Appendix 5. Noise Impact Analysis

KIRBY HILL GAS STORAGE FACILITY
(SOLANO COUNTY, CALIFORNIA)

RESULTS OF NOISE IMPACT ANALYSES FOR A

PROPOSED NEW NATURAL GAS STORAGE FACILITY

H&K Report No. 1914

H&K Job No. 3711

Date of Report: July 8, 2005

Prepared for: **Lodi Gas Storage, LLC**
14811 St. Mary's Lane, Suite 150
Houston, Texas 77079

Submitted by: Paul D. Kiteck, P.E. (Primary Author)
Hoover & Keith Inc.
11391 Meadowglen, Suite D
Houston, Texas 77082

Hoover & Keith Inc.
Consultants in Acoustics and Noise Control Engineering
11391 Meadowglen, Suite D, Houston, TX 77082 Phone: (281) 496-9876

REPORT SUMMARY

This report details the results of noise impact analyses for the proposed **Kirby Hill Gas Storage Facility,** to be located in Solano County, California. The facility will entail a natural gas compressor station (i.e., Station) and a natural gas storage field that will include several gas storage well sites. The noise impact analyses include an estimate of the potential noise impact due to the Station and an assessment of the noise generated by temporary and/or intermittent activities at the site, such as the noise due to well drilling operations, Station construction activities, routine Station gas blowdown event or a planned temporary gas compressor.

The following table summarizes the estimated sound level attributable to the Station at the closest noise-sensitive areas (NSAs), such as a residence, school, hospital or park, along with the estimated total sound contribution of the Station at the closest NSA (i.e., sound contribution of the Station at full load plus the estimated ambient sound level). The results presented in this table are defined as the "Noise Quality Analysis" for the Station.

Noise Quality Analysis for the Station associated with the Kirby Hill Gas Storage Facility

Closest NSA and Direction of NSA from the Site Center (i.e., Compressor Bldg.)	Distance of NSA to the Site Center (i.e., Compressor Building)	Est'd Ambient Lden * (dBA)	Est'd Lden of the Station (dBA)	Calc'd Station Lden + Ambient Lden (dBA)	Potential Increase above Ambient
Residence (SE)	4,200 feet	45.0 *	41.0	46.5	1.5 dB

* Note: Since the ambient noise levels around the proposed site were not measured, a typical ambient noise level for the environment surrounding the NSA was chosen.

The noise impact analysis indicates that if the recommended and/or planned noise control measures are successfully employed, the noise attributable to the Station associated with the proposed **Kirby Hill Gas Storage Facility** during full load operation will be lower than **50 dBA** CNEL (i.e., L_{den}) at the nearby NSAs (i.e., residences) surrounding the site, which is considered the noise policy (noise criterion) for the facility per the "Solano County General Plan".

The noise assessment also indicates that the noise generated by temporary and/or intermittent activities at the site (i.e., well drilling operations, Station construction activities, Station gas blowdown or temporary gas compressor) should be lower than the noise guideline (i.e., criterion) of **50 dBA** (L_{den}) at the nearby NSAs. Consequently, the noise of the Station and the temporary/intermittent activities for the proposed Kirby Hill Gas Storage Facility should have minimum noise impact on the surrounding environment.

TABLE OF CONTENTS

Table of Contents (continued next page)

1.0 INTRODUCTION

In this report, we present the results of noise impact analyses for the proposed **Kirby Hill Gas Storage Facility**, which will include a natural gas compressor station (i.e., Station) that will serve a natural gas storage field. The Kirby Hill Gas Storage Facility will be operated by the **Lodi Gas Storage, LLC** and owned by **Lodi Holdings, LLC.** The Kirby Hill Gas Storage Facility will also entail several gas storage well sites located within the anticipated property line for the facility that will require well drilling operations. The following summaries the purpose of the noise impact analyses:

- Project the sound level contribution of the Station at the nearby noise-sensitive areas (NSAs), such as residences, schools, hospitals or parks, which would result from full load operation of the Station and associated equipment.

- Project the noise contribution at the nearby NSAs resulting from temporary or intermittent activities at the site that could generate noise, such as: (a) Noise of construction activities at the Station, (b) Noise due to a routine gas venting (i.e., gas blowdown event) at the Station, (c) noise due to drilling operations at the planned gas storage well sites, and (d) noise generated by a temporary gas compressor (located at Well Site S-2).

- Determine noise control measures and noise requirements for the Station equipment and other noise-generating activities to insure that the facility meets applicable sound criteria and noise guidelines.

2.0 TYPICAL METRICS, TERMINOLOGY AND SOUND CRITERIA/GUIDELINES

For the reader's information, a summary of applicable acoustical terminology and typical metrics used to measure and regulate environmental noise is provided at the end of the report (**Appendix D**, pp. 19-21). There are several metrics used for quantifying and regulating environmental noise level although the most common metric used by state and municipal agencies is the A-wt. sound level (i.e., dBA). There are also other metrics, such as L_{eq}, L_{dn} and/or Community Noise Equivalent Level (abbreviated CNEL or L_{den}) used to correlate human reaction to an intruding sound.

The "Health and Safety Element" of the "Solano County General Plan", dated May 1977, is specifically designed to provide the county or cities with a basis for controlling the actions of private individuals or firms and other public agencies who use or proposed to use planning area lands. This document provides specific policies/guidelines regarding the subject of noise-emitting industrial facilities (i.e., pp. 17-23 & pp. 61-69 of the "Element"), such as the proposed Kirby Gas Storage Facility. In summary, "Specific Policies" of the "Health and Safety Element", which are assumed to apply to this proposed facility, state the following:

"The introduction of any fixed point, permanent, non-residential, noise-emitting land use (industrial, commercial, public utility, etc.) shall be prohibited if the projected noise emission level will exceed one or more of the following:

a. **50 dBA** CNEL (L_{den}), as measure at the boundary of a nearby residential zone.

b. **60 dBA** CNEL (L_{den}), as measured at the boundary of a nearby commercial zone, business zone (personal service, offices), or noise-sensitive industrial or manufacturing zone (research, communications, etc.)."

Consequently, we interpret this policy to require that the projected and resulting noise contribution of the proposed Kirby Gas Storage Facility (i.e., noise generated by the Station and other associated temporary/intermittent activities) should be equal to or lower than **50 dBA** (L_{den}) at the nearby NSAs, such as a nearby residential property. If the facility can meet this noise criterion, the proposed land use for the facility should be acceptable and within the noise policy/guidelines of the General County Plan.

3.0 SITE/FACILITY DESCRIPTION

3.1 Site Description

Figure 1 (p. 9) provides an area layout around the proposed Kirby Hill Gas Storage Facility that shows the location of the nearby NSAs, anticipated location of the Station and location of the planned well sites. The Station will be located in Solano County, California, approximately 10 miles southeast of Fairfield, CA.

The closest NSA is a residence (i.e., single-family dwelling) located approximately 4,200 feet southeast of the site center (i.e., anticipated location of the Compressor Building for the Station), and there are other scattered residences and a church located within 1 mile of the site. Note that the locations of the NSAs were provided by personnel at Lodi Gas Storage. Consequently, H&K did not visit the site to conduct an ambient sound survey or verify the location of nearby NSAs, but we believe the information provided is accurate and reliable.

