8.7 NOISE

This section presents an assessment of potential noise and vibration effects related to the Russell City Energy Center (RCEC) and adjacent Advanced Water Treatment (AWT) Plant. This assessment includes an evaluation of the potential effects to the nearest sensitive receptors and to plant operations personnel. Conference of the project to the City of Hayward's noise impact criteria for the Industrial Zone was also assessed. Section 8.7.1 discusses the affected environment, including baseline noise level survey methodology and results. Section 8.7.2 discusses the environmental consequences from construction and operation of the AWT plant and associated facilities. Section 8.7.3 discusses cumulative impacts. Section 8.7.4 discusses mitigation measures. Section 8.7.5 presents applicable laws, ordinances, regulations, and standards. Section 8.7.6 presents agency contacts, and Section 8.7.7 presents permit requirements and schedules. Section 8.7.8 contains references.

8.7.1 Affected Environment

The proposed site of the RCEC and AWT plant is located within the Hayward Industrial Corridor. The nearest residences are on the east side of Industrial Boulevard, about 0.82 miles from the RCEC property line. The area between the site and the nearest residential areas contains large concrete and metal buildings which help to obstruct noise. Land uses surrounding the project site include the City of Hayward Water Pollution Control Facility (WPCF) to the north, trucking terminals to the east and west, heavy industrial uses (Rohm and Haas paint polymers plant) and offices to the southeast, and open space to the south. Primary sources of noise in the area include equipment at the WPCF, and truck traffic noise on local streets. There is also some noise from airplanes in the flight paths of the Oakland, Hayward, and San Francisco airports.

The Hayward shoreline area and Hayward Shoreline Regional Park are located west of the site. This marshy area also contains the City of Hayward's WPCF oxidation ponds. A system of nature trails has been developed along the San Francisco Bay shoreline and through the Cogswell Marsh, and the Hayward Shoreline Interpretive Center is located at the end of Breakwater Avenue adjacent to the Hayward-San Mateo Bridge approach (State Route 92).

The CEC's power plant certification regulations require that noise measurements be made at noise-sensitive locations where there is a potential for an increase of 5 dBA or more over existing background noise levels during construction or operation of a proposed power plant. Although it was not anticipated that plant noise would increase the ambient levels at the nearest residences by 5 dBA, an ambient noise survey was conducted adjacent to these residences, because there are no other noise-sensitive uses nearer to the site. Measurements were also made at one location along the bay trail system, at the Hayward Shoreline Interpretive Center, in the wildlife refuge, and at one location on the power plant site boundary near the WPCF.

The survey was conducted at four of the locations on February 27 and 28, 2001 and at a fifth location on March 25 and 26, 2001. The five monitoring locations and receptor locations are shown in Figure 8.7-1. A brief description of each monitoring location and the types of sounds heard during the survey are presented below. Photographs of each location are presented in Figure 8.7-2.

Location 1—This site is located at the north boundary of the proposed site, across the street from the WPCF. The microphone was mounted on the chainlink fence beside the entrance gate to the existing KFAX radio transmitter site at 3636 Enterprise Avenue. The primary source of ambient noise in this location is the WPCF, which produced a near-constant level of noise during the monitoring period. Trucks and jet aircraft produced higher levels of intermittent noise.

Location 2—This monitoring site is adjacent to the nearest residence, which is located east of Industrial Boulevard at 2773 Depot Road, just east of Linda's Flower Shop. The microphone was positioned on the lower branch of a tree at the western edge of the resident's vegetable garden, about 50 feet from Depot Road and 100 feet from Industrial Boulevard. Traffic on Industrial Boulevard was the primary source of ambient noise in this location.

Location 3—This site is at the entrance to the Waterford Apartments, which are located at 25800 Industrial Boulevard, south of Depot Road. The microphone was attached to the apartment fence about 60 feet from the street. Traffic on Industrial Boulevard was the primary source of ambient noise in this location.

Location 4—This monitoring site is at the Hayward Shoreline Interpretive Center adjacent to the Hayward-San Mateo Bridge (State Route 92) approach at the edge of the bayshore marshlands area. The microphone was attached to a post on the observation deck behind the center about 150 feet from the highway. Traffic on State Route 92 was the primary source of ambient noise at this location. Aircraft noise was a secondary noise source.

Location 5—This site is on the footbridge crossing the Cogswell Marsh on the bay trail about 1.12 miles west of the project site. The microphone was mounted on a temporary steel post attached to the bridge railing at the north end of the bridge. Jet aircraft were the primary source of ambient noise on the trail. Industrial noise and traffic noise could only be heard under certain atmospheric conditions. Wind, birds, and waves lapping on the shore of the marsh also produced noise at the bridge.

8.7.1.1 Noise Survey Methodology

Continuous measurements of the A-weighted sound levels were made simultaneously over a complete 25-hour period using four (4) Larson-Davis Laboratories Model 700 sound level meters (LDL 700) with integral data loggers. The instruments were equipped with optional circuitry and microphones to permit them to meet the requirements of ANSI S1.4-1983 for Type I precision sound level meters. The Bruel & Kjaer (B&K) Type 4176 ½" prepolarized random incidence microphones were remotely mounted (via a 10-foot microphone extension cable and preamplifier) at a height of about 5 feet above the ground. Foam windscreens, 3½ inch in diameter, were used to reduce wind-generated noise.

The calibration levels of the instruments were checked before and after the 25-hour monitoring period using a B&K Type 4230 sound level calibrator. The analyzers were internally timed to turn on and off automatically on the start and stop days, respectively. They were generally unattended during the monitoring period, but the monitoring technician did visit each site four times to make observations about sounds heard and general weather conditions. Observations were made during the first hour between 1600 and 1700, in the evening between 2100 and 2200, late at night between 0300 and 0400, and mid-morning between 1000 and 1100.

The LDL 700s were programmed to measure and record the equivalent sound level (L_{eq}) for each minute of the 25-hour period as well as compute and store the statistical sound levels exceeded 10, 50, and 90 percent of each hour (L_{10}, L_{50} and L_{90}). The L_{eq} for each hour of the period was also computed and recorded. At the end of the 25-hour period, the data was downloaded directly into a laptop computer for storage and further analysis, including computation of the 24-hour L_{eq}, day/night level (L_{dn}), and the community noise equivalent level (CNEL). A spreadsheet program was used to generate graphs of the

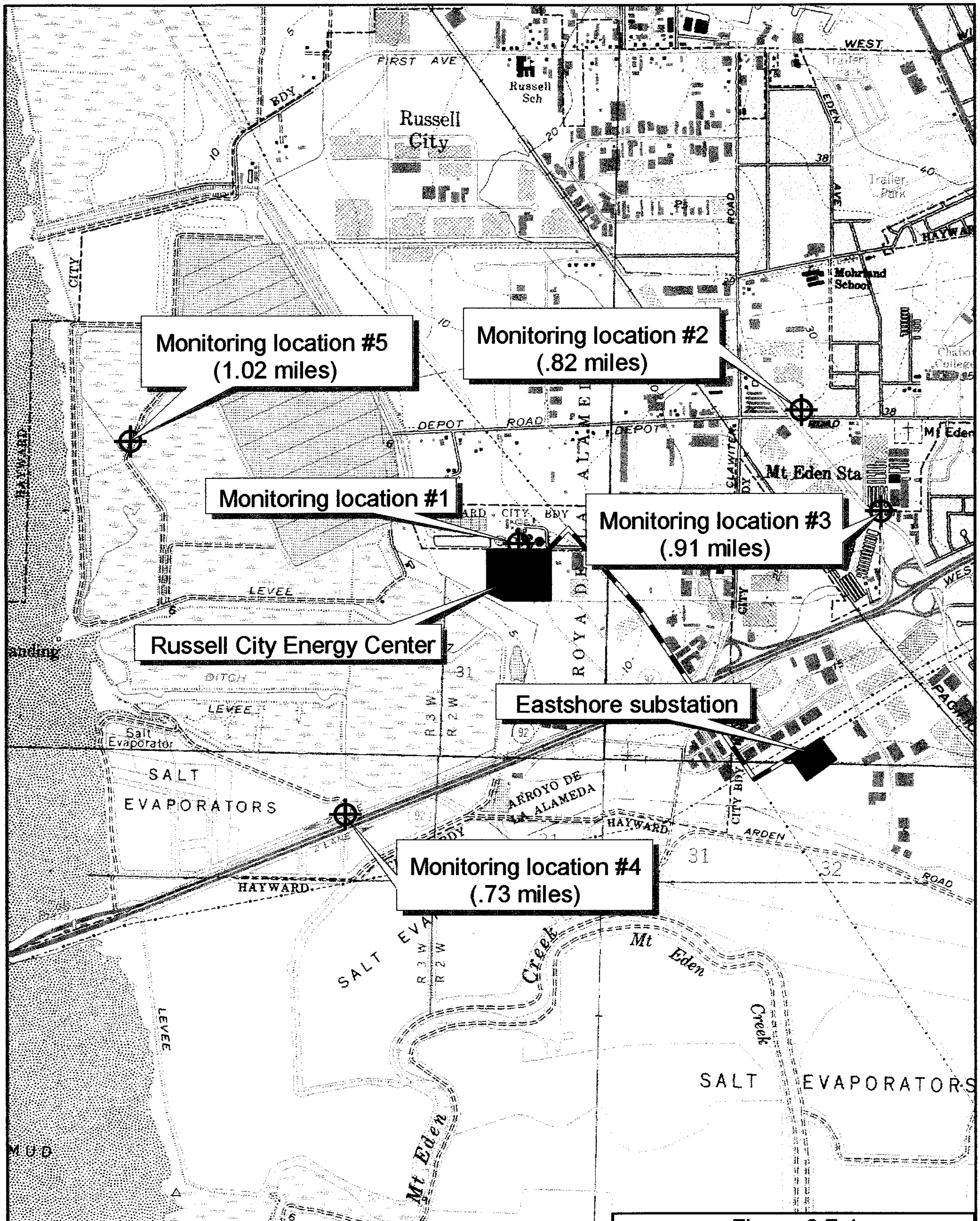


Figure 8.7-1

Noise Monitoring Locations

RUSSELL CITY ENERGY CENTER

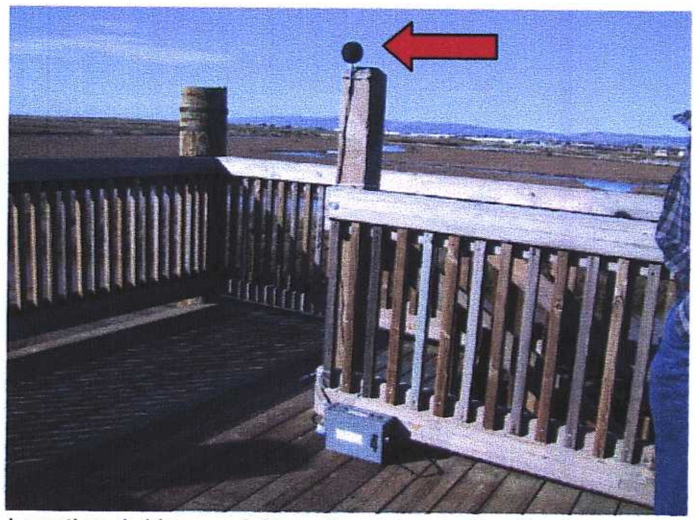
FOSTER WHEELER ENVIRONMENTAL CORPORATION

Russell City Energy Center AFC

May 2001

Location 2: 2773 Depot Road.

