

NOISE STUDY

SAVAGE BAKKEN PETROLEUM HUB INTERCONNECT TRENTON, WILLIAMS COUNTY, NORTH DAKOTA

KLJ PROJECT NO. 1716218

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1 INTRODUCTION

1.1 Project Objectives

Savage Bakken Connector, Inc. (Savage) operates three 700-horsepower pumps inside an injection pump station near Trenton, Williams County, North Dakota. The injection pump station is located south of 42nd Street Northwest. It has 4-inch insulated walls, 6-inch insulated ceilings, and spray foam insulation on the underside. The pumps are generally operational for 5 to 6 hours per day, starting at 7:30 a.m. The duration in which they are operational is dependent upon demand.

Due to public concern regarding potential noise emanating from the injection pump station and in accordance with North Dakota Public Service Commission (PSC) Orders (Case No. PU-16-753), Savage requested that KLJ conduct a noise study to determine whether or not noise emanating from the injector pump station impacts the nearest noise sensitive receptor. KLJ determined that the nearest noise sensitive receptor to the injector pump station is a residence/farmstead, located at 4156 149th Avenue Northwest, approximately 0.5 miles southeast of the pump station. The PSC requested that the noise emanating from the injector pump station be below 55.0 A-weighted decibels (dBA), so as not to impact nearby noise sensitive receptors.

To determine noise levels at the residence/farmstead, KLJ conducted continuous 24-hour noise monitoring beginning at 6:00 p.m. on June 5, 2017, and ending at 6:00 p.m. on June 6, 2017. During the 24-hour noise monitoring session, the pumps were periodically operational from 10:00 a.m. to 2:00 p.m. and 4:30 p.m. to 6:30 p.m. on June 6, 2017.

1.2 Noise Environment

The injector pump station is located within a semi-rural, industrial area composed of industrial complexes, agricultural fields, undeveloped rangeland, very few residences/farmsteads, and paved and gravel roadways. Northeast of the injector pump station, there is a large railroad switchyard area that supports storage, loading, and unloading and two large oil and gas facilities that support storage, loading, and unloading.

ND-1804 runs adjacent to the east of the injector pump station, and a railroad line runs adjacent to the west, primarily parallel to ND-1804. A north-south directional, unpaved, gravel roadway (i.e., 149th Avenue Northwest) runs approximately 100 feet west from the nearest noise sensitive receptor (i.e., residence/farmstead previously discussed). Noise sources in the area include agricultural operations, large industrial trucks, medium-sized pickup trucks, small vehicles, and trains.



2 CHARACTERISTICS OF SOUND AND NOISE

2.1 Definition of Sound and Noise

Sound is vibrational disturbance capable of being detected by the ear. Sound can be intermittent or continuous, steady, or impulsive, and can involve any number of sources and frequencies. Human response to sound varies according to the source type, characteristics of the sound source, distance between source and receptor, receptor sensitivity, and time of day.

Sound is measured on a logarithmic decibel (dB) scale. Environmental noise is characterized dBA, which best replicate how sound is received by the human ear. Please refer to **Table 1, Common Indoor and Outdoor Sound Sources** for a summary of the estimated sound levels for common indoor and outdoor sounds.

Noise is unwanted sound. Noise is a subjective term, because sound levels can be perceived differently by different people.

The human ear can barely perceive a noise level change of 3 dBA, but can readily perceive a noise level change of 5 dBA. The human ear perceives a noise level change of 10 dBA as a doubling in noise.

2.2 Sound Propagation

Sound propagation, or how sound travels, is affected by terrain and the elevation of the receptor relative to the noise source. From level-ground, noise travels in a straight path between the source and receptor. Please refer to **Figure 1, Sound Propagation at Level-Ground**. Noise levels can be affected by breaking the line-of-sight between the receptor and the noise source, such as a noise source at a lower elevation with an elevated receptor or an elevated noise source with a receptor at a lower elevation. Please refer to **Figure 2, Sound Propagation at Depressed Source/Elevated Receptor** and **Figure 3, Sound Propagation at Elevated Source/Depressed Receptor**.



