



Spire STL Pipeline Project

Resource Report 9
Air and Noise Quality

FERC Docket No. CP17-40-__ __

Amendment to FERC Application
April 2017

Public



RESOURCE REPORT 9 - GENERAL PROJECT DESCRIPTION	
SUMMARY OF FILING INFORMATION	
Information	Found in
<p>1. Describe existing air quality in the vicinity of the project. (§ 380.12(k)(1))</p> <ul style="list-style-type: none"> Identify criteria pollutants that may be emitted above U.S. Environmental Protection Agency (USEPA)-identified significance levels. 	Sections 9.1.2 and 9.1.3.
<p>2. Quantify the existing noise levels (day-night sound level (Ldn) and other applicable noise parameters) at noise sensitive areas and at other areas covered by relevant state and local noise ordinances. (§ 380.12(k)(2))</p> <ul style="list-style-type: none"> If new compressor station sites are proposed, measure or estimate the existing ambient sound environment based on current land uses and activities. For existing compressor stations (operated at full load), include the results of a sound level survey at the site property line and nearby noise-sensitive areas. Include a plot plan that identifies the locations and duration of noise measurements. All surveys must identify the time of day, weather conditions, wind speed and direction, engine load, and other noise sources present during each measurement. 	Not applicable.
<p>3. Quantify existing and proposed emissions of compressor equipment plus construction emissions, including nitrogen oxides (NOX) and carbon monoxide (CO), and the basis for these calculations. Summarize anticipated air quality impacts for the project. (§ 380.12(k)(3))</p> <ul style="list-style-type: none"> Provide the emission rate of NO, from existing and proposed facilities, expressed in pounds per hour and tons per year for maximum operating conditions, include supporting calculations, emission factors, fuel consumption rate, and annual hours of operation. 	Sections 9.1.3.



RESOURCE REPORT 9 - GENERAL PROJECT DESCRIPTION	
SUMMARY OF FILING INFORMATION	
Information	Found in
4. Describe the existing compressor units at each station where new, additional, or modified compressor units are proposed, including the manufacturer, model number, and horsepower of the compressor units. For proposed new, additional, or modified compressor units include the horsepower, type, and energy source. (§ 380.12(k)(4))	Not applicable.
5. Identify any nearby noise-sensitive area by distance and direction from the proposed compressor unit building/enclosure. (§ 380.12(k)(4))	Not applicable.
6. Identify any applicable state or local noise regulations. (§ 380.12(k)(4)) <ul style="list-style-type: none"> • Specify how the facility will meet the regulations. 	Sections 9.2.1.2 and 9.2.1.3.
7. Calculate the noise impact at noise-sensitive areas of the proposed compressor unit modifications or additions, specifying how the impact was calculated, including manufacturer's data and proposed noise control equipment. (§ 380.12(k)(4))	Not applicable.
INFORMATION RECOMMENDED OR OFTEN MISSING	
1. Include climate information as part of the air quality information provided for the project area.	Section 9.1.2.1.
2. Identify potentially applicable federal and state air quality regulations.	Section 9.1.4.
3. Provide construction emissions (criteria pollutants, hazardous air pollutants, greenhouse gases) for proposed pipelines and aboveground facilities.	Section 9.1.3.
4. Provide copies of state and federal applications for air permits.	Not applicable.
5. Provide operational and fugitive emissions (criteria pollutants, hazardous air pollutants, greenhouse gases) for pipelines and aboveground facilities.	Section 9.1.3.6
6. Provide air quality modeling for entire compressor stations.	Not applicable.



RESOURCE REPORT 9 - GENERAL PROJECT DESCRIPTION	
INFORMATION RECOMMENDED OR OFTEN MISSING	
Information	Found in
7. Identify temporary and permanent emissions sources that may have cumulative air quality effects in addition to those resulting from the project.	Resource Report 1.
8. Describe the existing noise environment and ambient noise surveys for compressor stations, liquefied natural gas facilities, meter and regulation facilities, and drilling locations.	Section 9.2.3.
9. Identify any state or local noise regulations applicable to construction and operation of the project	Section 9.2.1.
10. Indicate whether construction activities would occur over 24-hour periods.	Section 9.2.4.
11. Discuss construction noise impacts and quantify construction noise impacts from drilling, pile driving, dredging, etc.	Section 9.2.3.
12. Quantify operational noise from aboveground facilities, including blowdowns.	Section 9.2.3
13. Describe the potential for the operation of the proposed facilities to result in an increase in perceptible vibration and how this would be prevented.	Section 9.2.3
14. Identify temporary and permanent noise sources that may have cumulative noise effects in addition to those resulting from the project.	Resource Report 1.