3.2 Brief Description of the Facility and associated Station

Figure 2 (p. 10) shows a conceptual layout showing the anticipated location of buildings and equipment for the Station. In summary, the Station will serve a natural gas storage field, and there are generally two (2) operating modes of the Station: (a) gas injection mode, in which high pressure natural gas is injected into an underground wells/caverns for storage using gas compression, and (b) gas withdrawal mode, in which high pressure gas flows out of the gas wells/caverns ("free flow conditions") or is pumped out at times of low gas pressures.

We understand that the gas compressor station will eventually include four (4) "high-speed" engine-driven compressor packages (i.e., units), and each package will consist of a Caterpillar (CAT) Model G3606 engine (i.e., 1775 HP @ typical operating speed) driving an Ariel Model JGD-4 reciprocating compressor. The following describes auxiliary equipment and other items associated with the gas compressor units:

- Engines/compressors installed inside a single metal building (i.e., Compressor Building);
- Outdoor utility/gas cooler for each engine, shaft-driven by the engine, which provides engine jacket-water cooling and gas cooling;
- Exhaust engine system designed with a muffler system and emission-reduction system;
- Engine air intake filter assumed to be designed with an air filter/cleaner system;
- Aboveground gas piping and piping system components (e.g., suction/discharge headers, withdrawal separator, inlet filter separator and discharge filter/separator);
- Dehydration regenerator units (i.e., designed with 2 gas heaters on skids); and

The Station will also employ a gas flow-control system (i.e., Pressure Reduction Station) consisting of a pressure regulator valve(s), which will primarily be utilized during withdrawal of high-pressure gas. There will also be two (2) types of gas blowdown events: (1) a routine gas blowdown that occurs when a compressor unit is stopped (i.e., suction/discharge valves adjacent to the compressor are closed and gas is vented to the atmosphere through a blowdown silencer), and (2) an emergency shutdown (ESD) that will only occur at required DOT test intervals or in an emergency situation (gas leak or fire), and we understand that an ESD blowdown will also be vented through the same silencer as employed for a unit blowdown.

The Facility will also include several gas storage wells and a temporary gas compressor (located at Well Site S-2), and well drilling operations are expected to operate 24 hours/day. There is noise associated with the drilling operations at each storage well and noise generated by the temporary gas compressor. The closest NSA (i.e., residence) to a gas storage well site is located approximately 6,800 feet from Well Site S-10, and due to existing land contour (i.e., hills), none of the well sites should be in line-of-sight of the nearby NSAs.

4.0 NOISE IMPACT ANALYSES (COMPRESSOR STATION)

The following section addresses the potential noise impact due to Station operation. Included also is an assessment of the noise generated by a blowdown event that occurs occasionally at the Station. The predicted noise impact analyses were performed only for the closest NSA (i.e., residence approximately 4,200 feet from the Station) since the Station noise at more distant NSAs should be equal to or lower than the predicted noise level at the closest NSA.

4.1 Estimated Sound Contribution of the Station at the Closest NSA

The noise generated by the Station compressor units (e.g., gas injection mode) is considered the operating condition that will generate the greatest amount of noise during Station operation. Consequently, the noise impact analysis is performed assuming full load operation of all gas compressor units operating along with all auxiliary equipment that operates continuously, and the following sound sources associated with the Station were considered significant:

- Noise generated by the engines/compressors that penetrates the Compressor Building;
- Noise associated with the engine exhaust systems;
- Noise generated by the engine air intake systems;
- Noise radiated from outdoor aboveground gas piping and associated components;
- Noise of the outdoor utility/gas coolers; and
- Noise associated with the Dehydration Regeneration Units (Dehy. Regen. Units).

Table A (p. 11) shows the complete spreadsheet calculation of the estimated A-wt. sound level and unweighted octave-band SPLs at the closest NSA contributed by the Station noise sources for standard day propagating conditions (i.e., 30% R.H., 60 deg. F. & no wind). This spreadsheet analysis also includes an estimated noise reduction for anticipated noise control measures along with the estimated "total" sound level at the closest NSA (i.e., sound contribution of the Station plus the ambient noise level). Note that the estimated ambient noise level was based on our experience and sound level information given in an ANSI Standard[1] since ambient noise levels were not measured. A description of the acoustical analysis methodology and source of sound data used for the analysis for the Station are provided in **Appendix A** (pp. 15-16).

The following **Table 1** summarizes the calculated sound level contribution of the Station at the closest NSA assuming full load operation of all equipment associated with the Station.

Operating Condition	Est'd A-Wt. Sound Level (i.e., Leq)	Calc'd Lden (via Est'd A-Wt. Level)
Est'd sound contribution of Station during full load at the Closest NSA	34.3 dBA	41.0 dBA

Table 1: Est'd Sound Contribution of the Station at the Closest NSA during Full Load Operation

4.2 Sound Level Contribution of Station at the Closest Station Property Line

Table B (p. 12) is a spreadsheet calculation of the estimated A-wt. sound level and unweighted octave-band SPLs at the north property line of the Station contributed by the significant noise sources at the Station for standard day propagating conditions. The predicted Station sound contribution at the property line was performed only at the property line closest to the Station

[1] Typical Ldn, which is similar to the Lden, for a Quiet Residential Area given in Table 2 of Appendix D in the American National Standards Institute (ANSI) S12.9-1993/Part 3 entitled "Quantities and Procedures for Description and Measurement of Environmental Sound. Part 3: Short-Term Measurements with an Observer Present"

equipment (i.e., north property line of the facility). The following **Table 2** summarizes the estimated sound contribution of the Station at the closest property line assuming full load operation of all equipment associated with the Station.

Operating Condition	Est'd A-Wt. Sound Level (i.e., Leq)	Calc'd Lden (via Est'd A-Wt. Level)
Est'd sound contribution of the Station at north property line of station	43.5 dBA	50.2 dBA

Table 2: Est'd Sound Contribution of Station at the Closest Property Line of the Facility (N. Prop. Line)

4.3 Sound Contribution of a Blowdown Event at the Station

The noise of gas blowdown venting via a blowdown silencer will be specified to meet an A-wt. sound level of **70 dBA** at a distance of 300 feet. If this sound requirement is achieved, the noise of a unit blowdown will be approximately **35 dBA** (i.e., L_{den} of **41.7 dBA**) at the closest NSA, located approximately 4,200 feet from the blowdown silencer, which would be lower than **50 dBA** (L_{den}). Consequently, although the noise of a blowdown event may be audible at the nearby NSAs, it is not expected to present a significant noise impact, noting also that a unit blowdown event occurs infrequently for a short time frame (e.g., 1 to 5 minute period). A brief discussion of the acoustical analysis methodology and the source of sound data used for the noise assessment for Station blowdown event are provided in **Appendix A** (pp. 15-16).

5.0 <u>NOISE ASSESSMENT (DRILLING OPERATIONS AND TEMPORARY COMPRESSOR)</u>

The noise assessment of drilling operations considers the noise produced by drill rig equipment during normal drilling activity that could impact the sound contribution at the nearby NSAs. To reduce computation, the estimated sound contribution of the drilling operations was performed <u>only</u> for the storage well closest to a NSA (i.e., Well Site S-10).

The spreadsheet calculation of the estimated A-wt. sound level at the closest NSA to a well site contributed by well drilling operations is provided in **Table C** (p. 13). The results of this analysis indicates that the maximum A-wt. noise level of drilling operations at the storage wells will be equal to or less than **23.3 dBA** (i.e., L_{den} of **30.0 dBA**) at the closest NSA. Consequently, the noise of the drilling operations at any of the well sites will probably not be audible any the nearby NSAs (i.e., residences). A description of the analysis methodology and source of sound data for well drilling operations is provided in the **Appendix B** (p. 17) along with a summary of the primary equipment (e.g., potential noise sources) associated with a typical drilling rig.