Table 1, Common Indoor and Outdoor Sound Sources

Sound Sources	Sound Level (dB)	Effect
Boom Cars	145	–
Jet Engines (near)	140	–
Shotgun Firing; Jet Engine (100 to 200 feet)	130	–
Rock Concerts	110-140	Threshold of pain begins around 125 dB
Discotheque/Boom Box; Thunderclap (near)	120	Threshold of sensation begins around 120 dB
Stereos (more than 100 watts)	110-125	
Symphony Orchestra; Chainsaw; Jackhammer	110	Regular exposure to sound over 100 dB longer than 1 minute risks permanent hearing loss
Snowmobile	105	
Jet Flyover (1,000 feet)	103	
Electric Furnace Area; Garbage Truck; Cement Mixer	100	No more than 15 minutes of unprotected exposure recommended for sounds between 90 and 100 dB
Farm Tractor	98	
Newspaper Press	97	
Subway; Motorcycle (25 feet)	88	Very annoying
Lawnmower; Food Blender	85-90	85 dB is the level at which hearing damage (8 hours) begins
Recreational Vehicles; Television	70-90	
Diesel Truck (40 miles per hour, 50 feet)	84	–
Average City Traffic; Garbage Disposal	80	Annoying; interferes with conversation; constant exposure may cause damage
Washing Machine	78	–
Dishwasher	75	–
Vacuum Cleaner; Hair Dryer	70	Intrusive; interferes with telephone conversation
Normal Conversation	50-65	Comfortable hearing levels are under 60 dB
Quiet Office	50-60	
Refrigerator Humming	40	–
Whisper; Broadcasting Studio	30	Very quiet
Rustling Leaves	20	Just Audible
Normal Breathing	10	–

Key: dB = decibels
Source: NIH 2010¹

¹ Common indoor and outdoor sound sources were derived from “*I Love What I Hear! Common Sounds*,” developed in 2010 by the National Institute on Deafness and Other Communication Disorders, US Department of Health and Human Services, National Institutes of Health.



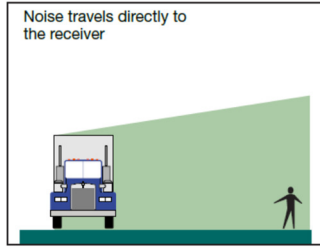


Figure 1, Sound Propagation at Level-Ground

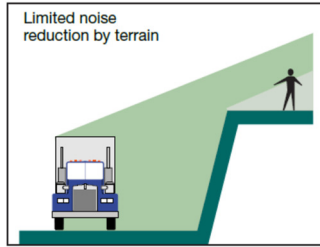


Figure 2, Sound Propagation at Depressed Source/Elevated Receptor

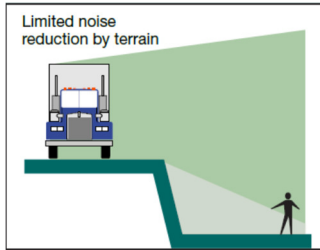


Figure 3, Sound Propagation at Elevated Source/Depressed Receptor



2.3 Noise Level Descriptors

The equivalent sound level (L_{eq}) is the preferred method to describe sound levels that vary over time, resulting in a single dB value that takes into account the total sound energy over a given time period. L_{eq} noise levels are logarithmic (dB) calculated values that cannot be added directly. A doubling of sound level results in a measured increase of 3 dB.

L_{eq} is a measure of total noise during a time period that places more emphasis on occasional high noise levels that accompany general background noise levels.

Either the total noise energy or the highest instantaneous noise level can describe short-term noise levels, such as those from a single truck passing by. The sound exposure level is a measure of total sound energy from an event and is useful in determining what the L_{eq} would be over a period in time when several noise events occur.

With L_n , “n” is the percent of time that a sound level is exceeded and is used to describe the range of sound levels recorded during the measurement period. For example, the L_{90} is the statistical noise level that is exceeded for 90 percent of the measurement period. It is generally considered to be representing the background or ambient level of a noise environment.

Sound varies in the environment and people will generally find a higher, but constant, sound level more tolerable than a quiet background level interrupted by higher sound level events. For example, steady traffic noise from a highway is normally less bothersome than occasional aircraft flyovers in an otherwise quiet area.



3 ANALYSIS AND METHODOLOGY

3.1 Field Noise Monitoring

KLJ conducted one continuous 24-hour field noise monitoring session at the residence/farmstead to determine existing noise levels throughout the day and night and noise levels when the pumps are operational. Noise levels were collected every minute of the 24-hour noise monitoring session.

