that pages 1 and 2 of 2 of our T/Cs are printed on the reverse side of the green and Yellow copies respectively.

05/01/07 Revision

Q&Q Graphic 714-898-9702

Calscience Environmental Laboratories, Inc.

WORK ORDER #: **08 - 0 2 - 1 1 5 1**

Cooler 1 of 2

SAMPLE RECEIPT FORM

CLIENT: URS **DATE:** 2/15/08

TEMPERATURE – SAMPLES RECEIVED BY:

CALSCIENCE COURIER:

_______ Chilled, cooler with temperature blank provided.
_______ Chilled, cooler without temperature blank.
_______ Chilled and placed in cooler with wet ice.
_______ Ambient and placed in cooler with wet ice.
_______ Ambient temperature.

_______ °C Temperature blank.

LABORATORY (Other than Calscience Courier):

0.9 °C Temperature blank.
_______ °C IR thermometer.
_______ Ambient temperature.

Initial: HT

CUSTODY SEAL INTACT:

Sample(s): _______ Cooler: _______ No (Not Intact) : _______ Not Present: ✓

Initial: HT

SAMPLE CONDITION:

	Yes	No	N/A
Chain-Of-Custody document(s) received with samples	✓		
Sampler's name indicated on COC	✓		
Sample container label(s) consistent with custody papers	✓		
Sample container(s) intact and good condition	✓		
Correct containers and volume for analyses requested	✓		
Proper preservation noted on sample label(s)	✓		
VOA vial(s) free of headspace.	✓		
Tedlar bag(s) free of condensation			✓

Initial: HT

COMMENTS:

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 08 - 0 2 - 1 1 5 1

Cooler 2 of 2

SAMPLE RECEIPT FORM

CLIENT: URS

DATE: 2/15/08

TEMPERATURE – SAMPLES RECEIVED BY:

CALSCIENCE COURIER:

_______ Chilled, cooler with temperature blank provided.
_______ Chilled, cooler without temperature blank.
_______ Chilled and placed in cooler with wet ice.
_______ Ambient and placed in cooler with wet ice.
_______ Ambient temperature.
_______ °C Temperature blank.

LABORATORY (Other than Calscience Courier):

0.9 °C Temperature blank.
_______ °C IR thermometer.
_______ Ambient temperature.

Initial: HT

CUSTODY SEAL INTACT:

Sample(s): _______ Cooler: _______ No (Not Intact) : _______ Not Present: ✓

Initial: HT

SAMPLE CONDITION:

	Yes	No	N/A
Chain-Of-Custody document(s) received with samples	✓		
Sampler's name indicated on COC	✓		
Sample container label(s) consistent with custody papers	✓		
Sample container(s) intact and good condition	✓		
Correct containers and volume for analyses requested	✓		
Proper preservation noted on sample label(s)	✓		
VOA vial(s) free of headspace	✓		
Tedlar bag(s) free of condensation			✓

Initial: HT

COMMENTS:

LA Testing
159 Pasadena Avenue, South Pasadena, CA 91030
Phone: (323) 254-9960 Fax: (323) 254-9982 Email: pasadenalab@latesting.com

Attn: **Vik Patel**
Calscience Environmental Labs, Inc.
7440 Lincoln Way
Garden Grove, CA 92841-1432

Fax: (714) 894-7501 Phone: (714) 895-5494
Project: **08-02-1151**

Customer ID: 32CALS51
Customer PO: 08-02-1151
Received: 02/15/08 12:40 PM
LA Testing Order: 320801961

LA Testing Proj:
Analysis Date: 2/21/2008
Report Date: 2/21/2008

Determination of Asbestos Structures over 10um in Length in Waste Water Performed by the EPA 100.2 Method

Sample ID	Sample Prep Date	# Fibers Asbestos	# Fibers Non-Asbestos	Type(s) Of Asbestos	Analytical Sensitivity (MFL)	Confidence Limits	Concentration Of Asbestos Fibers (MFL)	Comments
IRW-1 *320801961-0001*	2/21/2008	0	0		0.19	0.00-0.69	<0.19	Total area of filter examined = 0.23 mm2

Effective filtration area = 1288 mm2. Sample prepped past 48 hour hold time. UV ozonated.