The noise generated by the temporary gas compressor, which will be located a Well Site S-2, should be even less than the noise generated by drilling operations, and consequently, the noise of the temporary compressor will probably not be audible at the nearby NSAs.

6.0 NOISE ASSESSMENT (STATION CONSTRUCTION ACTIVITIES)

The noise impact analysis of the construction-related activities at the site of the Station considers the noise produced by any significant noise sources associated with the primary construction equipment that could impact the sound contribution at the nearby NSAs. The predicted sound contribution of construction equipment/activities was performed only for the closest NSA. Construction of the Station will consist of earth work (e.g., site grading, clearing & grubbing) and construction of the site buildings, and it is assumed that the highest level of construction noise would occur during site earth work (i.e., time frame when the largest amount of construction equipment would operate).

Table D (p. 14) shows the calculation of the estimated maximum A-wt. sound level at the closest NSA contributed by the construction activities at the Station for standard day propagating conditions. The analysis indicates that the maximum A-wt. noise level of construction activities at the closest NSA would be equal to or less than **34.0 dBA** (i.e., L_{den} of **41.0 dBA**). A description of the analysis methodology and source of sound data for the analysis of construction noise are provided in **Appendix C** (p. 18).

7.0 NOISE CONTROL MEASURES AND EQUIPMENT NOISE SPECIFICATIONS

The following section provides recommended noise control measures and noise specifications for Station equipment and auxiliary components along with other assumptions that may affect the noise generated by the Station equipment.

7.1 Building for the Station Engines-Compressors

Noise control measures will be applied to the building that encloses the engines-compressors rather than to the equipment themselves. The following describes specific requirements and other items related to the components of the building and associated air ventilation system.

- As a minimum, walls/roof of the building should be constructed with exterior steel of 22 gauge and an interior layer of 4-inch thick unfaced mineral wool (e.g., 6.0-8.0 pcf uniform density) covered with 26-gauge perforated liner.

- No louvers should be installed in the building walls, and a minimum number of skylights could be installed in the building roof to provide natural light.

- It is assumed that the building forced-air ventilation system will employ wall-mounted and/or rooftop air-supply fans and building exhaust air would be vented through roof openings (e.g., via a gravity-type roof ridge vent and/or via rooftop exhaust fans). The noise associated with each fan associated with the ventilation system should not exceed **60 dBA** at 50 feet.

7.2 Station Engine Exhaust System

The exhaust system for each engine should include a muffler system that provides the following dynamic sound insertion loss (DIL) values at the rated operating conditions (i.e., DIL values if a single muffler system is employed):

DIL Values in dB per Octave-Band Center Freq. (Hz) for Exhaust Muffler System

31.5	63	125	250	500	1000	2000	4000	8000
18 dB	22 dB	30 dB	35 dB	38 dB	38 dB	35 dB	30 dB	20 dB

7.3 Station Aboveground Gas Piping and Components

Valves and aboveground gas piping should not have to be covered with any type of acoustical insulation and/or acoustical covering/material to meet the noise criteria. It is recommended that the aboveground outdoor discharge and suction piping should be inserted underground soon after exiting the Compressor Building.

7.4 Engine Air Intake System

It is recommended that the air intake system of each engine should include a CAT "heavy-duty" air filter/cleaner system (i.e., type of air filter system with a "pre-cleaner"). This "heavy-duty" type of air filter system provides significant reduction the engine air intake noise although the station noise requirement could probably be achieved if a "standard" CAT filter is employed.

7.5 Utility/Gas Cooler

The utility/gas cooler associated with each compressor unit should not exceed **68 dBA** at **50 feet** from the cooler perimeter with all fans/motors operating at the maximum tip speeds (i.e., equivalent to a PWL of approximately **100 dBA**).

7.6 Station Pressure Reduction System

The pressure regulator valve(s) employed for the Pressure Reduction System should be capable of meeting a sound level requirement of **95 dBA** during the expected maximum design pressure drop and gas flow across the valve (i.e., estimated sound level at 3 feet from piping, immediately downstream of the valve).

7.7 Station Blowdown Silencer

The unit blowdown silencer should attenuate the unsilenced blowdown noise to a noise level equal to or less than **70 dBA** at 300 feet from the outlet of the silencer, which includes the noise radiated from the shell of the silencer during the blowdown event.

7.8 Gas Heaters of the Dehy. Regen. Units

As a minimum, each heater associated with the Dehydration Regeneration Skids should be designed to meet an A-wt. sound level of **70 dBA** at a distance of **50 feet** from the heater perimeter at the rated maximum operating conditions. This sound requirement includes the noise radiated from the burner and stack opening(s) for each heater, if operated at maximum rated conditions.

8.0 SUMMARY AND FINAL COMMENT

The following **Table 3** summarizes the estimated sound level attributable to the Station associated with the facility at the closest noise-sensitive areas (NSAs), such as a residence, school, hospital or park, along with the estimated total sound contribution of the Station at the closest NSAs (i.e., sound level of the compressor units at full load plus the estimated ambient sound level). The results presented in this table are defined as the "Noise Quality Analysis" for the facility.

Closest NSA and Direction of NSA from the Site Center (i.e., Compressor Bldg.)	Distance of NSA to the Site Center (i.e., Compressor Building)	Est'd Ambient Lden (dBA)	Est'd Lden of the Station (dBA)	Calc'd Station Lden + Ambient Lden (dBA)	Potential Increase above Ambient
Residence (SE)	4,200 feet	45.0	41.0	46.5	1.5 dB

Table 3: Noise Quality Analysis for the Station associated with the Kirby Hill Gas Storage Facility

The noise impact analysis indicates that if the recommended and/or planned noise control measures are successfully employed, the noise attributable to the Station associated with the proposed **Kirby Hill Gas Storage Facility** during full load operation will be lower than **50 dBA** CNEL (i.e., L_{den}) at the nearby NSAs (i.e., residences) surrounding the site, which is considered the noise policy (noise criterion) for the facility per the "Solano County General Plan".

The noise assessment also indicates that the noise generated by temporary and/or intermittent activities at the site (i.e., well drilling operations, Station construction activities, Station gas blowdown or temporary gas compressor) should be lower than the noise guideline (i.e., criterion) of **50 dBA** (L_{den}) at the nearby NSAs. Consequently, the noise of the Station and/or these temporary/intermittent activities for the proposed Kirby Hill Gas Storage Facility should have minimum noise impact on the surrounding environment.