The noise monitor was positioned on the western side of the tree line at the residence/farmstead, approximately 100 feet from 149th Avenue Northwest. The session began on June 5, 2017, at 6:00 p.m. The temperature was approximately 88 degrees Fahrenheit, with 32 percent humidity. Wind speeds were approximately 15 to 18 miles per hour (mph), with wind gusts up to 20 mph. The session ended on June 6, 2017, at 6:00 p.m. The temperature was approximately 58 degrees Fahrenheit, with 67 percent humidity. Wind speeds were approximately 5 to 6 mph, with wind gusts up to 7 mph.

During the monitoring session, the pumps were periodically operational from 10:00 a.m. to 2:00 p.m. and 4:30 p.m. to 6:30 p.m. on June 6, 2017. As the noise monitor was being set up and in the beginning of the session, dogs were barking nearby at the residence/farmstead. In addition, throughout the session, there were occasional vehicles traveling along 149th Avenue Northwest and ND-1804, as well as trains traveling along the railroad tracks.



4 RESULTS AND CONCLUSION

Results of the 24-hour field noise monitoring session are provided in **Appendix A, Session Results**. The results indicate that the existing noise environment at the noise sensitive receptor nearest to the injector pump station (i.e., residence/farmstead) is primarily influenced by vehicles traveling along 149th Avenue Northwest and ND-1804, as well as trains traveling along the railroad tracks near the residence/farmstead. Data collected during the session show sporadic, random peaks in noise (up to 64.7 dBA in some instances) that last on average from 1 to 5 minutes, which suggests vehicles and/or trains passing near the residence/farmstead.

From 10:00 a.m. to 2:00 p.m. and 4:30 to 6:00 p.m. on June 6, 2017, when the pumps were operational, the L_{90} (i.e., ambient noise level) ranged from 34.4 to 59.6 dBA and 37.4 to 57.4 dBA, respectively.

The overall calculated L_{eq} at the residence/farmstead is 54.6 dBA. These results indicate that the nearest noise sensitive receptor is not impacted by the operation of the pumps.



5 ACRONYMS AND ABBREVIATIONS

dB	decibel
dba	A-weighted decibels
L _{eq}	equivalent sound level
mph	miles per hour
PSC	Public Service Commission
Savage	Savage Services, Corp.



6 APPENDICES

Appendix A - Session Results



APPENDIX A

Session Results



Session Report

6/13/2017

Information Panel

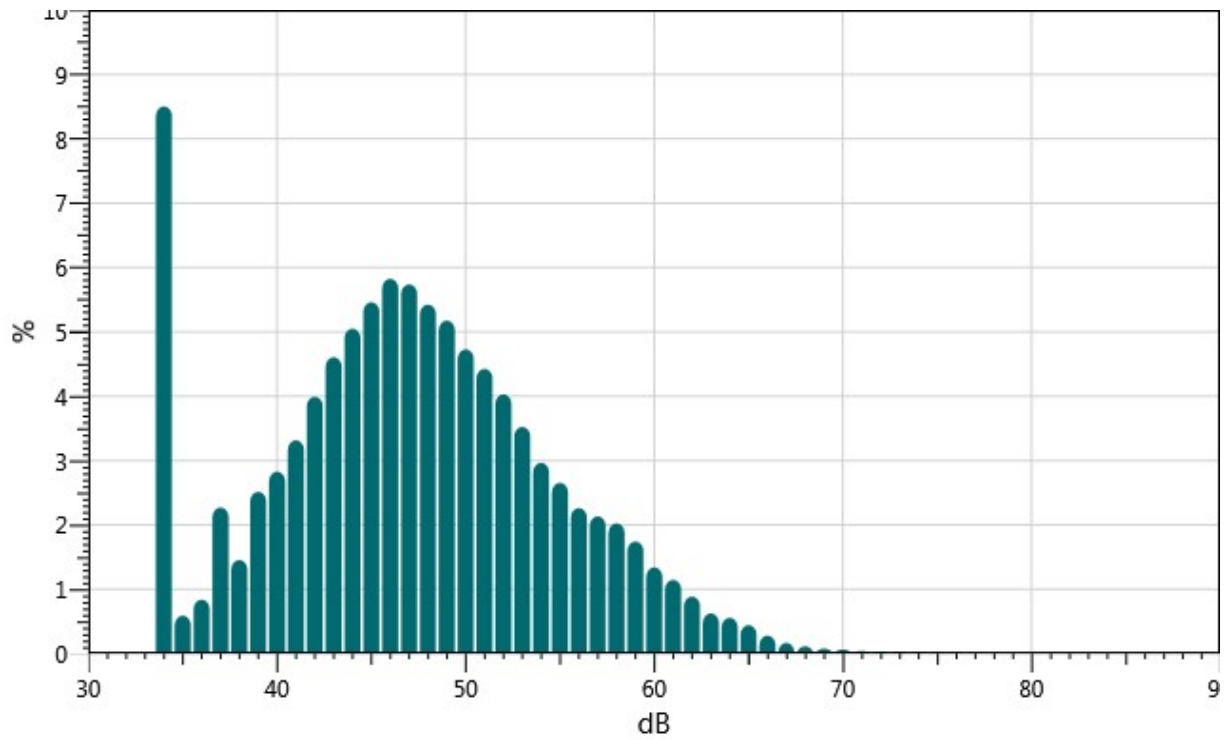
Name Savage Pump Station - 24-hour Monitoring
Start Time 6/5/2017 6:08:51 PM
Stop Time 6/6/2017 6:13:25 PM
Comments There were periodic dogs barking, periodic vehicles passing in front of the house on gravel roadway, and trains and traffic passing adjacent to ND-1804
Location
Run Time 1.00:04:34
Company Name