Analyst(s)
Sherrie Ahmad (1)

Derrick Tanner, Laboratory Manager
or other approved signatory

Sample collection and containers provided by the client, acceptable bottle blank level is defined as <=0.01MFL>10um. ND=None Detected. This report relates only to those items tested.
This report may not be reproduced, except in full, without written permission by EMSL Analytical, Inc. Samples received in good condition unless otherwise noted.
ACCREDITATIONS: NVLAP 200232-0, California State DHS #2283

Case Narrative (2 Pages) : An overview of the work performed at FGL.
Chemical Results (1 Page) : Results for each sample submitted.
Quality Control (2 Pages) : Supporting Quality Control (QC) results.

This report package pertains to the following sample:

Sample Description	Date Sampled	Date Received	FGL Lab Sample ID #	Matrix
IRW-1	02/14/2008	02/15/2008	SP 801769-01	DW

Sampling and Receipt Information: The sample was received, prepared and analyzed within the method specified holding times. All samples arrived at 3 °C. All samples were checked for pH if acid or base preservation required (except for VOAs). For details of sample receipt information, please see the attached Chain of Custody and Condition Upon Receipt Forms.

Quality Control: All samples were prepared and analyzed according to the following tables:

Radio Chemistry QC

900.0	02/22/2008:A207 All preparation quality controls are within established criteria.
	02/28/2008:B - GP218 All analysis quality controls are within established criteria.
903.0	02/20/2008:A215 All preparation quality controls are within established criteria.
	02/20/2008:A - GP215 All analysis quality controls are within established criteria.
905.0	02/26/2008:B - GP217 All analysis quality controls are within established criteria.
906.0	02/25/2008:A217 All preparation quality controls are within established criteria.
	02/26/2008:A - LS201 All analysis quality controls are within established criteria.
908.0	02/27/2008:A218 All preparation quality controls are within established criteria, except: The following note applies to Uranium: 325 QC not within Acceptance Range (AR). Data could not be confirmed by reanalysis. Use results with discretion. The following note applies to Uranium: 410 Relative Percent Difference (RPD) not within Maximum Allowable Value

~~Table continued on next page...~~

Corporate Offices & Laboratory
P.O. Box 272 / 853 Corporation Street
Santa Paula, CA 93061-0272
TEL: (805) 392-2000
FAX: (805) 525-4172
CA NELAP Certification No. 01110CA

Office & Laboratory
2500 Stagecoach Road
Stockton, CA 95215
TEL: (209) 942-0182
FAX: (209) 942-0423
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Ra-05	02/21/2008:A212 All preparation quality controls are within established criteria.
	02/27/2008:A - GP218 All analysis quality controls are within established criteria.

Certification: I certify that this data package is in compliance with NELAC Standards, both technically and for completeness, except for any conditions listed above. Release of the data contained in this data package is authorized by the Laboratory Director or his designee, as verified by the following signature.

FGL ENVIRONMENTAL

KAD:kdm

Kelly A. Dunnahoo, B.S.
Laboratory Director

Sample Results - Radio

Constituents	Result ± Error	MDA	Units	MCL	Preparation Method	Preparation Date/ID	Analysis Method	Analysis Date/ID
Radio Chemistry P:1,5								
Gross Alpha	9.36 ± 3.16	3.9	pCi/L	15*	900.0	02/22/08:A207	900.0	02/29/2008:B01
Gross Beta	0.000 ± 2.11	3.7	pCi/L	50	900.0	02/22/08:A207	900.0	02/29/2008:B01
Strontium 90	1.03 ± 0.467	0.74	pCi/L	8	905.0	02/25/08:A214	905.0	02/27/2008:B01
Alpha Radium(226)	0.237 ± 0.184	0.18	pCi/L	5	903.0	02/20/08:A215	903.0	02/21/2008:A01
Tritium	0.000 ± 198	400	pCi/L	20,000	906.0	02/25/08:A217	906.0	02/26/2008:A01
Uranium	6.00 ± 1.16	0.76	pCi/L	20	908.0	02/27/08:A218	908.0	03/03/2008:A01
Ra-228	0.241 ± 0.651	0.55	pCi/L	2	Ra-05	02/21/08:A212	Ra-05	02/27/2008:A01

MDA = Minimum Detectable Activity; Data utilized by the DHS to determine matrix interference. MCL = Maximium Contaminat Level.

Containers: (P) Plastic Preservatives: (1) Cool 4°C, (5) HNO3 pH < 2

* Including Radium but excluding Uranium. (Ref. Title 22 sec. 64442.)