Location 3: Waterford Apartments, 25800 Industrial Boulevard.



Location 4: Hayward Shoreline Interpretive Center.

Location 5: footbridge crossing Cogswell Marsh

Figure 8.7-2. Noise monitoring locations (arrow indicates microphone).

data. One graph was produced of the 1-minute L_{eq} levels to show the often rapid variation in sound levels experienced in outdoor environments. Another graph was produced of the hourly L_{eq} levels and the L_{50} and L_{90} statistical sound levels, showing all three curves in the same plot.

8.7.1.2 Noise Survey Results

Weather conditions during both surveys were similar, with mild to cool temperatures, calm to moderate winds, and clear skies. Daytime temperatures ranged from about 50 degrees in the early morning to about 75 degrees in mid-afternoon. Nighttime temperatures ranged from about 48 to 55 degrees. Wind speeds varied from calm to about 8 mph at locations 1 through 3. Winds were generally higher, with gusts up to 25 mph, at Locations 4 and 5 in the open wildlife refuge. Average wind speeds were about 8 to 10 mph along the bay trail. The wind was generally out of the west to north from across the bay during the day and out of the north to east during the early morning hours. Relative humidity varied from about 50 to 65 percent during the surveys. Skies were clear and there was no precipitation during either survey period.

The hourly L_{eq} levels along with the three commonly used 24-hour composite noise descriptors of the continuous A-weighted sound levels are presented in Table 8.7-1 for the five monitoring locations. The average nighttime L_{90} for the locations is also presented on the bottom row of the table. This descriptor has no regulatory basis but is useful for comparison with continuous sources of industrial noise such as power plants, and for assessing noise impacts.

The City of Hayward Planning Department's Noise Element Policies document (1977) indicates that CNEL or L_{dn} levels of up to 55 dBA are acceptable for outdoor residential spaces. Higher levels up to 70 dBA are considered to be conditionally acceptable. The measured levels at the 5 locations monitored are within the conditionally acceptable level. The lowest levels, as expected, were measured on the nature trail (Location 5), which is the furthest of the monitoring stations from sources of man-made noise. This is the only location monitored that had L_{dn} and CNEL ambient noise levels that were clearly acceptable for residential use at 56.7 and 57.0 dBA, respectively. All of the residential areas monitored are significantly impacted by traffic noise and have L_{dn}/CNEL levels ranging from 66.0 to 69.1 dBA, which are at the upper end of the City's Conditionally Acceptable category (55 to 70 dBA).

The usefulness of this energy-averaged data is somewhat limited in describing the noise environment, however, because of the disproportionate influence that a few high sound level intervals can have on the 24-hour averages. This is due to the logarithmic nature of the averaging process whereby, for example, a level of 60 dBA contains ten times the energy of a 50 dBA level and counts ten times as much in the average. Placement of the microphones near roadways further skews the data to the high side. Ideally, the microphone would be placed the same distance from roads as the houses of interest. However, this is seldom practicable. Using the statistical L_{50} and L_{90} levels (sound levels exceeded 50 percent or 90 percent of the time, respectively, at a given location) overcomes these problems by eliminating these short-duration intrusive events from the record. Graphs of the continuous data using these statistical measures present a much more accurate description of the noise environment against which noise from the proposed project should be considered. The most important time period is late at night during normal sleep hours when ambient noise levels are low because human activity is at a minimum, and wind speeds have generally diminished.

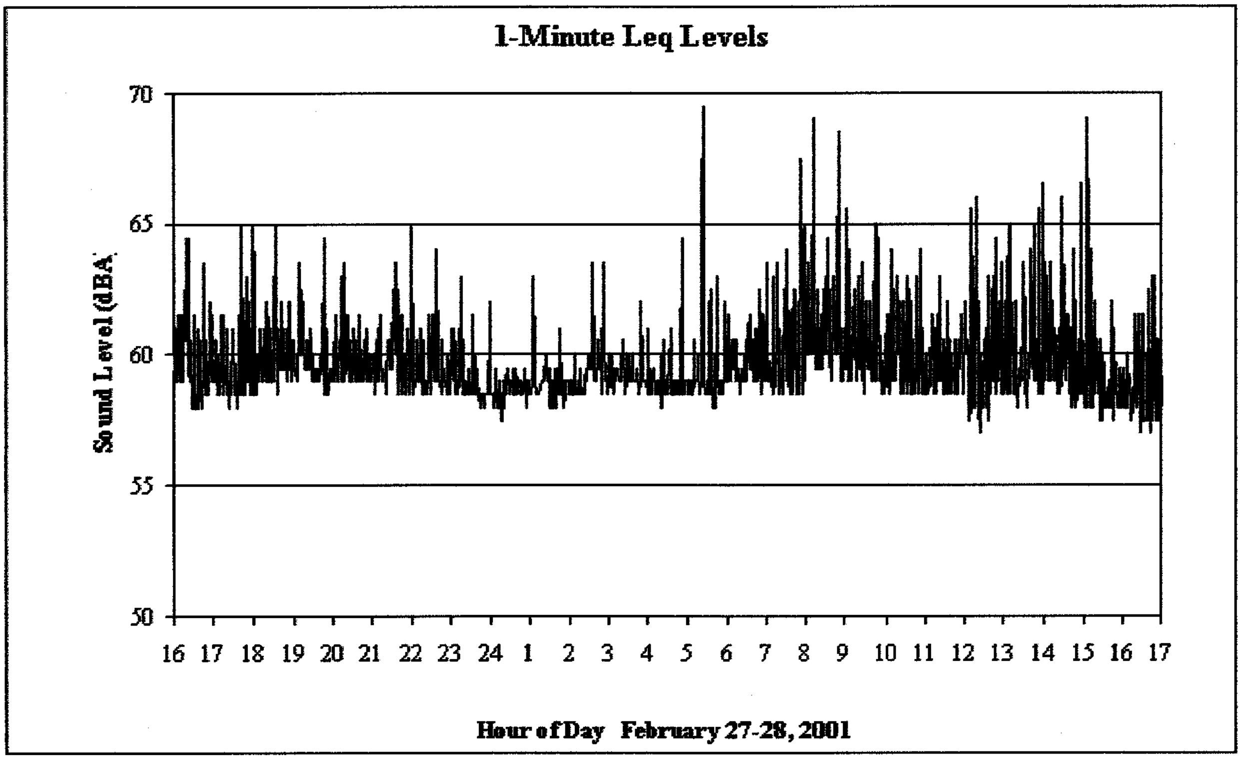
Table 8.7-1. Hourly L_{eq} and composite noise levels.

Date	Hour Beginning	Location 1 L_{eq} (dBA)	Location 2 L_{eq} (dBA)	Location 3 L_{eq} (dBA)	Location 4 L_{eq} (dBA)	Location 5 L_{eq} (dBA)
2/27/01	1600	60.0	66.5	67.0	60.5	52.5
2/27/01	1700	60.0	64.0	65.5	60.5	53.5
2/27/01	1800	60.0	62.5	65.0	60.5	54.0
2/27/01	1900	60.0	60.0	62.5	59.5	48.5
2/27/01	2000	60.0	60.5	61.5	60.0	50.0
2/27/01	2100	60.0	60.5	62.5	60.0	52.0
2/27/01	2200	59.5	59.5	61.0	58.5	50.5
2/27/01	2300	59.0	56.0	58.0	57.5	51.5
2/28/01	2400	58.5	52.0	56.0	55.0	50.0
2/28/01	0100	59.0	51.0	55.5	55.0	50.0
2/28/01	0200	59.5	52.0	55.0	53.0	48.0
2/28/01	0300	59.5	56.5	57.0	55.0	44.5
2/28/01	0400	59.0	56.5	58.5	58.5	47.5
2/28/01	0500	60.5	61.5	63.0	60.0	49.0
2/28/01	0600	60.0	63.5	65.5	59.5	48.5
2/28/01	0700	60.5	65.0	66.0	59.0	51.0
2/28/01	0800	61.5	63.5	75.0	57.5	49.0
2/28/01	0900	60.5	63.0	66.0	74.0	49.5
2/28/01	1000	60.5	64.0	65.0	63.5	50.0
2/28/01	1100	59.5	62.5	70.0	60.0	50.0
2/28/01	1200	60.5	62.5	66.0	60.0	55.5
2/28/01	1300	60.5	63.0	66.5	57.5	58.0
2/28/01	1400	60.5	63.5	66.0	57.0	55.0
2/28/01	1500	60.5	63.5	66.0	57.0	51.5
2/28/01	1600	59.0	63.5	66.5	57.0	51.0
	$L_{eq}(24)$	60.0	62.0	66.0	62.6	51.8
	L_{dn}	66.0	66.0	68.8	65.7	56.7
	CNEL	66.3	66.3	69.1	66.0	57.0
	Average Night L_{90}	58.1	45.8	49.5	51.2	44.5

Notes:
1. $L_{eq}(24)$, L_{dn} and CNEL were computed from the first 24 hours of the 25-hour survey.
2. Average night L_{90} is the arithmetic average of L_{90} levels for the hours 2200 to 0600.
3. Location 5 measurements were made between 1700 on March 25 and 1800 on March 26, 2001.

Graphs showing noise levels at the five monitoring stations are presented in Figures 8.7-3 through 8.7-7. The first graph in each figure is a plot of the 1-minute L_{eq} levels. The effects of individual noise events, such as the passage of heavy trucks and trains, can be seen as tall spikes in these graphs. The second graph for each location shows the hourly equivalent noise levels and the statistical levels exceeding 50 and 90 percent of each hour (L_{eq}, L_{50} and L_{90}). Of the three lines on these graphs, the L_{90} background or residual sound levels are the most important for impact assessment purposes. The L_{90} level would be most affected by a new facility such as a power plant that generally produces a constant level of noise, effectively raising the background noise level (L_{90}) near the plant.

