Appendix F

Noise Assessment

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Effluent Interceptor Construction Noise Assessment

Systems Conveyance and Operations Program

Clark County, Nevada

Clean Water Coalition

B&V Project 069427.0160

July 17, 2003

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Executive Summary

The Systems Conveyance and Operations Program (SCOP) includes the construction and operation of the Effluent Interceptor (EI) pipeline and the South Lateral Pipeline to be located on private, City of Las Vegas, City of Henderson, Bureau of Land Management (BLM), United States Bureau of Reclamation (USBR), and Clark County land in Nevada. The proposed route currently consists of undeveloped land, land near future developments, the Las Vegas Flood Control Wash, and a wetlands park. The surrounding areas include residential, recreational, and utility uses.

Based on the available information, Clark County, the City of Las Vegas, and the City of Henderson all have noise regulations included in their respective development code (County) or municipal code (City). As such, the construction noise emissions have been evaluated based on these regulations, as applicable.

In order to evaluate the potential noise impacts on the nearest noise sensitive receptors, the noise emissions associated with the construction of the proposed facility have been estimated. If the construction equipment is fitted with typical noise reduction equipment (e.g., mufflers) and is operated in typical fashion, then no significant noise impacts are anticipated to occur to the currently existing nearby residential areas from construction activities.

Some impacts may occur to the planned future residential developments during construction of Reach 1 of the EI and the South Lateral Pipeline. Impacts to the planned residential developments resulting from the construction of Reach 2 and Reach 3 of the EI are expected to be minimal.

1.0 Introduction

The proposed route for the SCOP EI is located in Clark County, Nevada. The EI and the South Lateral Pipeline will convey treated effluent from the City of Las Vegas Water Pollution Control Facility (WPCF), the Clark County Water Reclamation District (CCWRD), and the City of Henderson Water Reclamation Facility (WRF) to the EI Terminus. Currently, these three sources discharge effluent into the upper Las Vegas Wash (Wash). The EI will bypass the upper Wash and discharge the combined WPCF and CCWRD effluent at the EI Terminus, a point further downstream, approximately one mile upstream of Lake Las Vegas. The South Lateral Pipeline will bypass the upper Wash and convey WRF effluent to the EI Terminus.

The EI pipeline is divided into three sections, Reaches 1, 2, and 3. The first stretch of the EI, Reach 1, is further divided into two stretches. The first stretch of Reach 1 is approximately 7,200 feet long and will be constructed using cut-and-cover installation. The second stretch of Reach 1 is approximately 420 feet long will be constructed utilizing tunneling methods. Reach 2 is approximately 19,000 feet long and will be constructed using the cut-and-cover method. Reach 3 is approximately 6,500 feet long and will be constructed using tunneling methods. The South Lateral Pipeline is a separate pipeline that connects the City of Henderson WRF to the same terminus that serves the EI. The South Lateral Pipeline will convey effluent from the WRF to the EI Terminus and is approximately 17,500 feet long.

2.0 Acoustical Terminology

Noise is often considered unwanted sound. However, human response to sound is complex and is influenced by a variety of acoustic and non-acoustic factors. Acoustic factors generally include the sound's amplitude, duration, frequency content, and fluctuations. Non-acoustic factors typically include the listener's ability to become accustomed to the sound, the listener's attitude towards the noise and the noise source, the listener's view of the necessity of the noise, and the predictability of the noise. As such, response to noise is highly individualized.

Sound energy is physically characterized by amplitude and frequency. Sound amplitude is measured in decibels (dB) as the logarithmic ratio of a sound pressure to a reference sound pressure (20 microPa). The reference sound pressure corresponds to the typical threshold of human hearing. A 3 dB change in a continuous broadband noise is generally considered "just barely perceptible" to the average listener. Similarly, a 5 dB change is generally considered "clearly noticeable" and a 10 dB change is generally considered a doubling (or halving) of the apparent loudness.

Frequency is measured in hertz (Hz), which is the number of cycles per second. The typical human ear can hear frequencies ranging from approximately 20 Hz to 20,000 Hz. Typically, the human ear is most sensitive to sounds in the middle frequencies (1,000 to 8,000 Hz) and is less sensitive to sounds in the low and high frequencies. As such, the A-weighting scale was developed to simulate the frequency response of the human ear to sounds at typical environmental levels. The A-weighting scale emphasizes sounds in the middle frequencies and de-emphasizes sounds in the low and high frequencies. Any sound level to which the A-weighting scale has been applied is expressed in A-weighted decibels, dBA. For reference, the A-weighted sound pressure level and subjective loudness associated with some common noise sources are listed in Table 2-1.

Frequency is typically divided into nine octave bands ranging from 31 Hz to 8,000 Hz for the purpose of analyzing noise. An octave represents a bandwidth covering a frequency interval with the higher frequency limit being twice the lower frequency limit. For example, the 31 Hz band represents sound energy ranging in frequency from 22 Hz to 44 Hz, where 31 Hz is considered the mean frequency of the band. Similarly, the 8,000 Hz band represents sound energy ranging in frequency from 5,600 Hz to 11,200 Hz, where 8,000 Hz is the mean frequency of the band (*Noise Control for Buildings and Manufacturing Plants).*

Table 2-1

Typical Sound Pressure Levels Associated with Common Noise Sources.