CCR Section 64442: Compliance Note: If Gross Alpha (Result + (0.84 x error)) exceeds 5 pCi/L run Uranium. If Gross Alpha minus Uranium exceeds 5 pCi/L run Radium 226. Samples that exceed 5 pCi/L are held for 6 months at FGL.

Compliance:

Gross Alpha - Uranium ≤ 15 pCi/L

Uranium ≤ 20 pCi/L

Radium 226 + Radium 228 ≤ 5 pCi/L

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FAX: (559) 734-8435
Mobile: (559) 737-2399

			BSRPD	pCi/L		8.9%	≤35.5	
Alpha-α	903.0	02/20/2008:A	00-CCB	cpm		0.10	.084±.05	
			00-CCV	cpm	19760	45.9%	41.0±10	
Gross Alpha	900.0	02/22/2008:A207	Blank	pCi/L		ND	<1	
			LCS	pCi/L	114.2	101%	75-125	
			MS	pCi/L	114.2	86.7%	60-140	
		(SP 801910-01)	MSD	pCi/L	114.2	87.2%	60-140	
			MSRPD	pCi/L		0.5%	≤30	
Alpha-α	900.0	02/28/2008:B	00-CCB	cpm		0.12	.0775±.054	
			00-CCV	cpm	11700	42.0%	41.0±5.0	
Gross Beta	900.0	02/22/2008:A207	Blank	pCi/L		ND	<4	
			LCS	pCi/L	105.7	101%	75-125	
			MS	pCi/L	105.7	94.2%	80-130	
		(SP 801910-01)	MSD	pCi/L	105.7	84.0%	80-130	
			MSRPD	pCi/L		11.2%	≤30	
Beta-ß	900.0	02/28/2008:B	00-CCB	cpm		0.46	.373±.11	
			00-CCV	cpm	11700	91.3%	88.9±5.0	
Ra-228	Ra-05	02/21/2008:A212	RgBlk	pCi/L		0.01	3	
			LRS	pCi/L	101.2	40.0%	35- 50	
			BS	pCi/L	101.2	98.5%	75-125	
			BSD	pCi/L	101.2	96.5%	75-125	
			BSRPD	pCi/L		2.0%	≤25	
Beta-ß	Ra-05	02/27/2008:A	00-CCB	cpm		0.44	.373±.11	
			00-CCV	cpm	11700	91.2%	88.9±5.0	
	905.0	02/26/2008:B	00-CCB	cpm		0.44	.376±.097	
			00-CCV	cpm	11700	92.5%	88.6±5.0	
Tritium	906.0	02/25/2008:A217	Blank	pCi/L		ND	<518	
			LCS	pCi/L	2409	103%	75-125	
			BS	pCi/L	2409	103%	75-125	
			BSD	pCi/L	2409	107%	75-125	
			BSRPD	pCi/L		4.0%	≤25	
	906.0	02/26/2008:A	00-CCB	cpm		11	12±1.7	
			00-CCV	cpm	372.1	23.6%	25.5±4.5	
Uranium	908.0	02/27/2008:A218	RgBlk	pCi/L		0.23	1	
			LRS	pCi/L	20.27	85.4%	46-100	
			BS	pCi/L	20.27	95.5%	75-125	
			BSD	pCi/L	20.27	64.3%	75-125	325
			BSRPD	pCi/L		39.0%	≤20	410
Alpha-α	908.0	02/29/2008:A	00-CCB	cpm		0.10	.046±.08	

Report continued on next page...

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Mobile: (559) 737-2399

325	QC not within Acceptance Range (AR). Data could not be confirmed by reanalysis. Use results with discretion.
410	Relative Percent Difference (RPD) not within Maximum Allowable Value (MAV). Data was accepted based on the LCS or CCV recovery.

Definitions

Blank	: Method Blank - Prepared to verify that the preparation process is not contributing contamination to the samples.
RgBlk	: Method Reagent Blank - Prepared to correct for any reagent contributions to sample result.
LCS	: Laboratory Control Standard/Sample - Prepared to verify that the preparation process is not affecting analyte recovery.
LRS	: Laboratory Recovery Standard
MS/MSD	: Matrix Spikes - A random sample is spiked with a known amount of analyte. The recoveries are an indication of how that sample matrix affects analyte recovery.
BS/BSD	: Blank Spikes - A blank is spiked with a known amount of analyte. It is prepared to verify that the preparation process is not affecting analyte recovery.
CCB	: Continuing Calibration Blank - Analyzed to verify the instrument baseline is within criteria.
CCV	: Continuing Calibration Verification - Analyzed to verify the instrument calibration is within criteria.
ND	: Non-detect - Result was below the DQO listed for the analyte.
DQO	: Data Quality Objective - This is the criteria against which the quality control data is compared.