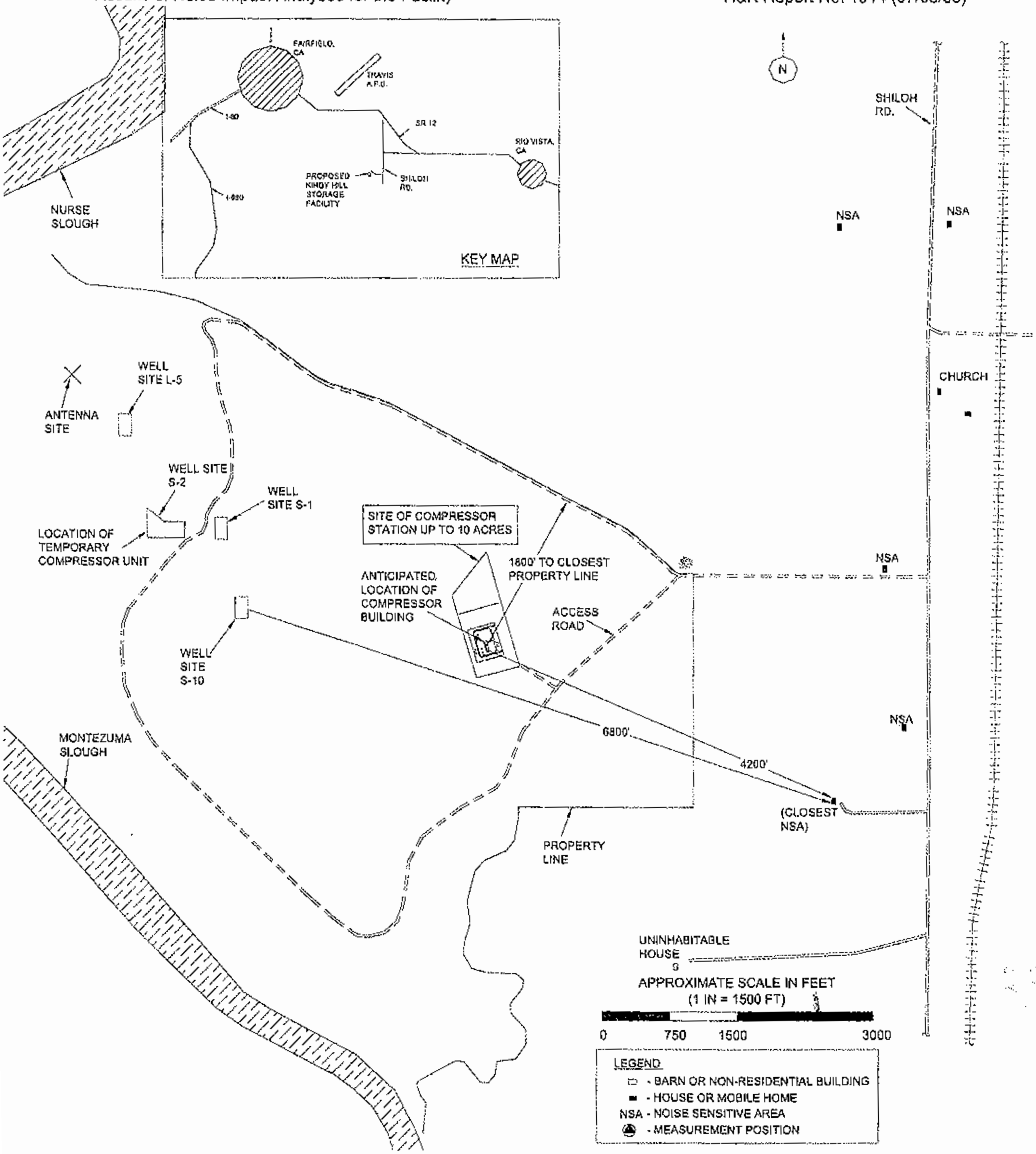


Figure 1: Kirby Hill Gas Storage Facility: Area/Site Layout Showing the Location of the Nearby NSAs, Location of the Station, Planned Storage Well Sites and other Areas of Interest.

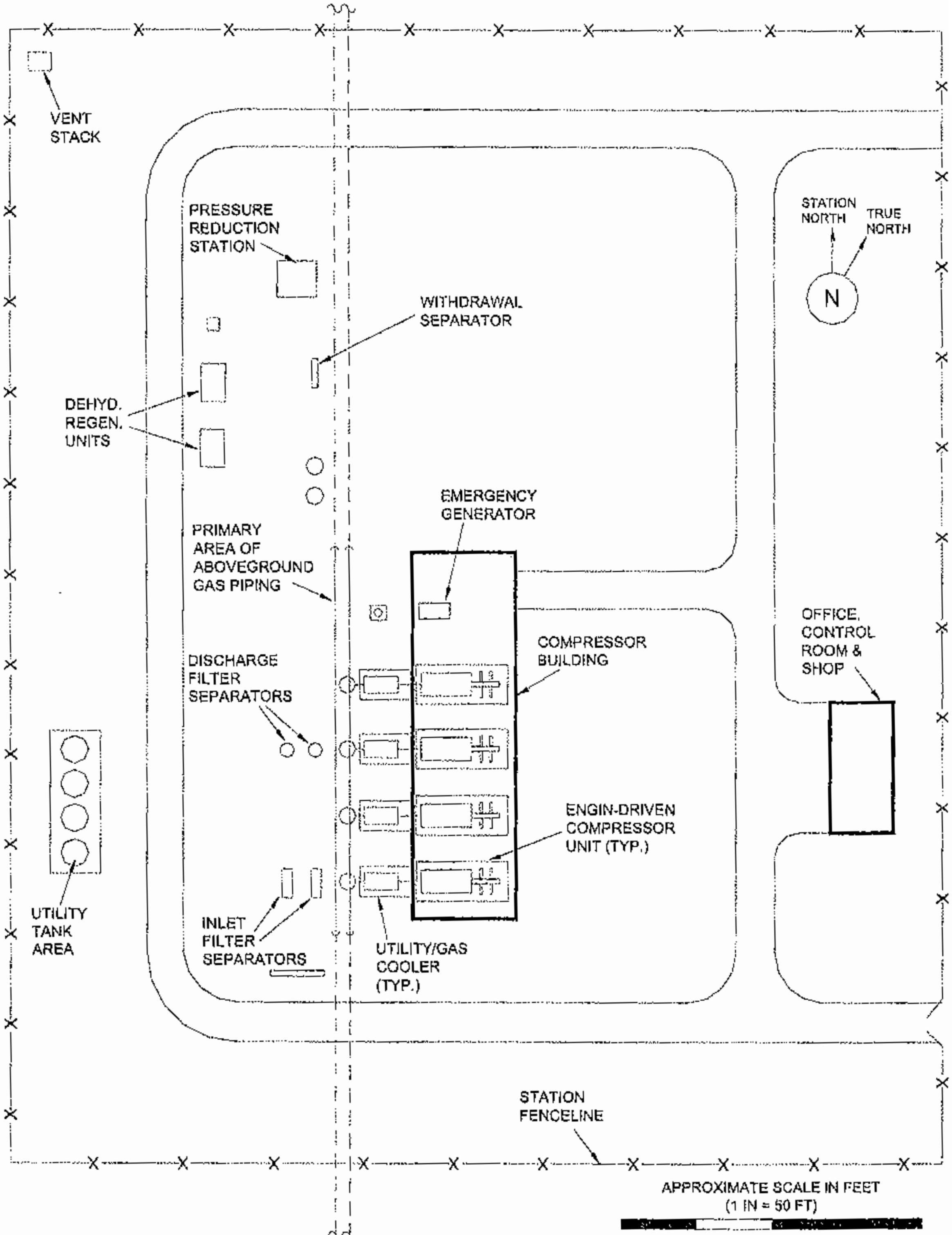


Figure 2: Kirby Hill Gas Storage Facility: Conceptual Layout of Buildings and Equipment associated the Compressor Station for the Facility.