Sound Pressure Level (dBA)	Subjective Evaluation	Environment	
		Outdoor	Indoor
140	Deafening	Jet aircraft at 75 ft	
130	Threshold of pain	Jet aircraft during takeoff at a distance of 300 ft	
120	Threshold of feeling	Elevated Train	Hard rock band
110		Jet flyover at 1000 ft	Inside propeller plane
100	Very Loud	Power mower, motorcycle at 25 ft, auto horn at 10 ft, crowd noise at football game	
90		Propeller plane flyover at 1000 ft, noisy urban street	Full symphony or band, food blender, noisy factory
80	Moderately Loud	Diesel truck (40 mph) at 50 ft	Inside auto at high speed, garbage disposal, dishwasher
70	Loud	B-757 cabin during flight	Close conversation, vacuum cleaner, electric typewriter
60	Moderate	Air-conditioner condenser at 15 ft, near highway traffic	General office
50	Quiet		Private office
40		Farm field with light breeze, birdcalls	Soft stereo music in residence
30	Very quiet	Quiet residential neighborhood	Bedroom, average residence (without t.v. and stereo)
20		Rustling leaves	Quiet theater, whisper
10	Just audible		Human breathing
0	Threshold of hearing		

Source: Adapted from Architectural Acoustics, M. David Egan, 1988 and Architectural Graphic Standards, Ramsey and Sleeper, 1994.

Noise in the environment is constantly fluctuating, such as when a car drives by, a dog barks, or a plane passes overhead. Therefore, noise metrics have been developed to quantify fluctuating environmental noise levels. These metrics include the exceedance sound levels. The exceedance sound level, L_x, is the sound level exceeded "x" percent of the sampling period and is referred to as a statistical sound level. The most common L_x values are L_{90}, L_{50}, and L_{10}. L_{90} is the sound level exceeded 90 percent of the sampling period. L_{90} represents the sound level without the influence of loud, transient noise sources and is therefore often referred to as the *residual* or *background* sound level. L_{50}

is the sound level exceeded 50 percent of the sampling period or the median sound level. L_{10} is the sound level exceeded 10 percent of the sampling period. L_{10} represents the occasional louder noises and is often referred to as the *intrusive* sound level. The variation between the L_{90}, L_{50}, and L_{10} sound levels can provide an indication of the variability of the acoustical environment. If the acoustical environment is perfectly steady, all values are identical. A large variation between the values indicates the environment experiences highly fluctuating sound levels. For instance, measurements near a roadway with frequent passing vehicles may cause a large variation in the statistical sound levels.

In addition to the statistical sound levels described above, another parameter, L_{eq}, is used to represent the equivalent sound pressure level over a specified time period. L_{eq} is the sound level of a steady-state sound that has the same (equivalent) total energy as the time-varying sound of interest, taken over a specified time period and covering a specified set of conditions. Thus, L_{eq} is a single-value level that expresses the time-averaged total energy of a widely varying or fluctuating sound level (*Noise Control for Buildings and Manufacturing Plants)*.

As previously discussed, the L_{90} environmental sound level typically represents the background sound level. Typical background sound levels in various types of communities are outlined in Table 2-2.

Table 2-2

Typical Daytime Residual (Background) Sound Pressure Levels in Various Types of Communities.

Type of Community	Range	Average
Very Quiet Rural Areas	31 to 35 dBA	33 dBA
Quiet Suburban Residential	36 to 40 dBA	38 dBA
Normal Suburban Residential	41 to 45 dBA	43 dBA
Urban Residential	46 to 50 dBA	48 dBA
Noisy Urban Residential	51 to 55 dBA	53 dBA
Very Noisy Urban Residential	56 to 60 dBA	58 dBA

Source: Adapted from U.S. Environmental Protection Agency, Community Noise, December, 1971.

3.0 Applicable Noise Regulations

Construction of SCOP will take place in the cities of Las Vegas and Henderson in Clark County, NV. As such, the project is subject to local regulations regarding construction noise emissions.

3.1 City of Las Vegas

The City of Las Vegas noise regulation falls under Title 9, Health and Safety, of the municipal code. The noise code is subjective in nature. As such, no noise level limits (measured on a decibel scale) are presented. Rather, the noise code prohibits "noise disturbances," defined as "any sound which is unreasonably loud, disturbing or unnecessary or which endangers or injures the health of humans or annoys or disturbs a reasonable person of normal sensitivities." Furthermore, prohibited noises are defined as "any noise disturbance within the corporate boundaries of the City." Since perception of noise is highly individualized, interpretation and enforcement of the Las Vegas noise code is subjective and lacks measurable criteria.