Summary Data Panel

Description	Meter	Value	Description	Meter	Value
Leq	1	54.6 dB	L10	1	57.7 dB
L50	1	47.3 dB	L90	1	36.9 dB
Exchange Rate	1	3 dB	Weighting	1	A
Response	1	SLOW	Bandwidth	1	1/1
Leq	2	77.7 dB	SEL	2	127.1 dB
Exchange Rate	2	3 dB	Weighting	2	C
Response	2	FAST			

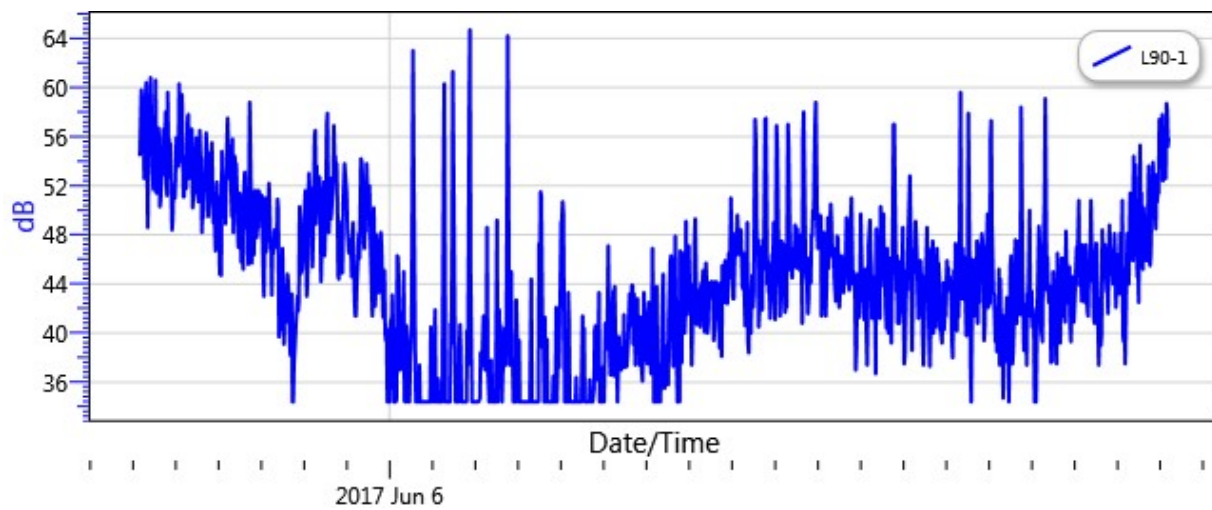
Statistics Chart

Savage Pump Station - 24-hour Monitoring: Statistics Chart



Logged Data Chart

Savage Pump Station - 24-hour Monitoring: Logged Data Chart



Logged Data Table

Date/Time	L90-1
6/5/2017 6:09:51 PM	54.4
6:10:51 PM	58.5

6:11:51 PM	59.8
6:12:51 PM	58.8
6:13:51 PM	54.8
6:14:51 PM	56.6
6:15:51 PM	52.6
6:16:51 PM	53.1
6:17:51 PM	59.3
6:18:51 PM	60.4
6:19:51 PM	54.9
6:20:51 PM	48.6
6:21:51 PM	49.3
6:22:51 PM	59.1
6:23:51 PM	57.1
6:24:51 PM	60.8
6:25:51 PM	58.2
6:26:51 PM	55.8
6:27:51 PM	53.1
6:28:51 PM	51.7
6:29:51 PM	56
6:30:51 PM	53.6
6:31:51 PM	60.6
6:32:51 PM	51.4
6:33:51 PM	53.6
6:34:51 PM	53.3
6:35:51 PM	56.7
6:36:51 PM	55.7
6:37:51 PM	50.3
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6:39:51 PM	52.3
6:40:51 PM	53.7
6:41:51 PM	54
6:42:51 PM	56.6
6:43:51 PM	55.3
6:44:51 PM	52.9
6:45:51 PM	58
6:46:51 PM	52.3
6:47:51 PM	51.2

6:48:51 PM	59.6
6:49:51 PM	54.8
6:50:51 PM	55.8
6:51:51 PM	54.3
6:52:51 PM	55.4
6:53:51 PM	51.9
6:54:51 PM	48.4
6:55:51 PM	49.2
6:56:51 PM	52
6:57:51 PM	51.2
6:58:51 PM	51
6:59:51 PM	52.5
7:00:51 PM	55.9
7:01:51 PM	55.3
7:02:51 PM	54.8
7:03:51 PM	53.6
7:04:51 PM	60.3
7:05:51 PM	56.7
7:06:51 PM	54
7:07:51 PM	59
7:08:51 PM	59.4
7:09:51 PM	53.4
7:10:51 PM	51.1
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7:12:51 PM	53.9
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7:36:51 PM	48.2
7:37:51 PM	52.1