Source No. & Dist (Ft)	SOURCE PWL & ESTIMATED SOUND LEVEL CONTRIBUTIONS AT SPECIFIED DISTANCE	PWL or SPL in dB Per Octave-Band Center Frequency (Hz)									A-Wt. Level	
		31.5	63	125	250	500	1000	2000	4000	8000		
1)	PWL of Engines/Compressors Inside Building	120	120	124	124	120	119	118	116	112	125	
	Attenuation of the Building	-6	-8	-12	-16	-22	-28	-32	-35	-38		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-3	-4	-5	-6	-8	-8		
4200	Hemispherical Radiation	-70	-70	-70	-70	-70	-70	-70	-70	-70		
4200	Atm. Absorption (30% R.H., 60 deg F)	0	0	-1	-2	-3	-6	-13	-32	-58		
4200	Source Sound Level Contribution	43	40	39	33	21	10	0	0	0	20	
2)	PWL of Unsilenced Engine Exhaust (4 Units)	128	134	140	136	132	132	130	118	110	137	
	Atten. of Noise Control (Muffler for each Engine)	-18	-20	-25	-30	-35	-35	-30	-25	-20		
	Misc. Atten. (Shielding and/or Land Contour)	0	0	0	0	0	0	0	0	0		
4200	Hemispherical Radiation	-70	-70	-70	-70	-70	-70	-70	-70	-70		
4200	Atm. Absorption (30% R.H., 60 deg F)	0	0	-1	-2	-3	-6	-13	-32	-58		
4200	Source Sound Level Contribution	39	43	44	34	24	21	17	0	0	31	
3)	PWL of Engine Air Intake with Filter (4 Units)	80	78	82	85	92	95	110	105	95	112	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-4	-6	-8	-9	-10	-10		
4200	Hemispherical Radiation	-70	-70	-70	-70	-70	-70	-70	-70	-70		
4200	Atm. Absorption (30% R.H., 60 deg F)	0	0	-1	-2	-3	-6	-13	-32	-58		
4200	Source Sound Level Contribution	9	6	9	9	13	11	18	0	0	20	
4)	PWL of Aboveground Gas Piping (Unlagged)	108	108	106	102	100	100	98	98	95	106	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-4	-6	-8	-9	-10	-10		
4200	Hemispherical Radiation	-70	-70	-70	-70	-70	-70	-70	-70	-70		
4200	Atm. Absorption (30% R.H., 60 deg F)	0	0	-1	-2	-3	-6	-13	-32	-58		
4200	Source Sound Level Contribution	37	36	33	26	21	16	6	0	0	23	
5)	PWL of Engine Utility/Gas Cooler (4 Units)	115	112	110	105	102	100	98	95	92	106	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-4	-6	-8	-9	-10	-10		
4200	Hemispherical Radiation	-70	-70	-70	-70	-70	-70	-70	-70	-70		
4200	Atm. Absorption (30% R.H., 60 deg F)	0	0	-1	-2	-3	-6	-13	-32	-58		
4200	Source Sound Level Contribution	44	40	37	29	23	16	6	0	0	26	
6)	PWL of Dehy. Regen. Units/Skid (2 Units)	105	110	102	95	92	90	92	88	82	98	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-3	-4	-5	-6	-8	-8		
4200	Hemispherical Radiation	-70	-70	-70	-70	-70	-70	-70	-70	-70		
4200	Atm. Absorption (30% R.H., 60 deg F)	0	0	-1	-2	-3	-6	-13	-32	-58		Calc'd
4200	Source Sound Level Contribution	34	38	29	20	15	9	3	0	0	19	Lden
Est'd Total Sound Contribution of Station at the Closest NSA		**48**	**47**	**46**	**38**	**29**	**23**	**21**	**0**	**0**	**34.3**	**41.0**
Est'd Ambient Noise Level at the Closest NSA; Note (1)		60	52	45	41	35	30	28	25	22	**38.3**	**45.0**
Est'd Sound Level of Station + Ambient Noise Level		**60**	**53**	**49**	**43**	**36**	**31**	**29**	**25**	**22**	**39.8**	**46.5**
					Potential increase in sound level (in dB):						1.5	

Table A: Kirby Hill Gas Storage Facility: Est'd Sound Contribution at the Closest NSA, located approx. 4,200 feet Southeast of the Compressor Building, assuming Operation of 4 Engine-Driven Compressor Units. Also, the Est'd Total Sound Level (i.e., Sound Contribution of Facility plus Est'd Ambient Noise).

Note (1): Est'd (typical) ambient sound level at the residences located around the proposed facility.

File: \Proj\Excel\Lodi Holdings-JN3711\Analysis of Kirby Hill Gas Storage Station.xls

NOTE: Muffler DIL & Equipment PWL values on this spreadsheet should <u>not</u> be used as the specified values. Refer to "Noise Control Measures" section in report or other company specifications for actual specified values.

Source No. & Dist (Ft)	SOURCE PWL & ESTIMATED SOUND LEVEL CONTRIBUTIONS AT SPECIFIED DISTANCE	PWL or SPL in dB Per Octave-Band Center Frequency (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
1)	PWL of Engines/Compressors inside Building	120	120	124	124	120	119	118	116	112	125	
	Attenuation of the Building	-6	-8	-12	-16	-22	-28	-32	-35	-38		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-3	-4	-5	-6	-8	-8		
1800	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
1800	Atm. Absorption (30% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-14	-25		
1800	Source Sound Level Contribution	51	48	47	41	30	20	12	0	0	36	
2)	PWL of Unsilenced Engine Exhaust (4 Units)	128	134	140	136	132	132	130	118	110	137	
	Atten. of Noise Control (Muffler for each Engine)	-18	-20	-25	-30	-35	-35	-30	-25	-20		
	Misc. Atten. (Shielding and/or Land Contour)	0	0	0	0	0	0	0	0	0		
1800	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
1800	Atm. Absorption (30% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-14	-25		
1800	Source Sound Level Contribution	47	51	52	42	33	31	32	17	3	40	
3)	PWL of Engine Air Intake with Filter (4 Units)	80	78	82	85	92	95	110	105	95	112	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-4	-6	-8	-9	-10	-10		
1800	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
1800	Atm. Absorption (30% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-14	-25		
1800	Source Sound Level Contribution	17	14	17	17	22	21	33	19	0	34	
4)	PWL of Aboveground Gas Piping (Unlagged)	108	106	106	102	100	100	98	98	95	106	
	Atten. of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-4	-6	-8	-9	-10	-10		
1800	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
1000	Atm. Absorption (30% R.H., 60 deg F)	0	0	0	-2	-1	-3	-5	-14	-25		
1000	Source Sound Level Contribution	45	44	41	33	30	26	21	12	0	32	
5)	PWL of Engine Utility/Gas Cooler (4 Units)	115	112	110	105	102	100	98	95	92	106	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-4	-6	-8	-9	-10	-10		
1800	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
1800	Atm. Absorption (30% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-14	-25		
1800	Source Sound Level Contribution	52	48	45	37	32	26	21	9	0	35	
6)	PWL of Dehy. Regen. Units/Skid (2 Units)	105	110	102	95	92	90	92	86	82	98	
	NR of Noise Control	0	0	0	0	0	0	0	0	0		
	Misc. Atten. (Shielding and/or Land Contour)	0	-1	-2	-3	-4	-5	-6	-8	-8		
1800	Hemispherical Radiation	-63	-63	-63	-63	-63	-63	-63	-63	-63		
1800	Atm. Absorption (30% R.H., 60 deg F)	0	0	0	-1	-1	-3	-5	-14	-25		Calc'd
1800	Source Sound Level Contribution	42	46	37	28	24	19	18	4	0	28	Lden
Est'd Contribution of Facility at the North Property Line		**56**	**55**	**54**	**46**	**38**	**34**	**36**	**21**	**3**	**43.5**	**50.2**

Table B: Kirby Hill Gas Storage Facility: Est'd Sound Contribution of the Facility at the Closest Property Line of the Facility (i.e., North Property Line, located approx. 1,800 Feet from the Compr. Bldg.)