3.2 City of Henderson

The City of Henderson noise regulation falls under Title 8, Public Peace and Safety, of the municipal code. Similar to the Las Vegas code, the City of Henderson code contains subjective language prohibiting "noise disturbances." The City of Henderson defines a noise disturbance as "any sound which endangers or injures the safety or health of humans or animals, or annoys or disturbs a reasonable person of normal sensitivities, or endangers or injures personal or real property."

In addition to the prohibition on noise disturbances, the City of Henderson noise code includes octave band sound level limits. The octave band limits are based on obsolete octave bands per Z24.10-1953 which are no longer used but can be converted to the new octave band scale per ANSI S1.11. Both the old limits and the new, converted limits are presented in Table 3-1. The octave band limits are operational performance standards and therefore should not apply to construction activity. They are provided here for informational purposes.

The converted limits equate to an overall sound pressure level of 54 dBA. This overall level is provided for informational purposes only and is not included as part of the City of Henderson noise code.

Table 3-1
Maximum Allowable Sound Pressure Level

Old Octave Band Range, Hz	Old SPL, dB	Octave Center Frequency, Hz	New Converted SPL, dB
Below 75	72	63	70.8
75-150	67	125	65.1
151-300	59	250	57.3
301-600	52	500	50.6
601-1200	46	1000	44.6
1201-2400	40	2000	38.6
2401-4800	34	4000	33.5
Above 4800	32	8000	31.5

In addition, the City of Henderson noise code includes correction factors for uneven or discontinuous noises. The correction factors are presented in Table 3-2 below.

Table 3-2
Correction to Uneven/Discontinuous Noise

Noise Source/Timing	Correction, dB
Daytime operation only.	+5
Noise source operates less than twenty percent of any one-hour period.	+5
Noise source operates less than five percent of any one-hour period.	+10
Noise of impulsive character such as hammering.	-5
Noise of periodic character such as humming or screeching.	-5

3.3 Clark County

Clark County has a noise regulation included in Title 30 of the Unified Development Code. However, the requirements of the County noise code do not apply to construction or demolition activities when conducted during daytime hours. As such, the project will not be subject to the County noise regulations if construction activities are limited to daytime hours. Although not specifically defined in the County code, daytime hours are typically defined as the hours between 7:00 a.m. and 10:00 p.m.

If construction activities take place outside of daytime hours then the following octave band limits presented in Table 3-3 shall apply. The octave band limits presented below equate to an overall sound pressure level of 48 dBA. Again, this overall level is provided for informational purposes and is not included as part of the Clark County noise code.

Table 3-3

Maximum Permitted Sound Levels

Octave Band Center Frequency, Hz	Within Residential Districts, dB		Within Business and Industrial Districts, dB	
	Daytime	Nighttime	Daytime	Nighttime
31.5	72	65	76	65
63	65	58	69	62
125	58	50	62	54
250	53	44	58	49
500	50	40	55	45
1000	47	37	52	42
2000	43	33	49	38
4000	40	30	46	35
8000	37	27	43	32

In the event that impulsive noise emissions related to construction activities are emitted, the sound level limits in Table 3-4 will also apply. Note that these limits do not include A-weighting, as described in Section 2.0 of this report.

Table 3-4

Impulsive Noise – Maximum Permitted Sound Levels

Within Residential Districts, dB		Within Business and Industrial Districts, dB	
Daytime	Nighttime	Daytime	Nighttime
56	46	65	61

3.4 U.S. Environmental Protection Agency

The Environmental Protection Agency (USEPA) has identified yearly day-night average sound levels, L_{dn}, sufficient to protect public health and welfare from the effects of environmental noise [*EPA Pub. No. 550/9-77, April 1977*]. According to the USEPA, yearly levels are sufficient to protect public health and welfare if they do not exceed an L_{dn} of 55 dBA outdoors in sensitive areas such as residences, schools, and hospitals. The day-night sound level, L_{dn}, is the 24-hour average sound level with a 10 dB penalty applied to the nighttime sound levels (10:00 p.m. to 7:00 a.m.) to account for increased sensitivity to noise during nighttime hours. As such, this equates to a constant sound level of 55 dBA during daytime hours and 45 dBA during nighttime hours.

It should be noted that the USEPA has also established an indoor guideline of L_{dn} 45 dBA for residences, schools, hospitals, and churches. The sound attenuation provided by a typical residential home (outdoor-to-indoor noise reduction) is approximately 15 dB with the windows open and 25 dB with the windows closed [*EPA Pub. No. 550/9-74-004, March 1974*]. As such, the USEPA outdoor guideline of L_{dn} 55 dBA would result in corresponding indoor levels below the USEPA indoor guideline.

The USEPA emphasizes that since the protective sound levels were derived without concern for technical or economic feasibility, and contain a margin of safety to ensure their protective value, they must not be viewed as standards, criteria, regulations, or goals. Rather, they should be viewed as levels below which there is no reason to suspect that the general population will be at risk from any of the identified effects of noise. Additionally, the USEPA has no authority to regulate ambient noise levels.

4.0 Construction Noise Emissions

The following sections discuss the methodology for estimating the construction activity noise emissions associated with the EI and South Lateral Pipeline construction and the evaluation of the noise levels.