7:38:51 PM	49.4
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7:40:51 PM	51.7
7:41:51 PM	52.7
7:42:51 PM	56.3
7:43:51 PM	54.5
7:44:51 PM	51.9
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7:46:51 PM	49.9
7:47:51 PM	52.2
7:48:51 PM	54.7
7:49:51 PM	52.7
7:50:51 PM	55.5
7:51:51 PM	51.6
7:52:51 PM	49
7:53:51 PM	51
7:54:51 PM	49.3
7:55:51 PM	46.7
7:56:51 PM	50.7
7:57:51 PM	52.3
7:58:51 PM	50.5
7:59:51 PM	51.1
8:00:51 PM	48.7
8:01:51 PM	44.8

8:02:51 PM	45.5
8:03:51 PM	44.7
8:04:51 PM	54.8
8:05:51 PM	51.7
8:06:51 PM	52.6
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8:08:51 PM	51.4
8:09:51 PM	48.9
8:10:51 PM	49.5
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8:12:51 PM	57.5
8:13:51 PM	53.5
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8:22:51 PM	54.4
8:23:51 PM	53.2
8:24:51 PM	53.8
8:25:51 PM	51.7
8:26:51 PM	50.6
8:27:51 PM	47
8:28:51 PM	47
8:29:51 PM	51.4
8:30:51 PM	51
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8:32:51 PM	47.2
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8:34:51 PM	45.2
8:35:51 PM	51.8
8:36:51 PM	53.1
8:37:51 PM	50.8
8:38:51 PM	48.6

8:39:51 PM	50.8
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9:00:51 PM	51.2
9:01:51 PM	49.5
9:02:51 PM	44.9
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9:07:51 PM	50.9
9:08:51 PM	47.9
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9:10:51 PM	52.2
9:11:51 PM	50
9:12:51 PM	46.9
9:13:51 PM	47.6
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6:11:51 PM	55.2
6:12:51 PM	55.9

Calibration History

<u>Date</u>	<u>Calibration Action</u>	<u>Level</u>	<u>Cal. Model Type</u>	<u>Serial Number</u>	<u>Cert. Due Date</u>
6/5/2017 6:03:14 PM	Calibration	114.1			