NOTE: Muffler DIL & Equipment PWL values on this spreadsheet should <u>not</u> be used as the specified values. Refer to "Noise Control Measures" section in report or other company specifications for actual specified values.

Dist (Ft) or Calculation	SOURCE PWL & EST'D SOURCE SOUND CONTRIBUTIONS AT SPECIFIED DISTANCE	SPL or PWL in dB Per Octave-Band Center Freq. (Hz) 31.5	63	125	250	500	1000	2000	4000	8000	A-Wt. Level	
	PWL of Drill Rig during Drilling Operation: Note (1)	125	122	118	108	110	112	112	105	100	117	
	Misc. Atten. (e.g., Shielding and/or Land Contour)	-2	-4	-5	-6	-8	-12	-15	-15	-15		
6800	Hemispherical Radiation	-74	-74	-74	-74	-74	-74	-74	-74	-74		Calc'd
6800	Atm. Absorption (30% R.H., 60 deg F)	-1	-1	-3	-5	-10	-17	-41	-68	-102		Lden
Est'd Sound Contribution of a Well Drilling Operation		**48**	**43**	**35**	**23**	**18**	**8**	**0**	**0**	**0**	**23.3**	**30.0**
Meas'd Ambient Noise Level at Closest NSA: Note (2)		60	52	45	41	35	30	28	25	22	**38.3**	**45.0**
Est'd Sound Level of Drill Operation + Ambient Noise Level		**60**	**53**	**45**	**41**	**35**	**30**	**28**	**25**	**22**	**38.5**	**45.2**
				Potential increase in sound level (in dB)							0.2	

Table C: Kirby Hill Gas Storage Facility: Est'd Sound Contribution of a Typical Drill Rig Operation at the Closest NSA (i.e., Residence located approximately 6,800 Feet ESE from the Well Site).

Note (1): Est'd maximum unweighted octave band sound power levels (PWLs) and A-wt. PWL of a well drilling operation based on field sound tests by H&K on a similar type of drill rig expected to be utilized at these well drilling sites.

Note (2): Est'd (typical) ambient sound level at the residences located around the proposed facility.

Type of Equipment	Equipment Power Rating or Capacity	Est'd Number Required	Est'd A-Wt. Sound Level at 50 Ft. *	Resulting A-Wt. PWL of Single Piece of Equip.	Assumed Max. No. Operating at One Time	Est'd Max. A-Wt. PWL or Sound Level of Equip.	
Diesel Generator	250 to 400 HP	1 to 2	81 dBA	113 dBA	1	113	
Bulldozer	250 to 700 HP	1 to 2	85 dBA	117 dBA	1	117	
Grader	450 to 600 HP	1 to 2	85 dBA	117 dBA	1	117	
Backhoe	130 to 210 HP	1 to 2	80 dBA	112 dBA	1	112	
Front End Loader	150 to 250 HP	1 to 2	85 dBA	117 dBA	1	117	
Truck Loaded	40 Ton	As needed	88 dBA	120 dBA	2	123	
	Est'd Total Maximum A-Wt. PWL (dBA) of All Construction Site Equipment					126	
	Atten. (in dB) due to Hemispherical Sound Propagation at Closest NSA (4,200 Ft.)					-70	Calc'd
	Est'd Atten. (in dB) due to Air Absorption (30% R. H., 60 deg F.) & Land Contour					-22	Lden **
	Est'd Sound Level (dBA) at the Closest NSA Considering a Maximum Number of Equipment Operating at One Time					34 dBA	41 dBA

Table D: **Kirby Hills Gas Storage Facility: Est'd Sound Contribution at the Closest NSA (i.e., approx. 4,200 Ft. SE of Site) during Construction Activity at the proposed Compressor Station. Sound Contribution assumes Operation of the "Loudest" Equipment during a Time Frame with the Largest Amount of Equipment Operating (e.g., Site Grading & Clearing/Grubbing)**

* Note: Noise Emission Levels of construction equipment based on an EPA Report (meas'd sound data for a railroad construction project) and measured sound data in the field by H&K or other published sound data.

** Note: Calc'd CNEL via the est'd sound level assumes evening or nighttime drilling activities, which may not be necessary for some of the well sites.

APPENDIX A: DESCRIPTION OF THE ANALYSIS METHODOLOGY AND THE SOURCE OF SOUND DATA FOR THE COMPRESSOR STATION

ANALYSIS METHODOLOGY (COMPRESSOR STATION)

In general, the predicted sound level contributed at the closest NSA by the equipment associated with the compressor station was calculated as a function of frequency from estimated octave-band sound power levels (PWLs) for each significant sound source. The following summarizes the analysis procedure:

- Initially, unweighted octave-band PWLs of the significant noise sources associated with the compressor station were determined from actual sound level measurements performed by H&K at similar type of gas compressor facilities.

- Then, expected noise reduction (NR) or attenuation in dB per octave-band frequency due to any noise control measures, sound propagation (hemispherical radiation), atmospheric sound absorption and/or sound shielding were subtracted from the unweighted octave-band PWLs to obtain the unweighted octave-band sound pressure levels (SPLs) of each noise source.

  Since sound shielding by buildings can influence the sound level contributed at the NSAs, we also included the sound shielding due to buildings, if appropriate. The sound attenuation effect due to vegetation or land contour were typically not considered in the analyses since there appears to be limited amount of vegetation (e.g., trees) or hills between the site and the nearby NSAs.

- Finally, the resulting estimated octave-band SPLs for all noise sources associated with the compressor station (with noise control and other sound attenuation effects) were logarithmically summed, and the total octave-band SPLs were corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the station at the closest NSA. The predicted unweighted octave-band SPLs and the A-wt. sound level of the station at the closest NSA was utilized to estimate the station noise contribution at the other nearby NSAs that are more distant that the closest NSA.

ANALYSIS METHODOLOGY (NOISE ATTRIBUTABLE TO A BLOWDOWN EVENT)

The noise resulting from a blowdown event was estimated by using the "inverse-square law" and included some attenuation due to atmospheric sound absorption. Consequently, the estimated noise of a blowdown event at the receptor (closest NSA) was calculated as follows:

SPL (receptor)= (Blowdown SPL at R1) – 20*log(R2/R1)– Atm. Atten.= **70 dBA**– 20*log (4200/300) –12 dB = **35 dBA**

Where: R1 = Distance of Specified Blowdown Noise Level Requirement (i.e., 300 ft.)
R2 = Distance of the Receptor from the Blowdown Silencer (4,200 ft.)

SOURCE OF SOUND DATA (COMPRESSOR STATION)

The following describes the source of sound data used for estimating the source sound levels and/or the source PWLs for the compressor station equipment (e.g., engines/compressors, associated equipment and components) and gas blowdown event.