4.1 Construction Activities

Major construction phases will consist of site preparation, pipeline installation (either cut-and-cover or tunneling), building structures, and site cleanup. Noise emissions will vary with each phase of construction depending on the construction activity and the associated equipment.

Site preparation will require the use of internal combustion engine powered earth moving equipment. This equipment will include backhoes, scrapers, dump trucks, graders, and front end loaders. Noise emissions during this construction phase will be dominated by the engine noise. Site preparation activities will occur at various locations along the pipeline route.

The pipeline installation will involve trenchers, tunnel boring machines, mobile cranes, earth moving equipment, equipment and materials delivery, welders, air compressors, and a variety of other equipment. A list of specific equipment pieces that will be used is provided in Appendix A.

Construction activities will be scheduled during daytime and evening periods (7:00 a.m. to 10:00 p.m.) to the fullest extent possible. Some activities may require extended hours of operation due to scheduling constraints or to avoid times of increased traffic. Any nighttime construction will be limited to low noise activities to the fullest extent possible.

Site clean-up will generally result in minimal noise emissions. It is anticipated that clean-up will include hauling activities to remove materials off site, collection activities, and final surface restoration.

4.2 Construction Equipment Noise Emissions

The variable nature of construction noise is best represented by an average noise level. The average noise levels account for the type and quantity of equipment, the typical usage of each piece of equipment, and the typical noise levels of the equipment used

during each phase of construction. The type of equipment, equipment usage, and equipment noise emissions for typical construction is listed in Appendix A. Furthermore, the information provided in Appendix A is separated for each construction technique (i.e., cut-and-cover and tunneling). Estimates of the construction equipment usage and noise levels are based on information provided in *EPA Document PB-250 430 - Noise Emission Standards for Construction Equipment (EPA 1975), Power Plant Construction Noise Guide, Electric Power Plant Environmental Noise Guide,* and available project-specific equipment information provided by the design team.

4.3 Impacts from Construction Noise

The variable nature of construction activity makes it difficult to predict construction noise emissions. While the average noise level is one representation of construction activities, certain activities will produce temporary elevations in the noise level.

As discussed, the EI can be divided into four sections, Reach 1, Reach 2, Reach 3, and the South Lateral Pipeline. The first stretch, Reach 1, is further divided into two stretches. The first stretch of Reach 1 is approximately 7,200 feet long and will be installed using cut-and-cover installation. The second stretch of Reach 1, approximately 420 feet long, will utilize tunneling methods for installation. Reach 2 is approximately 19,000 feet long and will be installed using the cut-and-cover method. Reach 3 is approximately 6,500 feet long and will be installed using the tunneling method. The South Lateral Pipeline is approximately 17,500 feet long and will be installed using the cut-and-cover method.

Currently, the nearest residences are located approximately 4,000 feet southwest of the transition point between Reach 1 and Reach 2, as shown on Figure 4-1. In addition to the direct pipe installation activity, a construction staging area is planned near the beginning of Reach 2 on the south side of the construction easement. However, it is anticipated that staging area related noise will be less significant than pipe installation construction.

Future development plans in the project area include residences to be located adjacent to tunnel shafts in Reach 1 and a 1,390-foot portion of the cut-and-cover construction of Reach 1. Also, residences are planned to be located adjacent to approximately 3,400 feet of South Lateral Pipeline cut-and-cover construction. These planned developments are shown on Figure 4-1 as Locations 4 and 5, respectively. It is anticipated that these new residences will be built before construction of the EI and the South Lateral Pipeline is complete. Furthermore, since these residential developments are located so close to the

project it is anticipated that these areas have the greatest potential to be impacted by construction-related noise.

Noise emissions attributable to construction activities are highly variable, depending on the location and operating load of the construction equipment. Based on information provided specific to the EI and on the guidelines provided in the EPA document referenced above, it is anticipated that sound levels from construction activities will be less than 45 dBA at the nearest *current* residences, identified as Location 1 on Figure 4-1. Since the receptors at Location 1 are closest to the construction zone, it is anticipated that the construction sound levels at Locations 2 and 3 will be less than the construction sound levels at Location 1. Appendix A of this report details the calculations and assumptions used to estimate the construction noise emissions. Sound level totals provided in Appendix A are based on a distance of 50 feet. Sound levels will decrease as distance from the contruction site increases.

Based on the EPA guidelines listed in Table 2-2 of this report, 45 dBA is consistent with "*normal suburban residential*" areas. As such, the construction noise emissions are not expected to be significantly disruptive to the currently existing community (i.e., Locations 1, 2, and 3).

Since the EI and the South Lateral Pipeline routes run adjacent to planned residential developments, it is anticipated that these areas will experience the greatest impacts from construction noise. Residences closest to the construction activities could experience sound levels that exceed 75 dBA. Based on Table 2-2, 75 dBA significantly exceeds even "*very noisy urban residential*" communities. For comparison, 75 dBA is typically associated with industrial areas. Due to the variable nature of construction-related noise, though, maximum sound levels should not persist at all times and will fluctuate with the passing of heavy trucks, machinery and intermittent use of the construction equipment.