The L_{90} pattern at Location 1 (Figure 8.7-3, lower curve of the lower graph) is typical of a location near such a source. In this case, it is the Hayward Water Pollution Control Facility producing a nearly constant noise level throughout the day and night. As seen in the upper graph of the figure, the levels never drop below about 55 dBA. The range of hourly noise levels at the site is also very narrow, indicating that intrusive sounds are not significant contributors to the overall noise. A comparison of the



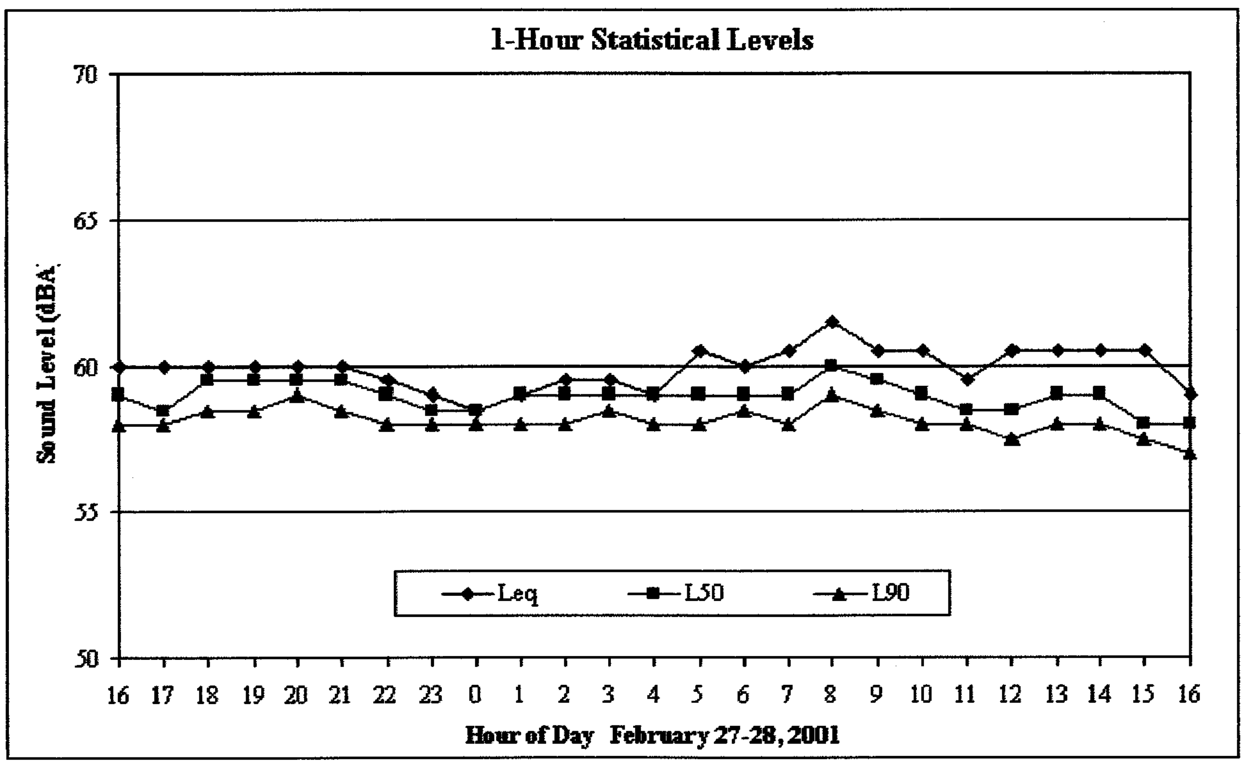


Figure 8.7-3

Monitoring Location 1
RUSSELL CITY ENERGY CENTER

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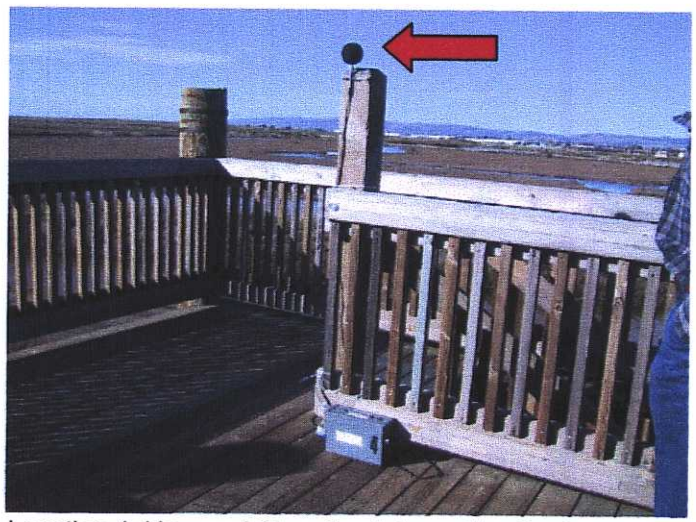
Location 2: 2773 Depot Road.

Location 3: Waterford Apartments, 25800 Industrial Boulevard.



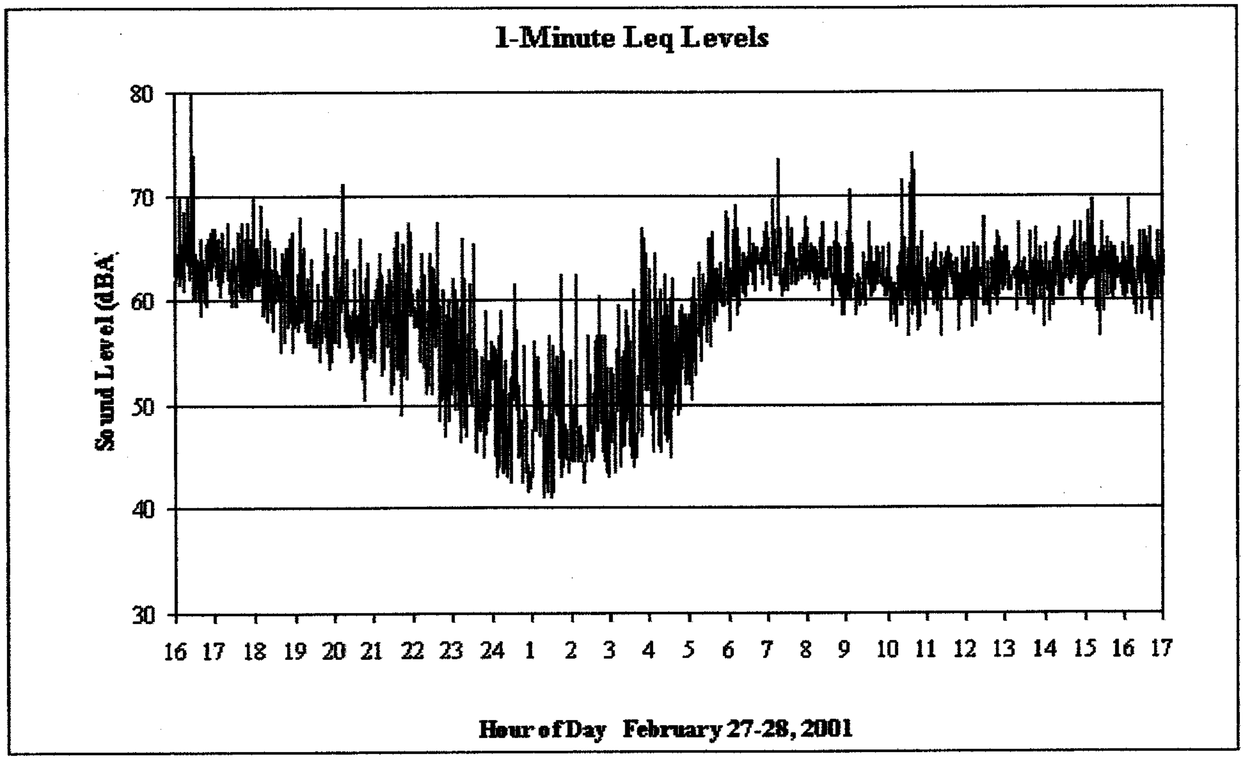
Location 4: Hayward Shoreline Interpretive Center.

Location 5: footbridge crossing Cogswell Marsh

Figure 8.7-2. Noise monitoring locations (arrow indicates microphone).