(1) Engine exhaust PWL were calculated from sound data measured in the field by H&K on a similar type of engines to be utilized at this facility. The DIL values for the exhaust muffler used in the analysis are generally lower than the recommended values in order that the noise design analysis incorporates an acoustical "margin of safety."

(2) The estimated PWL of equipment inside the building (i.e., engines & compressors and/or other equipment inside the building) was calculated from sound data measured by H&K on similar compressor installations.

(3) The noise radiated from aboveground gas piping is primarily a result the noise generated by the gas compressors. Measurement of both near field and far field sound data on gas piping is presumed to be an accurate method of quantifying the noise associated with the gas piping, and consequently, the estimated PWL values for gas piping used in the analysis were determined from near field and far field sound data by H&K on gas piping configurations similar to the anticipated gas piping design of the proposed compressor units.

(4) The estimated PWL for jacket-water (JW) coolers and gas coolers were designated to meet the design noise goal. Note that the estimated PWL for the JW coolers utilized in the acoustical analysis assumes some noise associated with jacket-water piping.

The noise level for the coolers used in the acoustical analysis is generally higher than the sound level requirement in order that the noise design analysis incorporates an acoustical "margin of safety." In addition, there can be other noise associated with the coolers that is not directly related to the operation of the cooler fans (e.g., noise of the JW piping and/or compressor noise radiated from the tubes of the gas coolers).

(5) The estimated PWL values for the engine air intake were calculated from measured sound data in the field tests by H&K on similar engine that will be employed.

The estimated A-wt. sound level of a unit blowdown event, assuming that the blowdown vent includes a silencer that meets the specified noise level, was calculated from sound data measured by H&K on similar type of blowdown operations.

APPENDIX B: ANALYSIS METHODOLOGY AND SOURCE OF SOUND DATA (DRILLING OPERATIONS AT THE SITE OF A GAS STORAGE WELL)

In general, the predicted sound level contributed by drilling operations at a gas storage well site was calculated as a function of frequency from estimated unweighted octave-band sound power levels (PWLs) and A-wt. PWL of the similar type of well drilling operations. The following summarizes the acoustical analysis procedure:

- Initially, unweighted octave-band PWLs of the specific type of drilling operations were determined from actual sound level measurements on a similar type of drilling operations/equipment expected to be utilized at this facility.

- Then, expected attenuation in dB per octave-band frequency due to sound propagation (hemispherical radiation), atmospheric sound absorption and sound shielding (e.g., attenuation due to forest/trees and land contour, if appropriate) were subtracted from the unweighted octave-band PWLs to obtain the unweighted octave-band sound pressure levels (SPLs) of the drilling operations.

- Finally, the resulting estimated total unweighted octave-band SPLs for the drilling operations, including sound attenuation effects, were logarithmically summed and corrected for A-weighting to provide the estimated overall A-wt. sound level contributed by the drilling operations at the specified distance(s).

The estimated sound level contribution of the drilling operations/rig is based primarily on measured sound data by H&K at drilling rigs with similar type of equipment expected to be used at the site. For reference, the following describes the primary equipment and other items (e.g., potential noise sources) associated with a typical drilling rig.

- Drawworks: engine-driven hydraulic power unit (e.g., 300 HP CAT 3406 engine)
- Derrick: 118' x 365,000 lb. capacity
- Triplex centrifugal mud pumps (e.g., 1,000 HP CAT engine and/or 300-500 HP CAT engine)
- Engine-driven electric generator sets (e.g., CAT 300 HP & 430 HP gen sets)
- Air compressors (i.e., Ingersol Rand 1250/350, driven by 500 HP CAT 3412 engine)
- Booster pumps (single stage pump driven by a 200-300 HP CAT 3406E engine)
- Mud mixing/cleaning equipment (e.g., 50 HP centrifugal pumps) and water pump
- Fluid systems shale shakers (associated with the mud mixing/cleaning equipment)
- Crane(s), dozer (CAT D7G), loader(s), backhoe and/or forklift
- Engine-driven light plants (i.e., used for nighttime operation)

APPENDIX C: ANALYSIS METHODOLOGY AND SOURCE OF SOUND DATA (CONTRUCTION ACTIVITIES AT THE STATION)

The predicted sound level contributed by the construction-related activity (i.e., construction of the compressor station) was calculated from estimated A-wt. PWL of noise sources (i.e., construction equipment noise) that typically operate during the specific construction activity. The following summarizes the acoustical analysis procedure utilized for the construction activity at the site:

- Initially, the A-wt. PWL of noise sources associated with the construction activity were determined from published sound data and/or actual sound level measurements by H&K, and the total PWL of each noise source (equipment) was based on the anticipated number of equipment operating.

- Next, the A-wt. PWL of all noise sources were logarithmically summed to provide the overall estimated A-wt. PWL contributed by the construction activity. It is assumed that the highest level of construction noise would occur during site earth work (i.e., time frame when the largest amount of construction equipment would operate).

- Finally, the estimated A-wt. sound level of the construction activity at the specific distance was determined by compensating for sound attenuation due to propagation (hemispherical radiation) and atmospheric sound absorption. The sound attenuation effect of vegetation or land contour was also considered in the analysis, if appropriate.

  The noise emission levels of construction equipment were based on an EPA Report (i.e., measured sound data from railroad construction equipment taken during the Northeast Corridor Improvement Project) that was summarized in a 1995 Report to the Federal Transit Administration as prepared by Harris Miller Miller & Hanson Inc. In addition, construction equipment noise emission levels listed in a recent publication in the Journal of Noise Control Engineering and sound data measured by H&K was utilized. The following list some references used by H&K to determine construction equipment noise emission levels:

(1) "Transit Noise and Vibration Impact Assessment", dated April 1995, prepared by Harris Miller Miller & Hanson Inc. for the Office of Planning of the Federal Transit Administration.

(2) Erich Thalheimer, "Construction Noise Control Program and Mitigation Strategy at the Central Artery/Tunnel Project", J of Noise Control Eng., 48 (5), pp. 157-165 (2000 Sep-Oct).

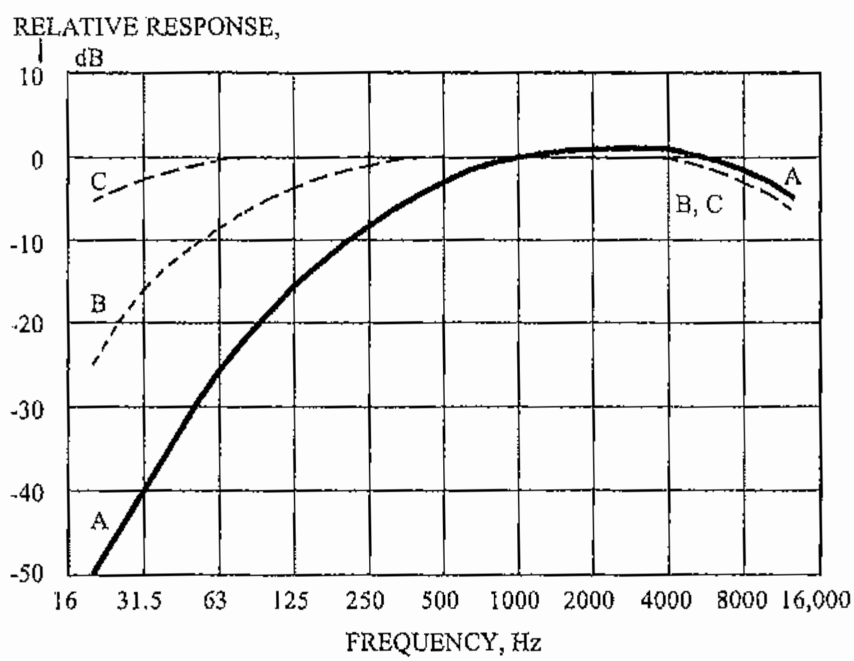
(3) "Noise Control for Building Manufacturing Plant Equipment and Products", course handout notes for a noise course given each year by Hoover & Keith Inc.