In addition, due to the variation in human response to noise, it is possible that the highly fluctuating nature of the noise will also negatively impact the nearest residents. As such, two potential impacts could result. The first is the "loudness" of the noise and the second is the "nature" of the noise.

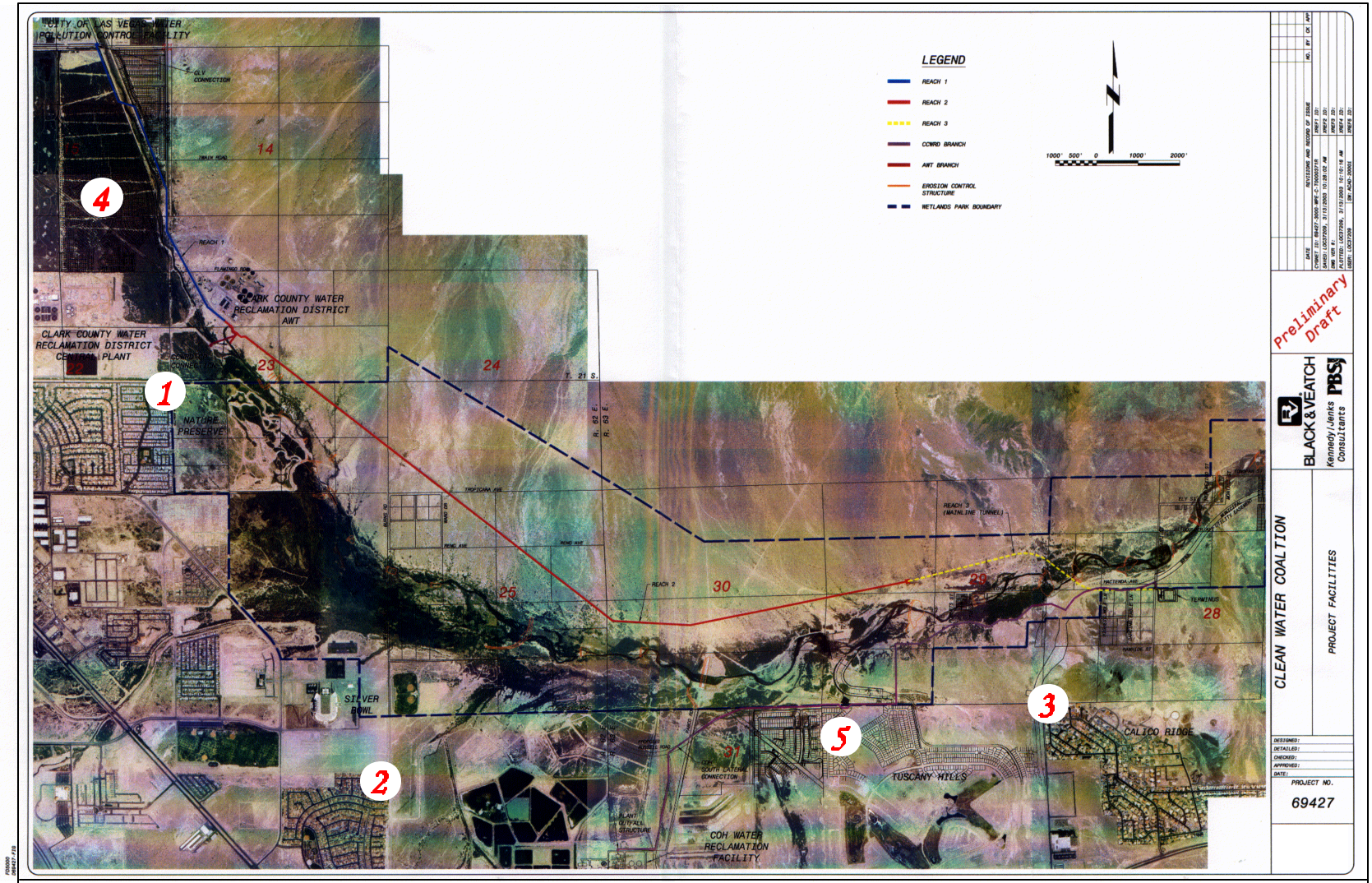

FIGURE 4-1
RECEPTOR LOCATIONS

5.0 Conclusions

The EI and South Lateral Pipeline routes are located in the Cities of Las Vegas and Henderson in Clark County, Nevada. Based on the information provided, there are local noise regulations that apply to the project.

Construction noise is highly variable in nature. As such, construction noise is best represented by an average noise level. The average noise level accounts for the type and quantity of equipment being used, the typical usage of each piece of equipment, and typical operating noise levels of each piece of equipment. Based on construction noise guidelines, the noise emissions associated with construction of the SCOP have been estimated and evaluated against applicable regulations as well as community noise parameters.

It is anticpated that construction noise emissions will be less than 45 dBA at the nearest *current* residences, identified as Location 1 in Figure 4-1. Additionally, construction noise emissions at Locations 2 and 3 are expected to be less than levels at Location 1. Forty-five dBA is consistent with "normal suburban residential" areas. As a result, impacts from construction-related noise are not expected to be significant to these three locations.