Russell City Energy Center AFC

May 2001



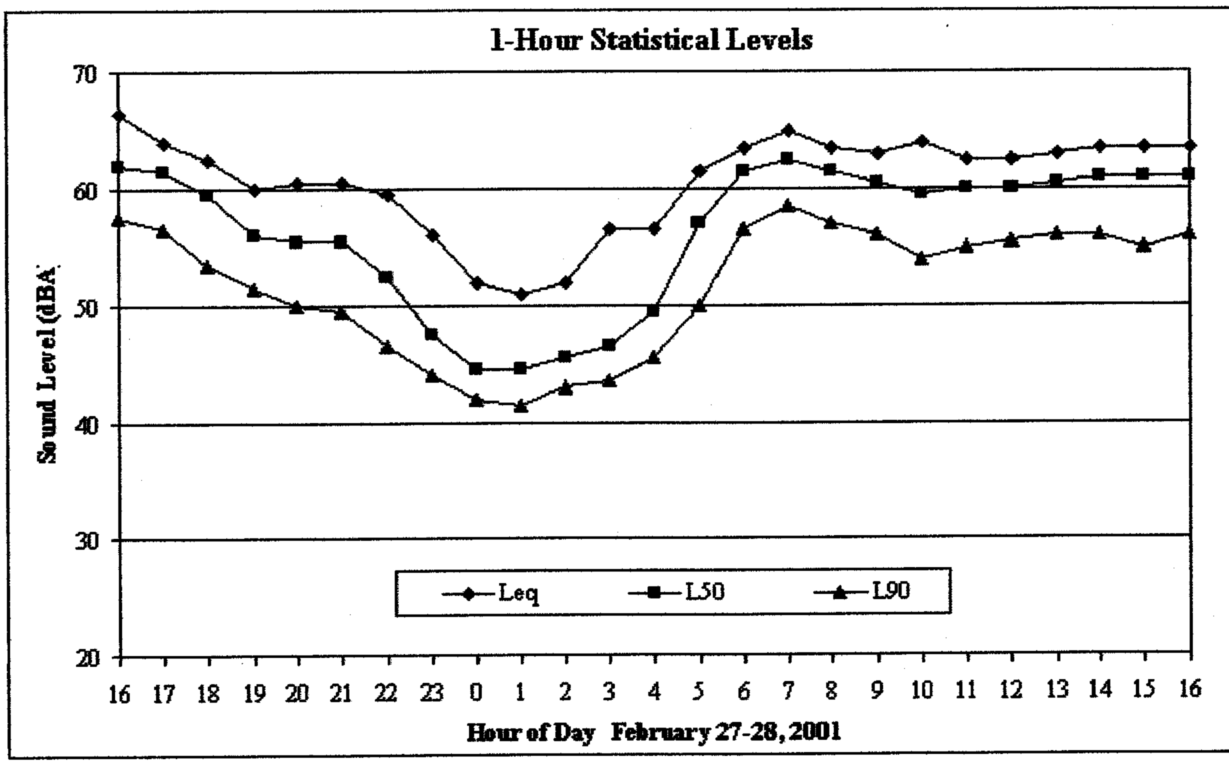


Figure 8.7-4

Monitoring Location 2
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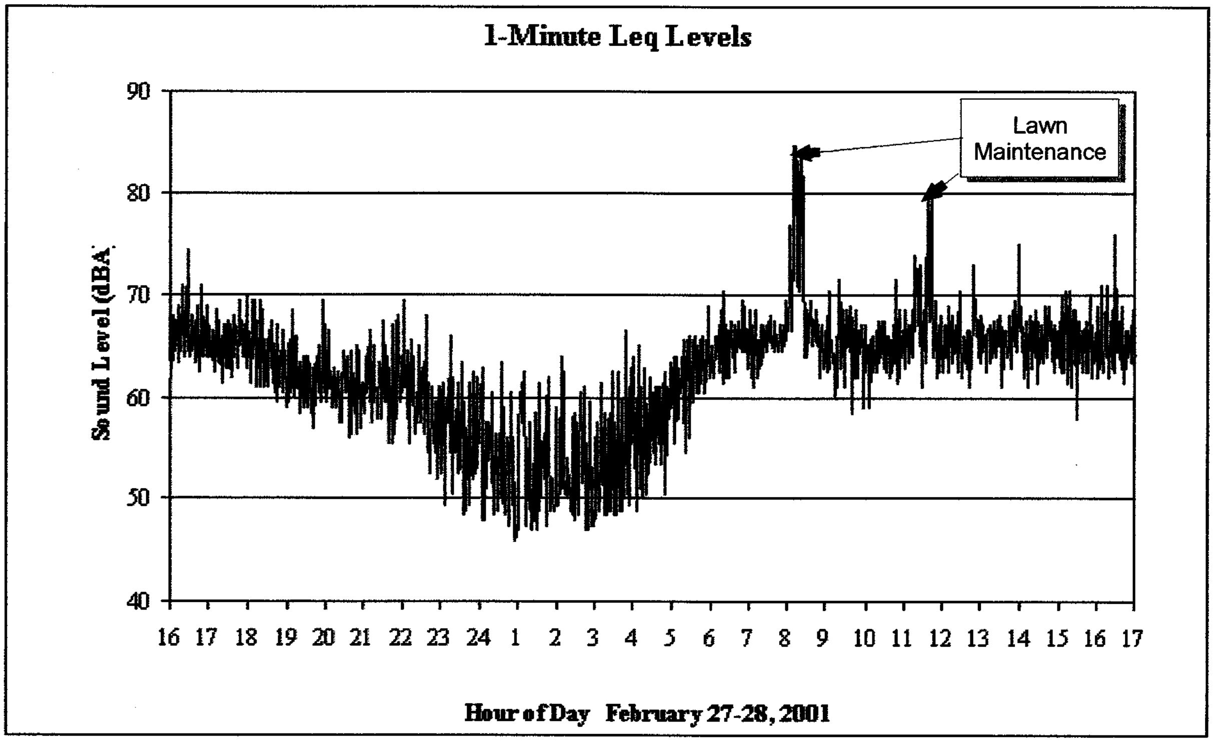

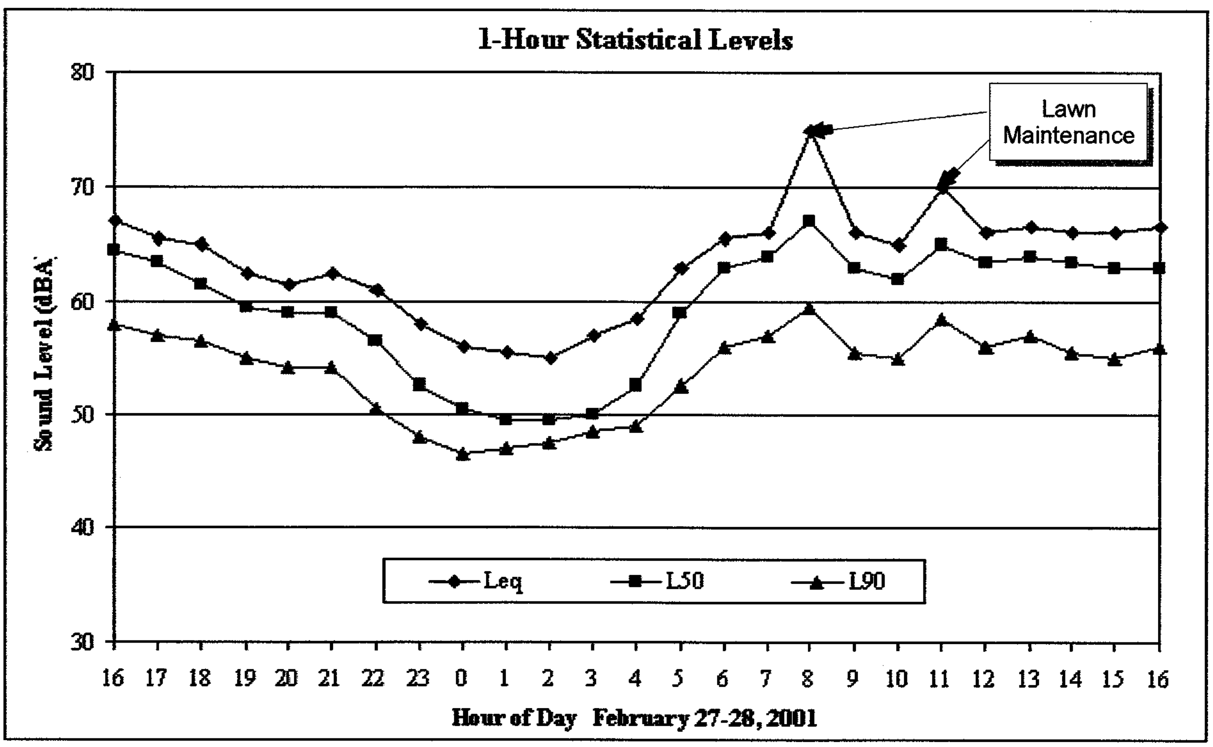

Figure 8.7-5

Monitoring Location 3
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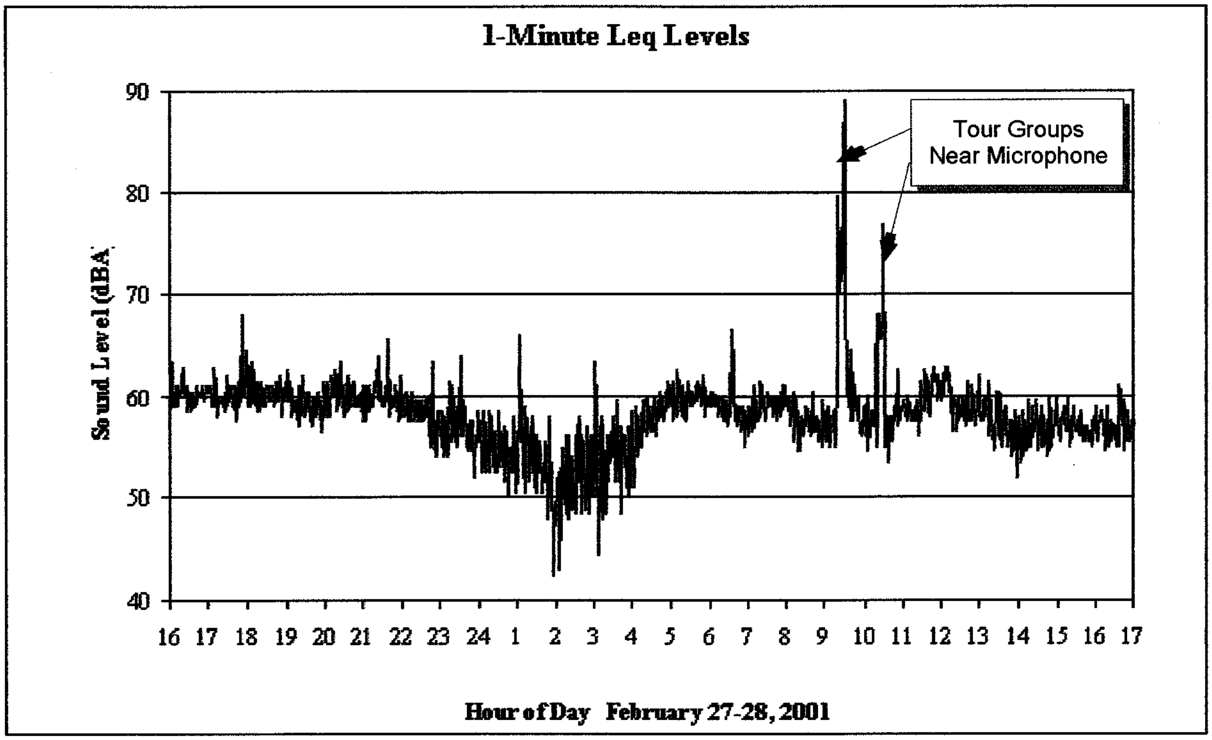