Table of Contents

Air and Noise Quality..... 9-1

- 9.1 Air Quality..... 9-1
 - 9.1.1 Design Basis..... 9-1
 - 9.1.2 Existing Conditions 9-2
 - 9.1.3 Project Emissions 9-6
 - 9.1.4 Regulatory Requirements for Air Quality..... 9-12
- 9.2 Noise Quality 9-15
 - 9.2.1 Regulatory Requirements for Noise..... 9-16
 - 9.2.2 Noise Level Impacts..... 9-19
 - 9.2.3 Noise Impacts..... 9-20
 - 9.2.4 Noise Mitigation..... 9-35
- 9.3 References..... 9-36

Tables

- 9.1-1 Climate Data for St. Charles County Airport, Missouri (1981 to 2010) for the Project... 9-2
- 9.1-2 Yearly Local Ozone Data for West Alton Site 9-4
- 9.1-3 Yearly Local Ozone Data for Orchard Farm Site 9-5
- 9.1-4 Yearly Local Ozone Data for Illini Junior High Site..... 9-5
- 9.1-5 Yearly Local PM2.5 Data for Illini Junior High Site..... 9-6
- 9.1-6 Summary of Temporary Construction Emissions 9-7
- 9.1-6(a) Equipment Type and Fuel Consumptions..... 9-8
- 9.1-7 Summary of Stationary Source Emissions 9-10
- 9.1-8 Methane to Carbon Dioxide Equivalent for Pipelines and Stations 9-11
- 9.1-9 General Conformity Thresholds 9-15
- 9.2-1 Measured Ambient Noise Levels..... 9-17
- 9.2-2 Noise Quality Analysis for HDD Bore at Mississippi River North Location 9-24
- 9.2-3 Noise Quality Analysis for HDD Bore at Mississippi River South Location 9-25
- 9.2-4 Noise Quality Analysis for HDD Bore at Missouri River North Location..... 9-27
- 9.2-5 Noise Quality Analysis for HDD Bore at Missouri River South Location..... 9-28
- 9.2-6 Noise Quality Analysis for HDD Bore at Coldwater Creek East 9-30
- 9.2-7 Noise Quality Analysis for HDD Bore at Coldwater Creek West..... 9-32
- 9.2-8 Noise Quality Analysis for HDD Bore at Spanish Lake Park East 9-33
- 9.2-9 Noise Quality Analysis for HDD Bore at Spanish Lake Park West..... 9-34



Appendices

- 9-A Emission Estimates
- 9-B Illinois Air Regulations
- 9-C Missouri Air Regulations
- 9-D Pre-Construction Noise Survey Data
- 9-E Fugitive Dust Control Plan



Acronyms and Abbreviations

AQCR	Air Quality Control Region
CAA	Clean Air Act
CFR	Code of Federal Regulations
CH ₄	methane
CO	carbon monoxide
CO ₂	carbon dioxide
dB	decibel
dBA	"A" weighting frequency scale
Enable MRT	Enable Mississippi River Transmission, LLC
°F	degrees Fahrenheit
FERC	Federal Energy Regulatory Commission
GHG	Greenhouse Gas
GWP	global warming potential
HDD	horizontal directional drill
IPCC	Intergovernmental Panel on Climate Change
Leq	Equivalent Sound Level
Ldn	Day-Night Level
Ln	Night Level
LGC	Laclede Gas Company
M&R	metering and regulating
MPH	miles per hour
N ₂ O	nitrous oxide
NAAQS	National Ambient Air Quality Standards
NO ₂	Nitrogen Dioxide
NO _x	Nitrogen Oxides
NSA	noise sensitive area
NSPS	New Source Performance Standards
NSR	New Source Review
PM _{2.5}	particulate matter sized 2.5 microns in aerodynamic diameter and smaller



PM ₁₀	particulate matter sized 10 microns in aerodynamic diameter and smaller
Project	Spire STL Pipeline Project
REX	Rockies Express Pipeline LLC
scfh	standard cubic feet per hour
SO ₂	Sulfur Dioxide
Spire	Spire STL Pipeline LLC
TPY	tons per year
USEPA	United States Environmental Protection Agency
VOC	Volatile Organic Compounds



Air and Noise Quality

9.1 Air Quality

This Resource Report addresses the effects of the Project on the existing air and noise environment and describes proposed measures to mitigate the effects for the Spire STL Pipeline LLC (“Spire”) Spire STL Pipeline Project (“Project”) within both Illinois and Missouri.