N WAY
OVE, CA 92841-1432
5-5494 . FAX: (714) 894-7501

TO: FGL LABS

CHAIN OF CUSTODY RECORD

DATE: 02/15/08

801769

PAGE: 1 OF 1

ies, Inc.

CLIENT PROJECT NAME / NUMBER: 08-02-1151

P.O. NO.:

PROJECT CONTACT: Vik Patel

QUOTE NO.:

SAMPLER(S): (SIGNATURE)

LAB USE ONLY: ☐ ☐ - ☐ ☐ ☐ ☐

01

E-MAIL: vipatel@calscience.com

☐ 72 HR ☐ 5 DAYS ☐ 10 DAYS

)

E SAMPLES UNTIL ___ / ___ / ___

ndard TAT

REQUESTED ANALYSIS

ION/ PTION	SAMPLING DATE	SAMPLING TIME	Matrix	#Cont	Radium 226	Radium 228	Gross Alpha & Beta	Tritium	Strontium 90	Uranium
	02/14/08	1410	W	7	X	X	X	X	X	X

	Received by: (Signature)	Date:	Time:
EL	GSO AB# 508949584	2/15/08	1600
overnight	JS	2/16/08	1016

further review. Please notify Microbiology personnel immediately of bacti samples received.

3. Do the number of bottles received agree with the COC? Yes No N/A
4. Were samples received intact? (i.e. no broken bottles, leaks etc.) Yes No
5. Were sample custody seals intact? N/A Yes No

Sign and date the COC, obtain LIMS sample numbers, select methods/tests and print labels.

Sample Verification, Labeling and Distribution:

1. Were all requested analyses understood and acceptable? Yes No
2. Did bottle labels correspond with the client's ID's? Yes No
3. Were all bottles requiring sample preservation properly preserved? Yes No N/A FGL
4. VOAs checked for Headspace? Yes No N/A
5. Were all analyses within holding times at time of receipt? Yes No
6. Have rush or project due dates been checked and accepted? N/A Yes No

Attach labels to the containers and include a copy of the COC for lab delivery.

Sample Receipt, Login and Verification completed by (initials): clc

Discrepancy Documentation:

Any items above which are "No" or do not meet specifications (i.e. temps) must be resolved.

1. Person Contacted:__________ Phone Number:__________
   Initiated By:__________ Date:__________
   Problem:

   Resolution:

2. Person Contacted:__________ Phone Number:__________
   Initiated By:__________ Date:__________
   Problem:

   Resolution:

(2-17756)