APPENDIX D: SUMMARY OF TYPICAL METRICS FOR REGULATION ENVIRONMENT NOISE AND ACOUSTICAL TERMINOLOGY

(1) Decibel (dB): A unit for expressing the relative power level difference between acoustical or electrical signals. It is ten times the common logarithm of the ratio of two related quantities that are proportional to power. When adding dB or dBA values, the values must be added logarithmically. For example, the logarithmic addition of **35 dB** plus **35 dB** is **38 dB**.

(2) A-Weighted Sound Level (dBA): The A-wt. sound level is a single-figure sound rating, expressed in decibels (Re 20 μPa), which correlates to the human perception of the loudness of sound. The dBA level is commonly used to measure industrial and environmental noise since it is easy to measure and provides a reasonable indication of the human annoyance value of the noise. The dBA measurement is not a good descriptor of a noise consisting of strong low-frequency components or for a noise with tonal components. The A-weighted curve approximates the response of the average ear at sound levels of 20 to 50 decibels. The following are the relative response of A-weighted filter per octave band frequency, and a graph/curve is provided that shows a graphical representation of the A-wt. filter response per frequency (in Hz).

31.5 Hz	63 Hz	125 Hz	250 Hz	500 Hz	1,000 Hz	2,000 Hz	4,000 Hz	8,000 Hz	16,000 Hz
-39.4 dB	-26.2 dB	-16.1 dB	-8.6 dB	-3.2 dB	0 dB	+1.2 dB	+1.0 dB	-1.1 dB	-6.6 dB



(3) Background or Ambient Noise: The total noise produced by all other sources of a given environment in the vicinity of a specific source of interest, and includes any Residual Noise.

(4) Human Perception of Change in Sound Level

- A **3 dB** change of sound level is barely perceivable by the human ear
- A **5 or 6 dB** change of sound level is noticeable
- If sound level increases by **10 dB**, it appears as if the sound intensity has doubled.

(5) Sound Pressure Level (L_p or SPL): Ten times the common logarithm to the base 10 of the ratio of the mean square sound pressure to the square of a reference pressure. Therefore, the sound pressure level is equal to 20 times the common logarithm of the ratio of the sound pressure to a reference pressure (20 micropascals or 0.0002 microbar).

(6) Octave Band Sound Pressure Level (SPL): Sound is typically measured in frequency ranges (e.g., high-pitched sound, low-pitched sound, etc.) that provides more meaningful sound data regarding the sound character of the noise. When measuring two noise sources for comparison, it is better to measure the spectrum of each noise, such as in octave band SPL frequency ranges. Then, the relative loudness of two sounds can be compared frequency range by frequency range. As an illustration, 2 noise sources can have the same dBA rating and yet sound completely different. For example, a high-pitched sound at a frequency of 2000 Hz could have the same dBA rating as a much louder low-frequency sound at 50 Hz.

(7) Daytime Sound Level (L_d) & Nighttime Sound Level (L_n): L_d is the equivalent A-weighted sound level, in decibels, for a 15 hour time period, between 07:00 to 22:00 Hours (7:00 a.m. to 10:00 p.m.). L_n is the equivalent A-weighted sound level, in decibels, for a 9 hour time period, between 22:00 to 07:00 Hours (10:00 p.m. to 7:00 a.m.).

(8) Equivalent Sound Level (L_{eq}): The equivalent sound level (L_{eq}) can be considered an average sound level measured during a period of time, including any fluctuating sound levels during that period. In this report, the L_{eq} is equal to the level of a steady (in time) A-weighted sound level that would be equivalent to the sampled A-weighted sound level on an energy basis for a specified measurement interval. The concept of the measuring L_{eq} has been used broadly to relate individual and community reaction to aircraft and other environmental noises.

(9) Day-Night Sound Level (L_{dn}): The L_{dn} is an energy average of the measured daytime L_{eq} (L_d) and the measured nighttime L_{eq} (L_n) plus **10 dB**. The **10-dB** adjustment to the L_n is intended to compensate for nighttime sensitivity. As such, the L_{dn} is not a true measure of the sound level but represents a skewed average that correlates generally with past sound surveys which attempted to relate environmental sound levels with physiological reaction and physiological effects. For a steady sound source that operates continuously over a 24-hour period and controls the environmental sound level, an L_{dn} is approximately **6.4 dB** above the measured L_{eq}. If both the L_d and L_n are measured, then the L_{dn} is calculated using the following formula:

$$L_{dn} = 10\log_{10}\left(\frac{15}{24}10^{L_d/10} + \frac{9}{24}10^{(L_n+10)/10}\right)$$

(10) Community Noise Equivalent Level (CNEL or L_{den}): A metric similar to the L_{dn}, except that a **5 dB** adjustment is added to the equivalent continuous sound exposure level for evening hours (i.e., L_e) between 19:00 to 22:00 hours (7:00 p.m. to 10:00 p.m.) in addition to the **10 dB** nighttime adjustment used in the L_{dn}. For a steady sound source that operates continuously over a 24-hour period and controls the environmental sound level, the CNEL is approximately **6.7 dB** above the measured L_{eq}. If the L_d, L_e (i.e., evening L_{eq}) and L_n are measured, then the CNEL is calculated using the following formula:

$$L_{den}(CNEL) = 10\log_{10}\left(\frac{12}{24}10^{L_d/10} + \frac{3}{24}10^{(L_e+5)/10} + \frac{9}{24}10^{(L_n+10)/10}\right)$$

(11) L-Percent Sound Levels: The L percent levels (e.g., L_{50}, L_{90} & L_{10}) refer to the A-weighted sound levels that are exceeded for 90, 50 and 10 percent of the time, respectively, during a sound measurement period. For example, the 50-percentile exceeded sound level is designated to as L_{50} and is sometimes described as the median sound level. The range between the L_{10} and L_{90} values usually provides a good indication of the variability of the sound levels during the period of measurement.

(12) Sound Level Meter (SLM): An instrument used to measure sound pressure level, sound level, octave-band SPL, or peak sound pressure level, separately or in any combinations thereof. The measured weighted SPL (i.e., A-Wt. Sound Level or dBA) is obtained by the use of a SLM having a standard frequency-filter for attenuating part of the sound spectrum.

(13) Sound Power Level (L_W or PWL): Ten times the common logarithm of the ratio of the total acoustic power radiated by a sound source to a reference power. A reference power of a picowatt or 10^{-12} watt is conventionally used.

(14) Tone: A tone is a sound sensation-having pitch, which is a listener's perception of the frequency (for example, the higher the frequency, the higher the pitch). For a measured sound spectrum, a tone is represented as a "peak" in the spectrum curve. Noise that contains significant tones is considered a tonal type of noise.

(15) Broadband Noise: Noise comprised of a wide frequency range and not characterized by any tonal components.

End of Report