However, it is anticipated that construction noise emissions could exceed 75 dBA at two planned residential developments, identified as Locations 4 and 5 in Figure 4-1. Seventy-five dBA significantly exceeds typical sound levels associated with community environments. Efforts should be made to minimize, as much as possible, noise-related impacts to these two residential areas. Efforts could include speed limits for delivery trucks, limiting certain construction activities to specific times of the day, and limiting the simultaneous use of the noisiest equipment pieces as much as possible.

6.0 References

1. *Noise Control for Buildings and Manufacturing Plants,* Hoover & Keith Inc., Fifteenth Printing, 2001.

2. *Power Plant Construction Noise Guide,* Bolt Beranek and Newman, Inc., May 1977.

3. Beis, D.A. and C.H. Hansen, *Engineering Noise Control.* London: Unwin, 1988.

4. *Noise Emission Standards for Construction Equipment,* Environmental Protection Agency, Document PB-250 430, December 1975.

5. *Community Noise,* Environmental Protection Agency, Document PB 207 124, December 1971.

6. *Toward a National Strategy for Noise Control,* Environmental Protection Agency, Document 550/9-77, April 1977.

7. *Information on Levles of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety,* Environmental Protection Agency, Document 550/9-74-004 (PB-239 429), March 1974.

8. Egan, M. David, *Architectural Acoustics,* McGraw-Hill Publishing Company, New York, 1988.

9. *Electric Power Plant Environmental Noise Guide, 2nd Edition,* Prepared by Bolt Beranek and Newman, Inc. for Edison Electric Institute, Rev. 1984.

Appendix A

Construction Noise Emissions Calculation

Systems Conveyance and Operations Program

Construction Noise Emissions Estimate

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[2]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	Usage Factor Correction Legend	
Cut-and-Cover	Hydraulic Backhoe	85	1	0.75	-1	4	80.0	89-100	0
	Grader	85	1	0.50	-3	6	76.0	71-88	-1
	Front End Loader	84	1	0.75	-1	5	78.0	56-70	-2
	Crane	83	1	0.75	-1	8	74.0	45-55	-3
	Hydraulic Drilling Rig	87	1	0.75	-1	5	81.0	36-44	-4
	Welder	73	1	0.10	-10	5	58.0	28-35	-5
	Air Compressor	74	1	0.10	-10	7	57.0	23-27	-6
	Portable Generator	73	1	0.10	-10	5	58.0	18-22	-7
	Concrete Vibrator	76	1	0.40	-4	5	67.0	15-17	-8
	Diesel Generator	78	1	0.50	-3	5	70.0	12-14	-9
	Dozer	87	1	0.75	-1	5	81.0	9-11	-10
	Compactor	80	1	0.50	-3	5	72.0	5-8	-12
	Truck, Large	88	1	0.85	-1	8	79.0	3.2-4.9	-14
	Water Truck	88	1	0.85	-1	8	79.0	2.0-3.1	-16
	Torque Wrench	85	1	0.10	-10	5	70.0	1.3-1.9	-18
	Concrete Delivery Truck	88	1	0.25	-6	8	74.0	0.8-1.2	-20
	Concrete Pump	82	1	0.25	-6	5	71.0		
	Concrete Saw	78	1	0.10	-10	5	63.0		
	Grinder	80	1	0.10	-10	5	65.0		
						Total[4]	**88.6**	**@ 50 ft**	

Systems Conveyance and Operations Program

Construction Noise Emissions Estimate

City of Las Vegas WWTF (Reach 1)

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[2]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)
Tunneling -- Excavation	Delivery Truck	88	1	0.40	4	8	76.0
	Diesel Generator	78	1	0.75	1	5	72.0
	Crane	83	1	0.40	4	8	71.0
	Front End Loader	84	1	0.40	4	5	75.0
	Dump Truck	88	2	0.26	6	8	77.0
	Water Truck	88	1	0.26	6	8	74.0
	Pneumatic Wrench	85	3	0.80	1	5	83.8
	Air Compressor	74	1	1.00	0	7	67.0
	Welder	73	1	0.80	1	5	67.0
	Grinder	80	1	0.80	1	5	74.0
	Vent Fan (20 hp)	65	1	1.00	0	0	65.0
						Total[4]	**86.5**

Usage Factor Correction	Legend
89-100	0
71-88	-1
56-70	-2
45-55	-3
36-44	-4
28-35	-5
23-27	-6
18-22	-7
15-17	-8
12-14	-9
9-11	-10
5-8	-12
3.2-4.9	-14
2.0-3.1	-16
1.3-1.9	-18
0.8-1.2	-20