Calscience Environmental Laboratories

SP 0801769

IV-02/18/2008-09:14:35

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

Note: After Year 2

SITE VICINITY MODEL RESULTS
CONSTRUCTION (YEAR 2) - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

N

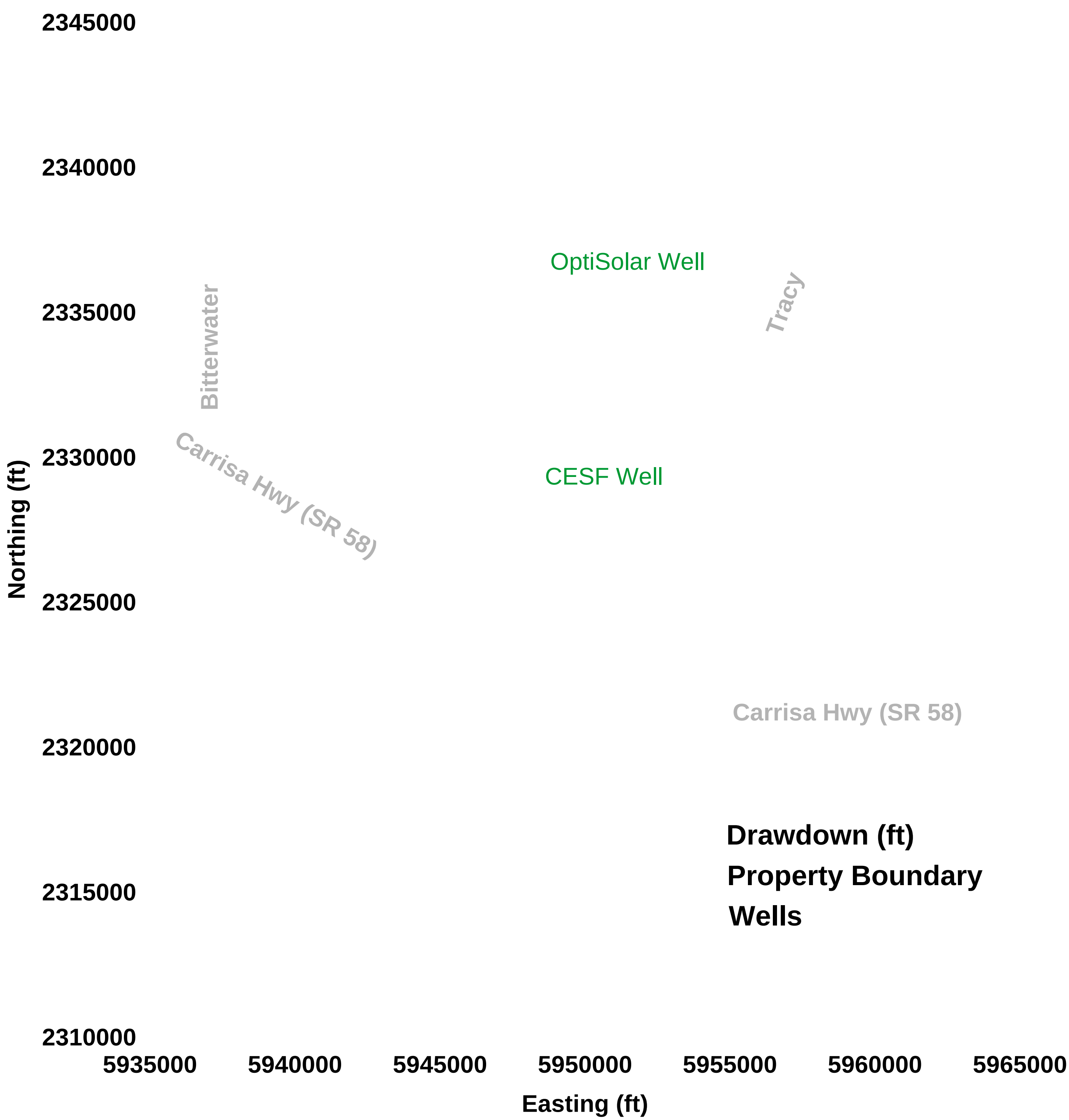
URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS DATE: 09-18-08 FIG. NO:

PM: AL PROJ. NO: 27658060.01800 G-1

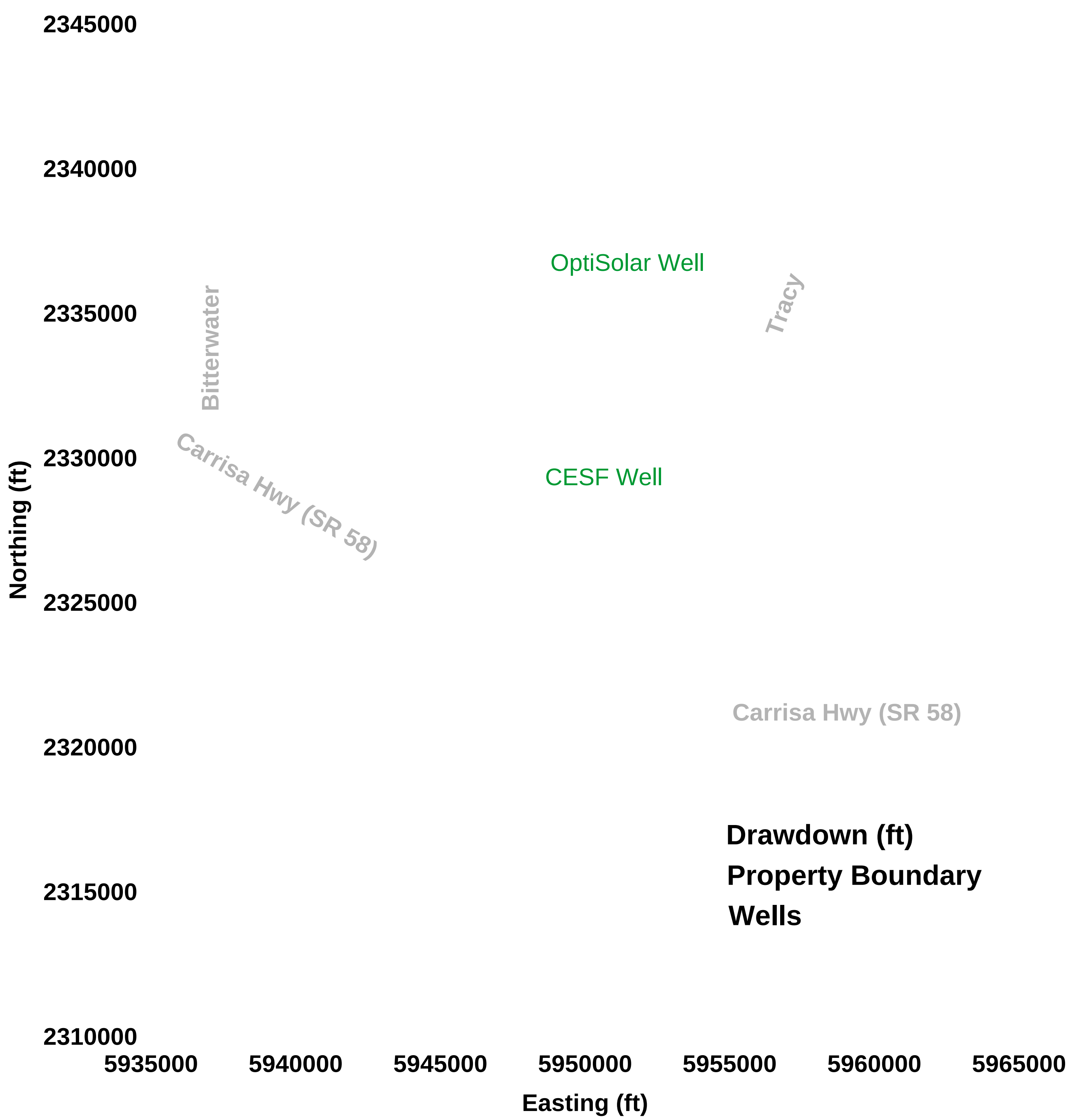


SITE VICINITY MODEL RESULTS
CONSTRUCTION (YEAR 3) - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

URS

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS | DATE: 09-18-08 | FIG. NO:
PM: AL | PROJ. NO: 27658060.01800 | G-2



Note: Construction/Combined Scenarios After Year 1

SENSITIVITY ANALYSIS: LOWER PUMPING RATES
DRAWDOWN - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

URS

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS | DATE: 09-18-08 | FIG. NO:
PM: AL | PROJ. NO: 27658060.01800 | G-3

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

Note: Construction/Combined Scenarios After Year 1

SENSITIVITY ANALYSIS: LOWER PUMPING RATES
DRAWDOWN - LAYER 3
CARRIZO ENERGY SOLAR FARM (CESF)

N

URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS DATE: 09-18-08 FIG. NO:

PM: AL PROJ. NO: 27658060.01800 G-4

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

Note: Constuction/Combined Scenarios After Year 1

SENSITIVITY ANALYSIS: LOWER Kv
DRAWDOWN - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

N

URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS DATE: 09-18-08 FIG. NO:

PM: AL PROJ. NO: 27658060.01800 G-5

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

Note: Constuction/Combined Scenarios After Year 1

SENSITIVITY ANALYSIS: LOWER Kv

DRAWDOWN - LAYER 3

CARRIZO ENERGY SOLAR FARM (CESF)