9.1.1 Design Basis

The proposed Project will consist of approximately 65 miles of new, greenfield, 24-inch-diameter steel pipeline in two segments. The first segment (referred to as the “24-inch pipeline” portion of the Project) will originate at a new interconnect with the Rockies Express Pipeline LLC (“REX”) pipeline in Scott County, Illinois and extend approximately 59.2 miles through Greene and Jersey Counties in Illinois before crossing the Mississippi River and extending east through St. Charles County, Missouri. The 24-inch pipeline then crosses the Missouri River into St. Louis County, Missouri, and terminates at a new interconnect with Laclede Gas Company (“LGC”). The second segment of new, greenfield pipeline (referred to as the “North County Extension”), will consist of a 24-inch-diameter steel pipeline which will extend approximately six miles from the LGC interconnect through the northern portion of St. Louis County and terminate at a new interconnect with Enable Mississippi River Transmission, LLC (“Enable MRT”) and LGC. The total length of the Project pipeline will be approximately 65 miles. The overall design capacity of the Project pipeline is expected to be 400,000 dekatherms per day. No compression will be required. The Project also includes the construction of three new metering and regulating (“M&R”) stations that provide interconnects with (1) REX in Illinois, (2) LGC in Missouri, and (3) Enable MRT and LGC in Missouri.

Fuel burning equipment associated with the construction of the 24-inch pipeline, North County Extension, and associated aboveground facilities (i.e., pipeline heaters) is discussed below.

As more fully explained in Resource Report 1, a primary purpose of the Project is to provide enhanced reliability and diversity of supply and pipeline capacity to support existing natural gas end use needs. As such, the natural gas transported on the Project for its Foundation Shipper, LGC, is anticipated to be used in the same manner as its current gas supply portfolio, to serve LGC’s existing retail gas utility customers. Approximately 70 percent of LGC’s utility gas supply is currently used for home and space heating needs of residential customers, and the remaining 30 percent is used for commercial and industrial purposes. The majority of the natural gas transported on Spire’s pipeline for LGC is anticipated to supply these same downstream uses. With the introduction of additional, competitively priced, natural gas supply access into the greater St. Louis/eastern Missouri region, however, there will also be the opportunity for increased use of natural gas, as opposed to other fossil fuels, by LGC’s industrial customers with dual boiler fuel capability, thereby reducing Greenhouse Gas (“GHG”) emissions.



An additional planned benefit of the Project is for LGC to be able to replace its historical reliance on liquid propane for winter peaking support with natural gas, which has cost, reliability, and environmental advantages over liquid propane. The actual displacement of liquid propane with natural gas is not anticipated to be significant, however, given that this peakshaving need arises only on the coldest winter days.

As also discussed in Resource Report 1, 12.5 percent of the firm capacity to be created by the Project is as yet unsubscribed. Accordingly, this new capacity will offer the opportunity for other end users in the region, including electric generators, to switch to natural gas from other fossil fuels and thereby lower GHG emissions in the greater St. Louis and southern Illinois areas.

9.1.2 Existing Conditions

9.1.2.1 Local Climate

The 24-inch pipeline is located in western Illinois and generally runs from north to south and crosses the Mississippi River, then parallels the Mississippi River until crossing the Missouri River just north of St. Louis, Missouri which is the nearest large city. This area is flat with the majority of the Project area being located on land in agricultural use in the upper Mississippi River Valley. The climate of this area is best classified as a Mid-latitude Continental which has warm summers and cold winters. Summer temperatures in this area are typically in the upper 80s [degrees Fahrenheit (°F)] while winter temperatures are typically in the lower 40s. Prevailing winds are usually from the northeast. Average annual precipitation totals are approximately 41 inches. There are several surface weather stations located near the Project area all with statistically equivalent data and located in areas with high agricultural use. The St. Charles County Airport located in St. Charles County, Missouri was used as the representative station for the Project area. A summary of climate data collected at this station is provided in Table 9.1-1.

Table 9.1-1. Climate Data for St. Charles County Airport, Missouri (1981 to 2010) for the Project

Month	Average Maximum Temperature (°F)	Average Minimum Temperature (°F)	Average Temperature (°F)	Precipitation (inches)
January	39	21	30	2.36
February	44	26	35	2.24
March	55	35	45	3.23
April	67	45	56	3.82
May	76	55	65.5	4.76
June	85	64	74.5	4.29
July	89	68	78.5	4.33
August	88	66	77	3.15
September	80	56	68	3.27
October	68	44	56	3.39
November	55	35	45	3.82
December	42	25	33.5	2.80

Note: Data sourced from United States Climate Data: <http://www.usclimatedata.com/climate/portage-des-sioux/missouri/united-states/usmo1709>



The United States Environmental Protection Agency (“USEPA”) has established National Ambient Air Quality Standards (“NAAQS”) for seven pollutants:

- sulfur dioxide (“SO₂”);
- carbon monoxide (“CO”);
- nitrogen dioxide (“NO₂”);
- inhalable particulate matter (“PM”) [i.e., PM sized 10 microns in aerodynamic diameter and smaller (PM₁₀)];
- fine PM [i.e., PM sized 2.5 microns in aerodynamic diameter and smaller (PM_{2.5})] excluding regulated precursors for PM_{2.5}, which are addressed by their own standards;
- lead; and
- ozone [for which nitrogen oxides (“NO_x”) and volatile organic compounds (“VOCs”) are regulated as precursors].