@ 50 ft

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)
Tunneling -- Shaft Excavation	Drill (pneumatic spade)	85	4	0.80	1	5	87.0
	Delivery Truck	88	1	0.26	6	8	86.0
	Diesel Generator	78	1	0.75	1	5	74.0
	Crane	83	1	0.40	4	8	79.0
	Front End Loader	84	1	0.40	4	5	83.0
	Dump Truck	88	2	0.26	6	8	89.0
	Water Truck	88	1	0.26	6	8	86.0
	Pneumatic Wrench	85	3	0.80	1	5	85.8
	Concrete Delivery Truck	88	2	0.40	4	8	87.0
	Grout Pump	82	1	0.50	3	5	80.0
	Air Compressor	74	1	1.00	0	7	67.0
	Welder	73	1	0.80	1	5	69.0
	Grinder	80	1	0.80	1	5	76.0
	Vent Fan (20 hp)	60	1	1.00	0	5	55.0
						Total[4]	**95.4**

@ 50 ft

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)
Pipe Placement & Grouting	Concrete Vibrator	76	1	0.10	10	8	58.0
	Delivery Truck	88	3	0.26	6	8	78.8
	Diesel Generator	78	1	0.75	1	5	72.0
	Crane	83	1	0.40	4	8	71.0
	Water Truck	88	1	0.26	6	8	74.0
	Pneumatic Wrench	85	3	0.80	1	5	83.8
	Concrete Delivery Truck	88	2	0.40	4	8	79.0
	Grout Pump	82	1	0.50	3	5	74.0
	Air Compressor	81	1	1.00	0	7	74.0
	Welder	73	1	0.80	1	5	67.0
	Grinder	80	1	0.80	1	5	74.0
	Vent Fan (20 hp)	60	1	1.00	0	5	55.0
						Total[4]	**87.2**

@ 50 ft

Systems Conveyance and Operations Program

Construction Noise Emissions Estimate

Clark County Sanitation District (Reach 2)

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[2]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	Usage Factor Correction	Legend
Tunneling -- Excavation	Delivery Truck	88	1	0.40	4	8	76.0	89-100	0
	Diesel Generator	78	1	0.75	1	*5*	72.0	71-88	-1
	Crane	83	1	0.40	4	8	71.0	56-70	-2
	Front End Loader	84	1	0.40	4	5	75.0	45-55	-3
	Dump Truck	88	2	0.26	6	8	77.0	36-44	-4
	Water Truck	88	1	0.26	6	8	74.0	28-35	-5
	Pneumatic Wrench	85	3	0.80	1	*5*	83.8	23-27	-6
	Air Compressor	74	1	1.00	0	7	67.0	18-22	-7
	Welder	73	1	0.80	1	*5*	67.0	15-17	-8
	Grinder	80	1	0.80	1	*5*	74.0	12-14	-9
	Vent Fan (20 hp)	65	1	1.00	0	*0*	65.0	9-11	-10
								5-8	-12
								3.2-4.9	-14
								2.0-3.1	-16
								1.3-1.9	-18
								0.8-1.2	-20
						Total[4]	**86.5**	**@ 50 ft**	

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	
Tunneling -- Shaft Excavation	Hoe Ram (50 hp)	85	1	0.40	4	4	85.0	
	Drill (pneumatic spade)	85	4	0.80	1	*5*	87.0	
	Delivery Truck	88	1	0.26	6	8	86.0	
	Diesel Generator	78	1	0.75	1	*5*	74.0	
	Crane	83	1	0.40	4	8	79.0	
	Front End Loader	84	1	0.40	4	5	83.0	
	Foundation Drill	85	1	0.80	1	*5*	81.0	
	Dump Truck	88	2	0.26	6	8	89.0	
	Water Truck	88	1	0.26	6	8	86.0	
	Pneumatic Wrench	85	3	0.80	1	*5*	85.8	
	Concrete Delivery Truck	88	2	0.40	4	8	87.0	
	Grout Pump	82	1	0.50	3	*5*	80.0	
	Air Compressor	74	1	1.00	0	7	67.0	
	Welder	73	1	0.80	1	*5*	69.0	
	Grinder	80	1	0.80	1	*5*	76.0	
	Vent Fan (20 hp)	60	1	1.00	0	*5*	55.0	
						Total[4]	**95.9**	**@ 50 ft**

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	
Pipe Placement & Grouting	Concrete Vibrator	76	1	0.10	10	*8*	58.0	
	Delivery Truck	88	3	0.26	6	8	78.8	
	Diesel Generator	78	1	0.75	1	*5*	72.0	
	Crane	83	1	0.40	4	8	71.0	
	Water Truck	88	1	0.26	6	8	74.0	
	Concrete Delivery Truck	88	2	0.40	4	8	79.0	
	Grout Pump	82	1	0.50	3	*5*	74.0	
	Air Compressor	81	1	1.00	0	7	74.0	
	Vent Fan (20 hp)	60	1	1.00	0	*5*	55.0	
						Total[4]	**84.1**	**@ 50 ft**

Systems Conveyance and Operations Program

Construction Noise Emissions Estimate

Main Tunnel Working Shaft (Reach 3)