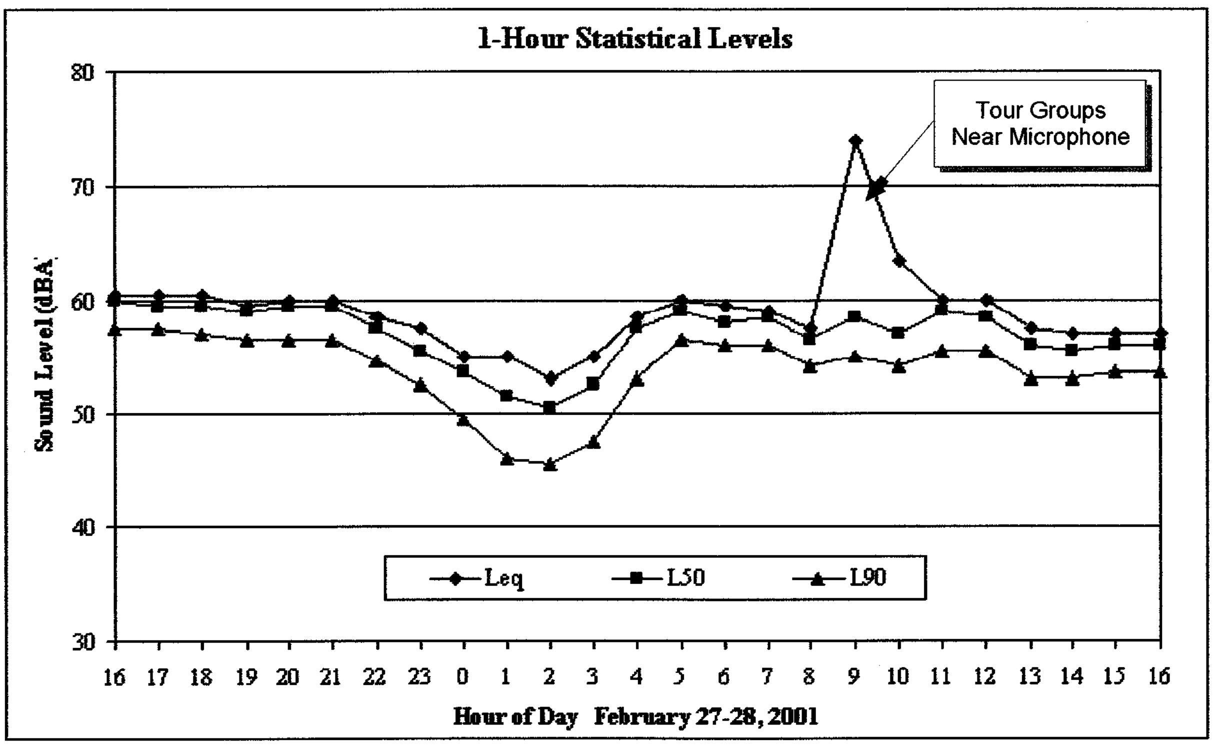

Figure 8.7-6

Monitoring Location 4
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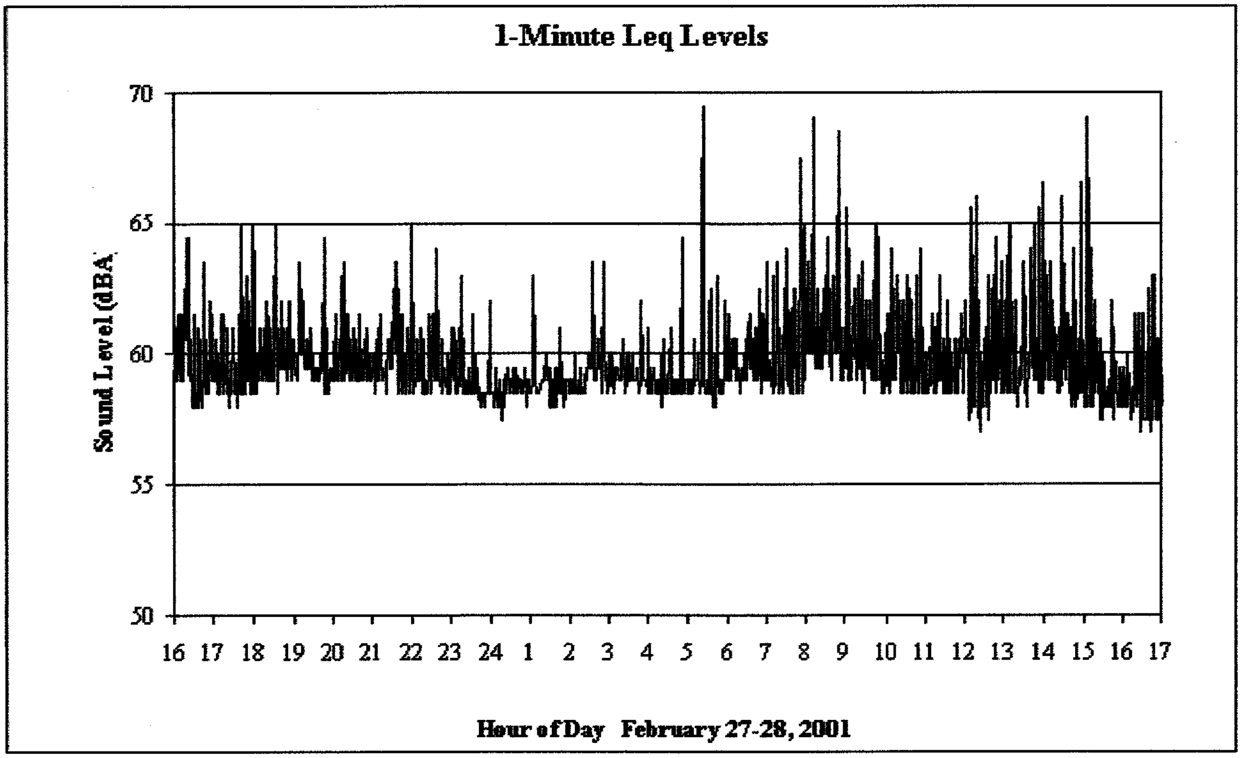

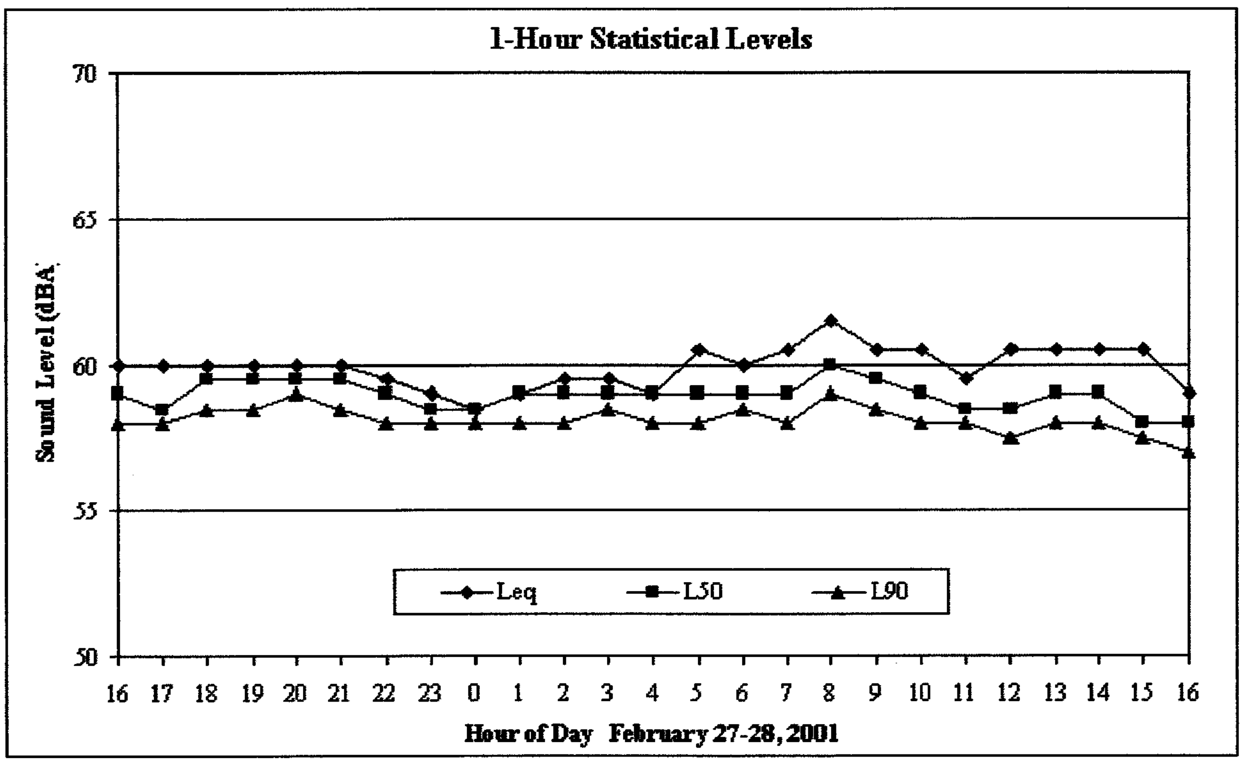

Figure 8.7-7

Monitoring Location 5
RUSSELL CITY ENERGY CENTER

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Average Nighttime L_{90} level (bottom row of Table 8.7-1) of 58.1 dBA with those from the other four locations, which range from 44.5 to 51.2 dBA, shows that of the five monitoring locations, this location is the loudest at night. The CNEL for the location is 66.3 dBA.

The graphs for Location 2 (Figure 8.7-4) demonstrate the classic diurnal pattern of lower levels at night related to man-made noise. These noise levels are directly related to the amounts of traffic on Depot Road and Industrial Boulevard. Nighttime levels reached a minimum of about 41 dBA between 1 and 2 am. Daytime levels were typically around 60 dBA. The average nighttime L_{90} level from Table 8.7-1 was 45.8 dBA. Predicted noise levels from the power plant will be compared with this level. The CNEL is 66.3 dBA.

Noise levels at Location 3, at the entrance to the Waterford Apartments complex, exhibit the same pattern as at Location 2 because of nearby traffic (Figure 8.7-5). The levels are slightly higher, however, at about 64 dBA during the day and 49.5 dBA at night. This is probably because the microphone was closer to traffic on Industrial Boulevard, which was the primary source of noise. The CNEL was 69.1 dBA or about 3 dBA higher than at Location 2. Fan noise from some of the commercial and industrial buildings to the west could be heard at night in this location.

At Location 4 on the observation deck of the Hayward Shoreline Interpretive Center, noise levels generally varied with the level of traffic on the Hayward-San Mateo Bridge approach. Daytime noise levels were generally in the upper 50s dBA. The CNEL was 66.0 dBA. The spikes as high as 89 dBA in Figure 8.7-6 are due to tour groups near the microphone at the Interpretive Center and indicate that the tour guide had to raise her voice to be heard over the traffic noise. Wind noise and birds were also heard at this location. Since the Interpretive Center and nearby trails close at night, nighttime noise levels are not relevant in this analysis.

Most of the sounds heard at Location 5, on the foot bridge on the Hayward Shoreline Nature Trail, were natural, produced by birds, the wind, waves lapping on the shore, etc. The primary manmade sounds were jet aircraft approaching Oakland or San Francisco airports. The charts shown in Figure 8.7-7 indicate a noise environment in which the background level rises and falls with some regularity. This pattern is very unusual and may be related to the tides, winds, or wildlife cycles. Noise levels at the bridge ranged from about 40 to 60 dBA and the CNEL was the lowest of any of the locations at 57.0 dBA.

In summary, the City of Hayward WPCF dominates the existing noise environment at the project site (Location 1), producing a level of about 60 dBA at the site boundary. The nearest noise-sensitive receptors are located are 0.82 and 0.91 miles away, respectively (Locations 2 and 3), where the ambient noise mostly varies with the traffic on Industrial Boulevard. Nighttime background levels at these two locations are 45.8 and 49.5 dBA, respectively. Noise levels near the Shoreline Interpretive Center are variable, with higher levels on the south end adjacent to the Hayward-San Mateo Bridge approach, with a CNEL of 66 dBA, and lower levels to the north at the foot bridge where the CNEL is 57 dBA.

8.7.1.3 Vibration

The RCEC will be a combined cycle facility which produces electricity by rotating combustion turbines and a steam turbine which uses steam produced in heat recovery steam generators (HRSGs) from the combustion turbine waste heat. As a side benefit, the HRSGs reduce the noise intensity emanating from the combustion turbines. The equipment that would be used in the RCEC is well-balanced and is designed to produce very low vibration levels that would be maintained throughout the life of the plant. Any imbalance could contribute to ground vibration levels in the vicinity of the equipment. Vibration monitoring systems installed in the equipment are designed, however to ensure that the equipment remains balanced. Should an imbalance occur, the event would be detected and the equipment would be automatically shut down for repair and re-balancing.

This section concludes that the air and ground vibration that would be produced by the proposed RCEC would be less than those that presently exist in the local urban environment. Vibration-sensitive facilities in the urban community surrounding the RCEC are suitably designed for the expected vibrations from the RCEC.