N

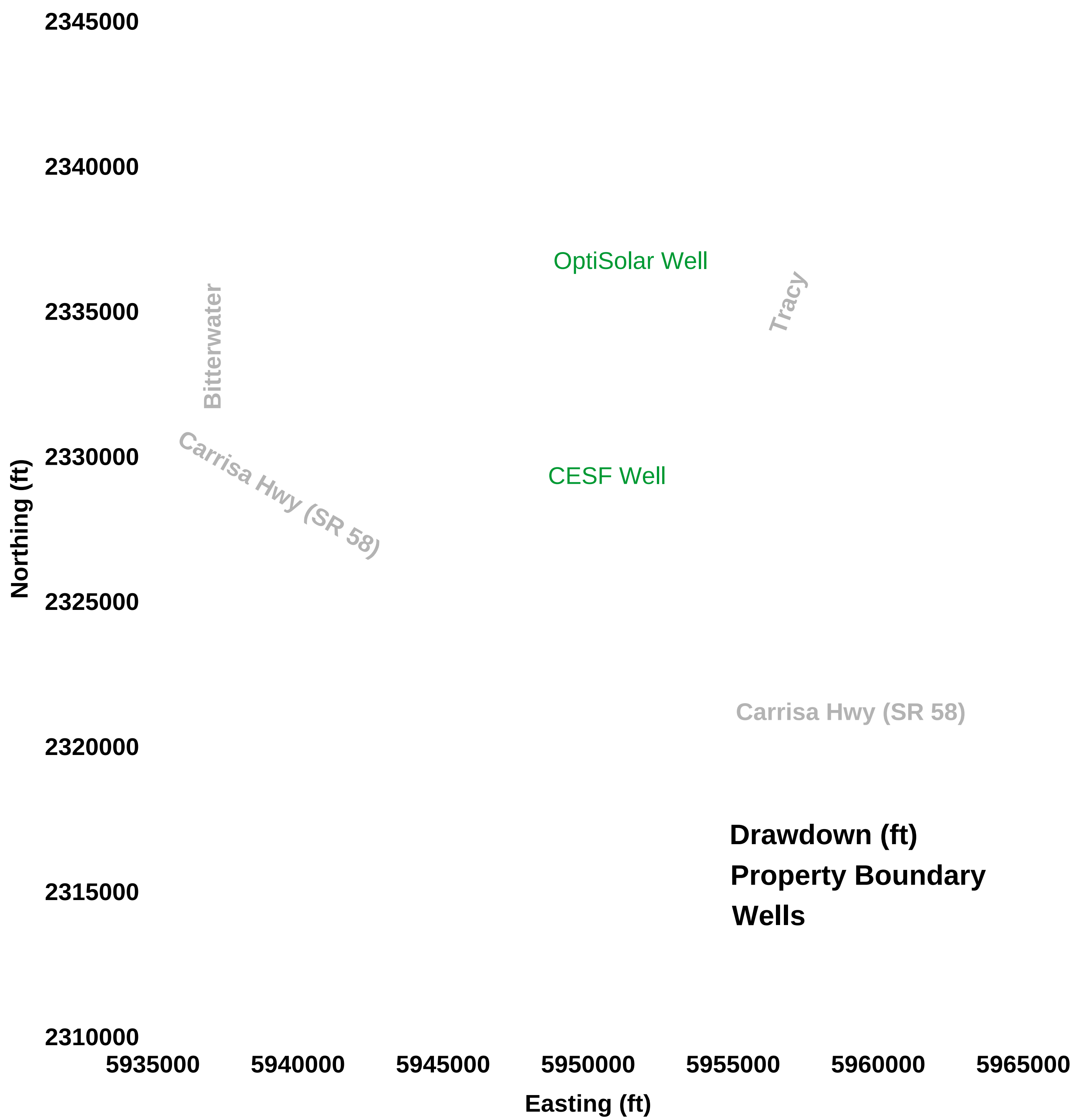
URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS DATE: 09-18-08 FIG. NO:

PM: AL PROJ. NO: 27658060.01800 G-6



N

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

URS

SENSITIVITY ANALYSIS: HIGHER Kv
DRAWDOWN - LAYER 1
CARRIZO ENERGY SOLAR FARM (CESF)

CREATED BY: RS | DATE: 09-18-08 | FIG. NO:
PM: AL | PROJ. NO: 27658060.01800 | G-7

2345000

2340000

OptiSolar Well

Tracy

2335000

Bitterwater

2330000

Carrisa Hwy (SR 58)

CESF Well

Northing (ft)

2325000

Carrisa Hwy (SR 58)

2320000

Drawdown (ft)

Property Boundary

Wells

2315000

2310000

5935000 5940000 5945000 5950000 5955000 5960000 5965000

Easting (ft)

SENSITIVITY ANALYSIS: HIGHER Kv
DRAWDOWN - LAYER 3
CARRIZO ENERGY SOLAR FARM (CESF)

N

URS

0 .5 1 Mile

SCALE CORRECT WHEN PRINTED AT 8.5X11

CREATED BY: RS DATE: 09-18-08 FIG. NO:

PM: AL PROJ. NO: 27658060.01800 G-8