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[2]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	Usage Factor Correction	Legend
Tunneling -- Excavation	Boom Truck	88	1	0.40	4	8	76.0	89-100	0
	Delivery Truck	88	2	0.40	4	8	79.0	71-88	-1
	Diesel Generator	78	1	0.75	1	*5*	72.0	56-70	-2
	Crane	83	1	0.40	4	8	71.0	45-55	-3
	Front End Loader	84	1	0.40	4	5	75.0	36-44	-4
	Dump Truck	88	2	0.26	6	8	77.0	28-35	-5
	Water Truck	88	2	0.26	6	8	77.0	23-27	-6
	Pneumatic Wrench	85	3	0.80	1	*5*	83.8	18-22	-7
	Dozer	87	1	0.40	4	5	78.0	15-17	-8
	Air Compressor	74	1	1.00	0	7	67.0	12-14	-9
	Welder	73	1	0.80	1	*5*	67.0	9-11	-10
	Grinder	80	1	0.80	1	*5*	74.0	5-8	-12
	Vent Fan (50 hp)	65	1	1.00	0	*0*	65.0	3.2-4.9	-14
								2.0-3.1	-16
								1.3-1.9	-18
								0.8-1.2	-20
						Total[4]	**87.9**	**@ 50 ft**	

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)
Tunneling -- Shaft Excavation	Sinking Drills	85	4	0.40	4	4	91.0
	Delivery Truck	88	1	0.26	6	8	86.0
	Diesel Generator	78	1	0.75	1	*5*	74.0
	Crane	83	1	0.40	4	8	79.0
	Front End Loader	84	1	0.40	4	5	83.0
	Dump Truck	88	2	0.26	6	8	89.0
	Water Truck	88	1	0.26	6	8	86.0
	Pneumatic Wrench	85	3	0.80	1	*5*	85.8
	Concrete Delivery Truck	88	2	0.40	4	8	87.0
	Grout Pump	82	1	0.50	3	*5*	80.0
	Air Compressor	74	4	1.00	0	7	73.0
	Welder	73	1	0.80	1	*5*	69.0
	Grinder	80	1	0.80	1	*5*	76.0
	Vent Fan (20 hp)	60	1	1.00	0	*5*	55.0
						Total[4]	**96.2**

@ 50 ft

Systems Conveyance and Operations Program

Construction Noise Emissions Estimate

Main Tunnel Retrieval Shaft (Reach 3)

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	
Tunneling -- Shaft Excavation	Hoe Ram (50 hp)	85	1	0.40	4	4	85.0	
	Drill (pneumatic spade)	85	4	0.80	1	*5*	87.0	
	Delivery Truck	88	1	0.26	6	8	86.0	
	Diesel Generator	78	1	0.75	1	*5*	74.0	
	Crane	83	1	0.40	4	8	79.0	
	Front End Loader	84	1	0.40	4	5	83.0	
	Foundation Drill	85	1	0.80	1	*5*	81.0	
	Dump Truck	88	2	0.26	6	8	89.0	
	Water Truck	88	1	0.26	6	8	86.0	
	Pneumatic Wrench	85	3	0.80	1	*5*	85.8	
	Concrete Delivery Truck	88	2	0.40	4	8	87.0	
	Grout Pump	82	1	0.50	3	*5*	80.0	
	Air Compressor	74	1	1.00	0	7	67.0	
	Welder	73	1	0.80	1	*5*	69.0	
	Grinder	80	1	0.80	1	*5*	76.0	
	Vent Fan (20 hp)	60	1	1.00	0	*5*	55.0	
						Total[4]	**95.9**	**@ 50 ft**

Construction Type	Equipment	Lp @ 15m (dBA)	Quantity[1]	Usage[2]	Usage Factor Correction[1]	Acoustic Max Factor[3]	Leq @ 15 m (dBA)	
Pipe Placement & Grouting	Concrete Vibrator	76	1	0.10	10	*8*	58.0	
	Delivery Truck	88	1	0.26	6	8	74.0	
	Diesel Generator	78	1	0.75	1	*5*	72.0	
	Boom Truck	88	1	0.40	4	8	76.0	
	Water Truck	88	1	0.26	6	8	74.0	
	Concrete Delivery Truck	88	2	0.40	4	8	79.0	
	Grout Pump	82	1	0.50	3	*5*	74.0	
	Air Compressor	81	1	1.00	0	7	74.0	
	Vent Fan (20 hp)	60	1	1.00	0	*5*	55.0	
						Total[4]	**83.7**	**@ 50 ft**

NOTES:

1. Based on information provided by the project design team.
2. Based on Table 4.5-1, Summary of Construction Equipment Types, Sound Levels and Usage Factors, Electric Power Plant Environmental Noise Guide, 2nd Edition; Edison Electric Institute; Prepared by Bolt, Beranek and Newman Inc., 1984.
3. With the exception of italicized values, the AMF reductions are based on Table B.5, Measured and Suggested Acoustic Max Factor for Construction Equipment and Plant Noise Sources, Power Plant Construction Noise Guide; Bolt, Beranek and Newman Inc., 1977. Italicized values are based on in-house data and previous experience.
4. Assumes simultaneous operation of all equipment from similar distances. The overall sound level may decrease when certain equipment pieces are not in use.

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