Site and Subsurface Conditions

Site-specific geologic and geotechnical characteristics underlying the site are not yet fully known. However, it can be generally assumed that the primary foundation support system will consist of deep foundations installed through the upper loose and compressible soils, reaching a bearing level in the underlying competent materials. The deep foundation system will be used to support virtually all equipment that could generate vibration during the plant operation.

Waves Generated by Vibrating Foundations

Energy generated by vibrating and/or rotating equipment and construction activities is transmitted through surrounding soils in three principle wave forms: compression (P-waves), shear (S-waves), and surface waves. P- and S-waves are referred to as body waves. The primary type of surface wave is the Rayleigh wave. Of the three types of waves, approximately 70 percent of the energy is transmitted as a Rayleigh wave and therefore the wave propagation characteristics of the Rayleigh wave largely govern the vibration effects.

The Rayleigh wave propagates radially outward from the source of the vibration. All waves lose energy as they travel outward and pass through an increasingly larger volume of material. This loss energy is called geometrical damping. The decrease in energy (attenuation) for Raleigh waves is inversely proportional to the square root of the distance from the source. Since soils are not perfectly elastic, internal friction also reduces the energy of the wave vibration, increasing the attenuation predicted by just geometrical damping alone. This factor is called the material damping coefficient and its value is somewhat dependent on the soil types.

For practical applications, considerations of geometrical and material damping, as well as the type of wave and the wave's energy attenuation characteristics, have been combined into a single expression:

$$A = A_o \, (r_o/r)^{\gamma}$$

where:

A = Wave amplitude at distance "r"
A_o = Wave amplitude at source, "r_o"
r = Distance
γ = Dimensionless damping coefficient with an approximate value of 1.5 forsoft soil sites and 1.0 for firm soil sites

As a simple example, the vibration from a source on a site with firm soils is approximately 100 times less at a distance from the source of 100 feet and 1,000 times less at a distance of 1,000 feet. As can be seen from the relationship, the position of the water table does not affect the attenuation of seismic waves to a measurable extent. In addition, attenuation is greater for sites built on soft soil than for sites built on firm soils.

Foundation Design Principles

Several key principles need to be satisfied to assure that machine foundations meet the operating requirements of the plant. For static loading, the foundations must be safe against bearing capacity failure and excessive settlement. For dynamic loading, the foundation should not resonate, the amplitudes of motion should not exceed permissible values, the natural frequency of the foundation-soil system should not be a multiple of the operating frequency of the machine, and the vibrations caused by the machine should not affect equipment or machinery in the facility or neighboring facilities.

In general, the permissible amplitudes of motion control the machine foundation design and affect the vibration levels at the surrounding structures. For modern power plants, the permissible levels of motion, expressed in terms of peak particle velocity, are set in the range of 0.10 to 0.20 inches per second. For the major components of the plant, such as the combustion turbines, the permissible vibration levels are set even lower, at a maximum of 0.06 inches per second.

Vibration perception levels, which range from "imperceptible" to "very disturbing," are a commonly used human response rating system. Immediately adjacent to the power plant equipment, vibration levels range from "slightly perceptible" to "strongly perceptible" to persons. At distances from 300 to 1,000 feet from the equipment (at the site boundary or neighboring facilities), the vibration levels would be 300 to 1,000 times less than at the source, due to attenuation. Vibration levels at 300 to 1,000 feet are not expected to be perceptible to persons or machinery and are expected to be less than the normal road-generated vibrations. For comparison, the vibration generated by a moving truck on a typical city street at a distance of 10 feet is approximately 0.60 inches per second peak particle velocity (approximately 10 times the vibration level anticipated for major RCEC plant components).

International organizations have also set standards for permissible vibration levels. The Swiss have set the most restrictive standards and the most restrictive level of induced vibration is called "Swiss IV." This criteria limits the vibration induced in buildings that are "very sensitive to vibrations" to a level of 0.12 to 0.20 inches per second. The vibration levels anticipated at the RCEC are significantly below even this most restrictive threshold level.

Structural Vibration Induced by Airborne Noise

Gas turbines in simple cycle operation commonly produce airborne low frequency noise emissions that are capable of inducing perceptible vibration in nearby structures with lightweight frame construction. Gas turbines in combined cycle installations, on the other hand, rarely, if ever, cause this type of problem. The expansion of the combustion turbine exhaust gases inside the large cavity of the HRSG (which has dimensions that are comparable with the wavelength of sound in the typically problematic 20 to 30 Hz region of the spectrum) and the subsequent contraction in the exhaust stack act to dissipate acoustic energy. The ability of HRSG's to attenuate turbine exhaust noise, even when no specific silencing measures are incorporated into the design, is a well-established phenomenon.

American National Standards Institute (ANSI) B133.8 (1989 Gas Turbine Installation Sound Emissions) recommends limiting the noise emissions of new gas turbine facilities to 75 to 80 dBC at the nearest private residence in order to avoid any annoyance. C-weighting is used since it puts a greater emphasis on the lower end of the frequency spectrum and a range of values are given because the threshold is not sharply defined.

A generally equivalent criterion has been developed for use in the design of HVAC systems where thresholds for the perception of noise-induced vibration have been roughly determined in the lowest octave bands. Specifically, in the 31.5 Hz octave band, sound levels with magnitudes in the region between 65 and 75 dB are considered likely to cause moderately perceptible vibrations in lightweight, frame structures and levels above 75 dB are associated with clearly perceptible vibrations. The same sound level would be less perceptible in a structure of more substantial construction.

In view of these criteria, a representative sampling of noise levels produced by typical combined cycle plants at fairly short distances is given below in Table 8.7-2.

Table 8.7-2. Noise levels produced by typical combined cycle plants at short distance.

	Octave Band Center Frequency, Hz										
Description	**31**	**63**	**125**	**250**	**500**	**1000**	**2000**	**4000**	**8000**	**dB(A)**	**dB(C)**
500-MW CC plant[1/], 120 m from nearest HRSG	72	71	65	59	59	55	61	52	37	64	74
500-MW CC plant, 120 m from GT inlets	71	70	65	52	53	54	50	42	30	58	72
130-MW CC plant, 120 m from nearest HRSG	72	72	67	59	57	56	58	56	43	63	75
130 MW CC plant, 120 m from GT inlets	72	70	66	60	58	57	57	54	42	63	74
500-MW CC Plant, 150 m from nearest HRSG	71	70	62	60	59	57	53	48	46	62	73
700-MW CC plant, 80 m from nearest HRSG	77	76	73	62	61	60	57	52		65	79
700-MW CC plant, 200 m from GT inlets	70	68	63	52	53	50	46	39		55	71
Threshold of moderately perceptible noise-induced vibration	65	69									75
Threshold of clearly perceptible noise-induced vibration	75	79									80

1/ CC = combined cycle

Whether noise vibration from any given plant exceeds a particular threshold depends on the distance to the measurement location and the nature of the structure at that location. It is intuitively obvious that a building with light frame construction would probably experience some perceptible vibrations only 80 m from a 700-MW plant, where a noise level of 79 dBC exists, but a structure with a more substantial construction would probably remain unaffected.

The nearest residence to the RCEC is 0.82 miles away from the facility and, therefore, will not be affected. Commercial facilities much closer to the plant may see levels near this lower threshold for residential disturbance, but are not expected to be adversely affected.

8.7.2 Environmental Consequences

The power plant equipment and construction equipment will generate noise at known levels and the noise generated will dissipate at a predictable rate over distance. Modeling the expected noise levels at sensitive receptor locations involves calculating the combined noise levels from the power plant equipment (operations phase) or construction equipment (construction phase) at a given sensitive receptor and comparing this noise level to applicable regulatory standards.

8.7.2.1 Significance Criteria

The project would cause a significant impact if it were to violate a local noise ordinance, regulation, or standard, or would increase by 5 dB or more the ambient noise levels in a residential area that currently exceeds General Plan guidelines for residential area noise levels.

8.7.2.2 Construction Phase Impacts

Noise will be produced at varying levels during the 18 to 21-month-long construction period, depending upon the construction phase. Construction of power plants and other industrial facilities can generally be divided into five phases, which involve different types of construction equipment and produce different amounts of noise. The phases are: 1) excavation, 2) concrete pouring, 3) steel erection, 4) mechanical, and 5) cleanup. Two activities, pile driving and steam blowing, will be analyzed separately because of their potential for producing higher noise impacts. Pile driving would occur during Phase 1 and steam blowing would occur during Phase 5. Construction of the natural gas pipeline, electrical transmission line, water supply and wastewater return pipelines, and the AWT plant were also analyzed.

RCEC Plant Site

Both the Environmental Protection Agency Office of Noise Abatement and Control and the Empire State Electric Energy Research Company have extensively studied noise from individual pieces of construction equipment as well as from construction sites of power plants and other types of facilities (EPA, 1971 and Barnes et al., 1976). Since specific information on types, quantities, and operating schedules of construction equipment is not available for the project at this point in the project development, information from these documents for similar-sized industrial projects will be used. Use of this data, which is between 25 and 30 years old, is conservative since construction equipment has moved toward more effective noise abatement.

The noisiest equipment types generally operating at a site during each phase of construction are presented in Table 8.7-3. The composite average or equivalent site noise level, representing noise from all equipment, is also presented in the table for each phase. Rock drills, at 98 dBA, produce the highest noise levels of any individual piece. The use of rock drills is very unlikely at the RCEC site, however, due to the lack of bedrock in the construction zone. Heavy trucks operating at maximum engine speed are the second loudest equipment items, at 91 dBA.

Pile driving will be necessary to provide a solid foundation for the power plant equipment. There are several types of pile drivers, but the most common is the impact type that lifts a heavy hammer, then drops it on the pile repeatedly until the pile arrives at the desired depth. This type of driver produces peak noise levels upon impact ranging from 95 to 106 dBA. The pile driver's diesel engine operates at a lower noise level similar to the other diesel-powered construction equipment.

Table 8.7-3. Construction equipment and composite site noise levels.

Construction Phase	Loudest Construction Equipment	Equipment Noise Level at 50 feet (dBA)	Composite Site Noise Level at 50 feet (dBA)
Site Clearing and Excavation	Dump Truck	91	89
	Backhoe	85	
Concrete Pouring	Truck	91	78
	Concrete Mixer	85	
Steel Erection	Derrick Crane	88	87
	Jack Hammer	88	
Mechanical	Derrick Crane	88	87
	Pneumatic Tools	86	
Clean-Up	Rock Drill	98	89
	Truck	91	
Pile Driving	Pile Driver	95-106	Not Applicable
Steam Blow	Steam Blow (unmuffled)	110 @ 1,000 feet	Not Applicable

Source: USEPA 1971, Barnes, et al., 1976.

The steam blow, with a level of 110 dBA at 1000 feet, is an activity, rather than a piece of equipment. This activity is designed to clean scale and other debris from the boiler tubes and steam lines prior to admitting any steam to the steam turbines where the foreign material would damage the blades. A temporary bypass line to the atmosphere is welded into the main steam line upstream of the steam turbines to divert the steam. Several short blows of about two minutes duration each will be performed per day and the entire process generally takes several weeks. It has become relatively common in recent years to fit the steam blow pipe with a temporary silencer at sites near populated areas. These silencers have the capability to reduce levels by about 30 dBA. Such a silencer will be employed at the RCEC.

Average or equivalent construction noise levels projected for five sensitive receptor monitoring sites are presented in Table 8.7-4.

These results are conservative since the only attenuating mechanism considered was divergence of the sound waves over the distances traveled. In actuality, the large buildings that surround the RCEC site will muffle and reduce the sound. Levels during the loudest normal construction activities are projected to be between 37 dBA and 49 dBA at the residences located at distances ranging from 0.82 miles to 0.88 miles. These levels are lower than the existing daytime L_{90} levels. Thus, average construction noise generally will be inaudible at the residences. Levels of 65 to 66 dBA during pile driving and muffled steam blowing will be similar to levels created by traffic and will not create an impact. However, unmuffled steam blowing could be as high as 96 dBA at the residences and would create a temporary impact.

Table 8.7-4. Average expected construction noise levels at receptor locations.

Construction Phase	Site 1 North site boundary 50 ft.	Site 2 Nearest nesidence 0.82 miles	Site 3 Waterford Apartments 0.91 miles	Site 4 Interpretive Center 0.731 miles	Site 5 Nature Trail Bridge 1.02 miles
Excavation	89	49	48	52	48
Concrete Pouring	78	38	37	41	37
Steel Erection	87	47	46	50	46
Mechanical	87	47	46	50	46
Clean-up	89	49	48	52	48
Pile Driving*	106	66	65	69	65
Steam blow* (unmuffled)	136	96	95	99	95
Steam blow* - (muffled)	106	66	65	69	65

* Pile driving and steam blow levels are instantaneous rather than averaged.

Construction noise levels will also be below existing ambient levels within the wildlife preserve to the west. Thus, no noise impacts are expected, except for unmuffled steam blowing, which would cause a temporary impact.

Construction Vibration— This section addresses the potential for construction of the RCEC to produce vibration that may affect the local area. Construction vibrations can be divided into three classes, based on the wave form and its source:

- Wave form: impact. Example source: impact pile driver or blasting
- Wave form: steady state. Example source: vibratory pile driver
- Wave form: pseudo steady state Example source: double acting pile hammer

The pile driver to be used in pile installation for the RCEC project would impart a relatively limited energy to the surrounding soil and this activity would occur at a significant distance from neighborhood structures and facilities. Therefore, it is not expected that there will be any significant vibration effects during construction of the RCEC. However, vibration and noise monitoring will measure the vibration produced during construction and ensure that it is less than the criteria appropriate for the neighboring facilities.

Electrical Transmission Line and Eastshore Substation Expansion

Transmission line construction equipment will include excavators, backhoes, concrete trucks, cranes, line trucks, and miscellaneous other equipment. Tower placement may be aided by the use of a helicopter. All of this equipment produces between about 80 dBA and 91 dBA at 50 feet. The potential for noise impacts will be greatest at each of the tower sites. However, since none of the tower sites are near noise-sensitive receptors, no noise impact is expected from this daytime only activity.

Natural Gas Pipeline

Natural gas pipeline construction equipment will include concrete saws, backhoes, trenchers, pipe layers, dump trucks, pavers, compactors, and other miscellaneous equipment. All of this equipment produces noise levels between about 80 dBA and 91 dBA at 50 feet. Workers operating the equipment and other workers within about 50 feet of the equipment will wear hearing protection. Persons outside the work area should never be exposed to levels above about 85 dBA. This activity may be conducted at night to minimize disruption to daytime traffic, but it should only be conducted during the day when adjacent to residential areas at the eastern end of the pipeline. Daytime noise levels near residential areas could increase to about 70 dBA, which is only about 5 to 10 dBA above existing daytime noise levels. Since this activity is short-duration at any given location, and will only occur during the day in noise-sensitive areas, the noise impact created will not be significant.

Wastewater Return Pipeline

The construction equipment and methods used for the wastewater return pipeline will be the same as for the natural gas pipeline, and the maximum levels of noise generated will be the same. This pipeline will cross Enterprise Avenue between the power plant site and Water Pollution Control Facility and construction will be of short duration. Construction noise levels at residential areas will be lower than for the natural gas pipeline, because the water pipeline is further from residential areas. As with the natural gas pipeline, the noise levels at sensitive receptors will not cause a significant impact.

AWT Plant

Construction equipment and methods used for the AWT plant will be similar to those used for the RCEC plant site, although on a smaller scale. As with the RCEC plant site, no significant noise impacts are expected.

8.7.2.3 Operational Phase Impacts

Operational noise will result from the operation of the power plant equipment including the gas and steam turbines, cooling towers, and HRSGs. A noise modeling program, Cadna/A, ver. 3.0, developed by the German firm DataKustik specifically for power plant applications, was used to evaluate the noise emissions of the facility. Based on the sound power levels input for each source, the program maps the noise contours of the overall plant in accordance with a variety of European standards, primarily VDI 2714 *Outdoor Sound Propagation* and ISO 9613. All sound propagation losses such as geometric spreading, air absorption, ground absorption, and barrier blockage are calculated automatically in accordance with these recognized standards. Internal shielding within the plant such as by the large HRSG structures is realistically accounted for in the model since the physical dimensions of each source are also input into the program and considered in the calculations. Shielding beyond the plant by the numerous intervening warehouse and commercial structures in the direction of Receptors 2 and 3 has been accounted for very conservatively—to the extent that the predicted levels at these receptors are virtually unaffected.

The key to the accuracy of this model is the accuracy of the sound power levels used to represent each source. All inputs to the current model have been derived exclusively from first-hand field measurements of similar or identical equipment in actual operation at combined-cycle facilities. In general, the initial baseline power levels used are representative of the normal in-situ performance of standard equipment, i.e., equipment that has not been upgraded or specially improved to reduce noise. Only noise abatement measures that are always supplied as a part of the standard system are assumed to be present. Noise suppression devices such as combustion turbine inlet silencers, and turbine weather enclosures are not included in the model.

The source power levels and the modeling results in general have been verified by comparing the predicted far field levels of specific plants to direct measurements. In all cases, the analytical results have been found to yield plant noise levels that are equal to or slightly higher than the true performance.

Noise Modeling Summary

Noise modeling results for the RCEC are summarized in Table 8.7-5. These results indicate that noise produced by a standard plant will be at or below the City of Hayward Noise Element Policies Document standard. This document identifies an L_{dn} level of 55 dBA as acceptable for residential and other noise-sensitive receptors. An L_{dn} of 55 dBA is equivalent to a continuous noise level of 49 dBA for 24 hours a day. The levels are also below the quietest measured ambient at all sensitive receptors. Consequently, no impact from steady state plant noise is anticipated at any of the receptors and no special or upgraded noise controls appear to be needed to protect noise-sensitive receptors around the site.

Table 8.7-5. Summary of noise modeling results.

Receptor Position	City of Hayward Noise Element Policies Document Levels (L_{dn} as Leq 24 (dBA)	Average measured background Level, L_{90} (10 p.m. - 7 a.m.) dBA	Expected baseline plant noise level, dBA
Depot Road & Industrial Boulevard	49	45.8 dBA	44
Waterford Apartments, Industrial Boulevard	49	49.5 dBA	42
Hayward Shoreline Interpretive Center	49	53 to 56 (Typical daytime when facility in use) 51.2 dBA night when closed	48
Cogswell Marsh trail bridge	49	49 to 58 (Typical daytime when trail in use) 44.5 dBA night when closed	40

In order to realize this performance, the equipment will be specified at the baseline values assumed in the model (per measurements of standard in-situ equipment). Special provisions to mitigate tonal sources will probably not be required because of the large distances to the receptors. Some attention will be given, however, to start-up transient noise. Vent silencers with reasonable performance will be needed to prevent any impact at the nearest residences. Detailed spreadsheets showing the modeling parameters and results for each of the locations are presented in Appendix 8.7-A.

The City of Hayward Noise Element Policies Document also identifies an L_{dn} level of 75 dBA as acceptable for industrial boundaries. An L_{dn} of 75 dBA is equivalent to a continuous level of 69 dBA 24 hours a day. With appropriately placed sound attenuation equipment, the 69 dBA noise contour is located entirely within the property boundary (Figure 8.7-8). The project is thus in compliance with the City's Policies Document.

Noise levels within the adjacent advanced wastewater treatment plant will range from about 50 dBA to 65 dBA, which are comparable to existing noise levels within the RCEC plant. The nearest office/warehouse and other light industrial neighbors should experience noise levels no greater than about 60 dBA due to operation of the RCEC. This level will not create any interference with normal activities at these nearby businesses.

Noise attenuation equipment that Calpine/Bechtel will install to meet the City's standard includes the following:

- Acoustical cladding on the south and east sides of the STG support structure
- Attenuated HRSG burner control skis
- Acoustically lagged gas lines and throttling valves on the HRSG
- Noise barrier wall on the south side of the circulating water pumps
- Low noise gas compressor building with masonry construction

In conclusion, no significant noise impacts are expected to result at any noise-sensitive receptor around the plant because of the large distances between the plant and the sensitive receptors. The highest level predicted at any residence is 44 dBA east-northeast of the site on Depot Road (monitoring location 2). In other directions, the predicted levels range from 40 to 48 dBA at the other receptors. Thus, no significant unavoidable adverse impact on noise resources is anticipated as a result of the construction and operation of the RCEC.

Vibration Impacts

As discussed in Section 8.7.1.3, the air and ground vibration levels that would be produced by the RCEC would be less than those that presently exist in the local urban environment (e.g., truck traffic). All urban facilities are designed to accommodate this level of vibration. Therefore, vibration sensitive facilities in the urban community surrounding the RCEC are suitably designed for the expected vibrations from the RCEC.

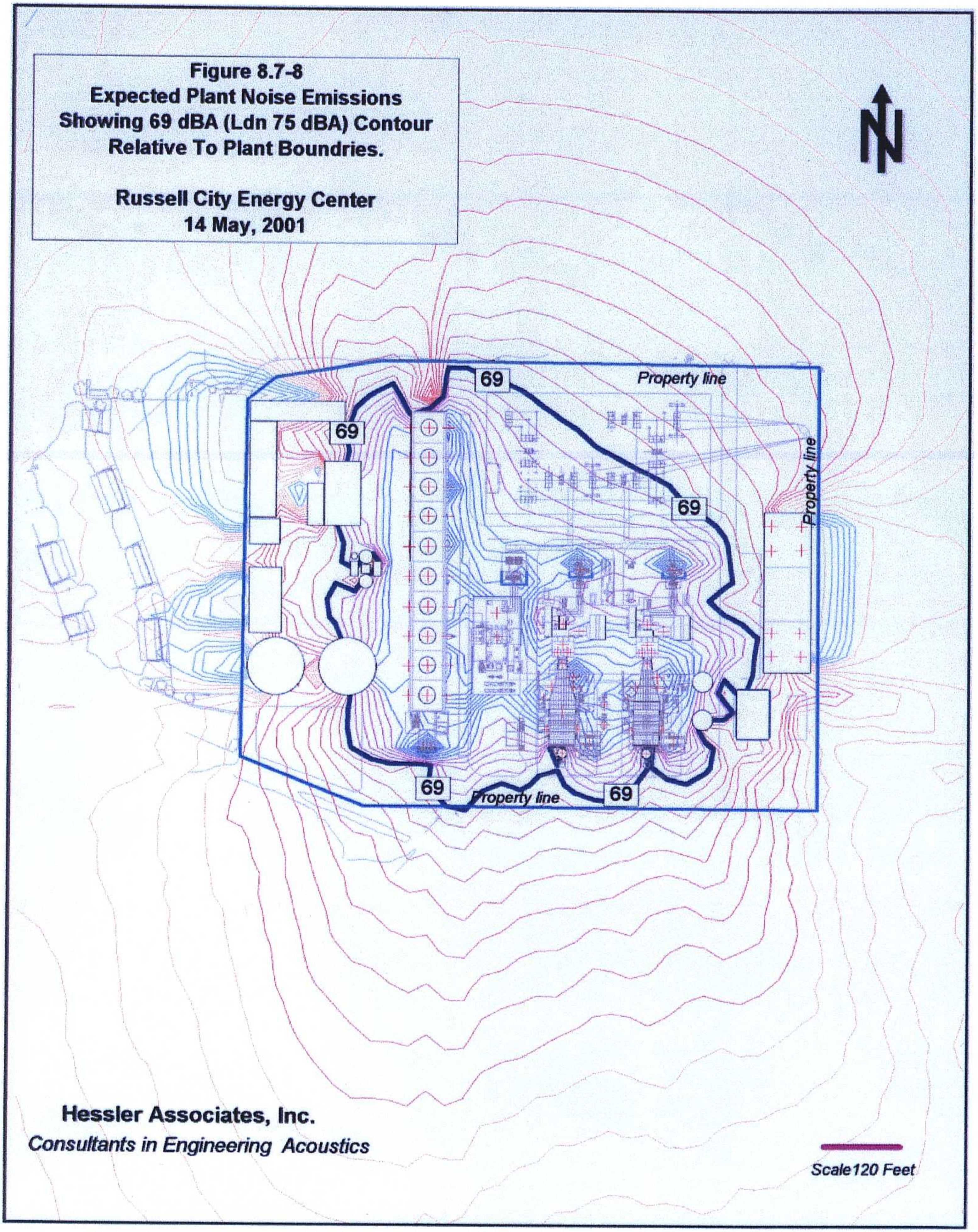
8.7.3 Cumulative Impacts

Increases in noise levels above existing ambient levels during construction and operation will generally not be noticeable beyond one mile from the site. Thus, direct cumulative impacts with other projects will only occur if the other new projects are located within a one-mile radius of the site. No similar projects are known to be planned in the area, and so no direct cumulative noise impacts will occur.

Very small increases in highway traffic noise will occur throughout a large area extending beyond the one-mile radius described above during construction and operation of the project. Increased traffic noise will exist from the origination point of each individual trip to the RCEC as well as on the return trip. Some overlap with traffic due to other new and planned projects will undoubtedly occur at distant locations. However, due to the logarithmic nature of decibel addition, significant changes in the volume of traffic are required to affect even minor changes in noise levels. For example, a doubling of the volume of traffic is required to increase the traffic noise level by the barely noticeable amount of 3

Figure 8.7-8
Expected Plant Noise Emissions
Showing 69 dBA (Ldn 75 dBA) Contour
Relative To Plant Boundries.

Russell City Energy Center
14 May, 2001



decibels. The cumulative increase in traffic volumes will not be doubled at any location, near or far. Thus, there will be no noticeable indirect cumulative noise impact due to highway traffic.

8.7.4 Mitigation Measures

A complaint resolution procedure presented in the following paragraphs will provide an efficient and effective means of receiving and resolving any noise complaints. An outline sample form for the procedure is provided in Appendix 8.7-B.

Any noise complaints received by the facility switchboard operator will be entered in a "Noise Complaint Logbook" kept at the switchboard desk. The date, time, name, address and phone number of complainant, nature of the complaint and name of the switchboard operator (or other person receiving the call) will be recorded. The logbook entries will always be chronological in order and simply provide evidence that a complaint was received. The caller will then be transferred to the plant manager or shift supervisor who will obtain a thorough understanding of the complaint so that appropriate action can be taken. The manager will briefly explain the resolution procedure to the caller and provide assurance that the problem will be investigated in a timely manner and corrected to the fullest extent practicable.

The manager will then record the information from the logbook on a blank "Noise Complaint Resolution" form presented below. This form provides additional space for a description of the problem and measures taken to resolve the problem. These loose-leaf-preprinted forms will be kept in a three-ring binder maintained by the plant manager or a designee.

The plant manager or designee will investigate the reported noise problem. The offending equipment or activity will be identified and noise levels documented by taking near- and far-field measurements prior to applying any treatment. Near-field noise levels are to be taken at a distance of 3 feet from the equipment and far-field measurements are to be taken at the complainant's property. Appropriate treatment will be determined to reduce or eliminate the noise and, after application of the treatment, additional noise measurements will be taken at the same locations to document the improved condition.

To the extent practicable, full resolution of small problems which can be corrected through a minimal change in procedure or by application of noise control materials costing less than $2,000, including installation, will occur within 30 days of the receipt of the complaint. For larger problems requiring measures which cannot be completed in 30 days, the plan and schedule for completion will be established within 30 days after receipt of complaint. After the initial investigation and determination of the schedule for correction, a letter will be sent to the complainant detailing the findings and expected date of completion of any modification. After the correction has been fully implemented and reduced noise levels documented, a second letter will be sent to the complainant explaining that the problem has been corrected.

In a situation where the complaint does not appear to be justified, as based on measured levels or other criteria, or where the plant manager believes the problem to be corrected but the complainant is not satisfied, additional recourse measures will be provided to the complainant. These will include the name and phone number of the City of Hayward noise code enforcement official responsible for ensuring compliance with conditions of certification of the project. The Noise Complaint Logbook, the loose-leaf book of noise forms, copies of letters sent to complainants, and any other material documenting changes in procedure or installation of noise control materials will be made available to the county officials, as requested.

8.7.5 Applicable Laws, Ordinances, Regulations, and Standards

The controlling criterion in the design of the noise control features for the project is the minimum, or most stringent, noise level required by any of the applicable LORS. Since the site is in the City of Hayward, it must satisfy the City regulations; and because the CEC will license the facility, it must also comply with CEC requirements. The CEC defines the area impacted by the proposed project as that area where there is a potential increase in existing noise levels of 5 dBA or more during construction or operation. The day/night level (L_{dn}) of 55 dBA, applicable to outside space at single-family residences, as specified in the City of Hayward Noise Element Policies Document (City of Hayward 1977), is applicable at residential receptors around the RCEC site. An L_{dn} of 75 dBA is applicable to commercial and industrial receptor locations.

Continuous 24-hour operation of the proposed facility may increase nighttime noise levels at nearby receivers, while remaining within the City's normally acceptable range. Since the project will be designed to be in compliance with this lowest applicable noise level from all the LORS, project-related noise levels will be in compliance with all LORS.

The following are the LORS that apply to noise generated by the RCEC and the AWT plant. These LORS are also summarized in Table 8.7-6.

8.7.5.1 Federal

The federal government has no standards or regulations applicable to off-site noise levels from the project. However, guidelines are available from the USEPA (1974) to assist state and local government entities in development of state and local LORS for noise.

On-site noise levels are regulated, in a sense, through the Occupational Safety and Health Act of 1970 and through the Occupational Safety and Health Administration (OSHA). The noise exposure level of workers is regulated at 90 dBA over an 8-hour work shift to protect hearing (29 Code of Federal Regulations [CFR] 1910.95). On-site noise levels will generally be in the 70 to 85 dBA range. Areas above 85 dBA will be posted as high noise level areas and hearing protection will be required. The power plant will implement a hearing conservation program for applicable employees and maintain exposure levels below 90 dBA.

8.7.5.2 State

Two state laws address occupational noise exposure and vehicle noise and apply to the RCEC. The California Department of Industrial Regions, Division of Occupational Safety and Health enforces California Occupation Safety and Health Administration (Cal-OSHA) regulations which are the same as the federal OSHA regulations described above. The regulations are contained in 8 California Code of Regulations (CCR), General Industrial Safety Orders, Article 105, Control of Noise Exposure, Sections 5095, et seq. Noise limits for highway vehicles are regulated under the California Vehicle Code, Sections 23130 and 23130.5. The limits are enforceable on the highways by the California Highway Patrol, the Alameda County Sheriff's Office, and the City of Hayward Police Department.

8.7.5.3 Local

The California State Planning Law (California Government Code Section 65302) requires that all cities, counties, and entities such as multi-city port authorities prepare and adopt a General Plan to guide community change. The day/night level (L_{dn}) of 55 dBA, applicable to outside space at single-family residences, as specified in the City of Hayward Noise Element Policies Document (City of Hayward

1977), is applicable at residential receptors around the RCEC site. An L_{dn} of 70 dBA is applicable to commercial and industrial receptor locations.

Table 8.7-6. LORS applicable to noise.

Law, Ordinance, Regulation, or Standard	Applicability	Mitigation Effective?	AFC Reference
Federal Offsite: USEPA	Guidelines for state and local governments	Not applicable	Not applicable
Federal Onsite: OSHA	Exposure of workers over 8-hour shift limited to 90 dBA	Yes	Section 8.7.6.1. See also Worker Safety section of AFC.
State Onsite: Cal-OSHA 8 CCR Article 105, Sections 5095 et seq.	Exposure of workers over 8-hour shift limited to 90 dBA	Yes	Section 8.7.6.2. See also Worker Safety section of AFC.
State Offsite: California Vehicle Code, Sections 23130 and 23130.5	Regulates vehicle noise limits on California highways.	Yes	Delivery trucks and other vehicles will meet Code requirements.
Local: California Government Code, Section 65302	Requires local government to prepare plans which contain noise provisions.	Yes	City of Hayward conforms.
City of Hayward Noise Element Policies Document	Limits noise to 55 dBA Ldn at single family residences, and 70 dBA L_{dn} at commercial and industrial locations.	Yes	Section 8.7.6.3.

8.7.6 Involved Agencies and Agency Contacts

The agency responsible for enforcement of noise levels at the RCEC is the City of Hayward Planning Department. The person to contact regarding noise emission levels from the RCEC is shown in Table 8.7-6.

Table 8.7-7. Involved agencies and agency contacts.

Permits/Reason for Involvement	Contact	Title	Telephone
Information regarding City Noise Policy.	Dyana Anderly City of Hayward Community and Economic Development Department	Planning Manager	510-583-4710

8.7.7 Permits Required and Permit Schedule

No noise permits are required.

8.7.8 References Cited

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