9.1.2.2 National Ambient Air Quality Standards

The Clean Air Act of 1970 (“CAA”) (Title 42 United States Code § 7401 et seq.) required the USEPA to establish NAAQS to protect public health and welfare.

Revisions to Section 107 of the CAA in 1977 required the states/commonwealths and USEPA to identify areas of the country which meet and do not meet the NAAQS. Areas meeting the NAAQS are called "attainment areas," and areas not meeting the NAAQS are called "nonattainment areas." The designation of an area is made on a pollutant-by-pollutant basis.

The USEPA maintains a list of attainment/non-attainment designations for all seven criteria pollutants on their "Green Book" website (USEPA, 2014). The Green Book was used to determine the area designations for the proposed Project area. The USEPA also designates areas where communities that are in close proximity to one another and share a common air quality as Air Quality Control Regions (“AQCRs”).

In the Project area there is only one AQCR that has a designation of non-attainment; the Metropolitan St. Louis Interstate AQCR. The Metropolitan St. Louis Interstate AQCR (Missouri-Illinois) consists of the territorial area encompassed by the boundaries of the following jurisdictions:

- in the State of Illinois - Bond County, Clinton County, Madison County, Monroe County, Randolph County, St. Clair County, Washington County; and
- in the State of Missouri - Franklin County, Jefferson County, St. Charles County, St. Louis City, St. Louis County.

The Project is located in both St. Charles and St. Louis Counties; otherwise, the rest of the counties in the Project area are designated as being in attainment for all pollutants and are not designated as maintenance areas. The Metropolitan St. Louis Interstate AQCR is designated as non-attainment for both Ozone (Marginal, eight-hour Ozone 2008) and PM_{2.5} (Moderate, PM_{2.5} 1997). Further discussion is provided in Section 9.1.4.2, General Conformity.



Additionally, Jersey County in Illinois was designated as a maintenance area for Ozone in 2012.

Of the 24-inch pipeline, 16.1 miles will be located in Jersey County, Illinois. Within the Metropolitan St. Louis Interstate AQCR, 12.8 miles of the 24-inch pipeline will be located in St. Charles County, Missouri and 0.7-mile of the 24-inch pipeline will be located in St. Louis County, Missouri. Six miles of the North County Extension is in St. Louis County, Missouri and the Metropolitan St. Louis Interstate AQCR.

Within the Project area, there are several existing, operational monitoring locations collecting data related to criteria air pollutants. This information is presented to provide background levels for these criteria pollutants. This data represents the latest, publicly available data from the USEPA and, therefore, note that it may be raw and invalidated.

Three active monitoring locations have been identified near the Project area (e.g., within counties where the proposed pipeline would be constructed). These are monitors 29-183-1004 (St. Charles County, Missouri), 29-183-1002 (St. Charles County, Missouri), and 17-083-1001 (Jersey County, Illinois), and are described in Tables 9.1-2, 9.1-3, 9.1-4, and 9.1-5.

Table 9.1-2. Yearly Local Ozone Data for West Alton Site

Location:		General Electric Store, Highway 94, St. Charles County, Missouri 63386	
Pollutants Monitored:		Active O3	
Status:		Active	
Monitor ID:		29-183-1002	
Year	Maximum One-Hour Average	Maximum Eight-Hour Average	Fourth Maximum Eight-Hour Average
2016	No Data Available		
2015	0.087	0.072	0.070
2014	0.092	0.078	0.072

Note:

Data sourced from https://aqhdr1.epa.gov/aqsweb/aqstmp/airdata/download_files.html#Annual



Table 9.1-3. Yearly Local Ozone Data for Orchard Farm Site

Location: 2165 Highway V, St. Charles County, Missouri 63301			
Pollutants Monitored: Active O3			
Status: Active			
Monitor ID: 29-183-1004			
Year	Maximum One-Hour Average	Maximum Eight-Hour Average	Fourth Maximum Eight-Hour Average
2016	No Data Available		
2015	0.085	0.078	0.066
2014	0.087	0.740	0.720

Note:

Data sourced from https://aqhdr1.epa.gov/aqswb/aqstmp/airdata/download_files.html#Annual

Table 9.1-4. Yearly Local Ozone Data for Illini Junior High Site

Location: Liberty Street and County Road, Jersey County, Illinois			
Pollutants Monitored: Active O3, PM _{2.5}			
Status: Active			
Monitor ID: 17-083-1001			
Year	Maximum One-Hour Average	Maximum Eight-Hour Average	Fourth Maximum Eight-Hour Average
2016 (through 6/7/16)	0.055	0.050	0.042
2015	0.091	0.074	0.067
2014	0.089	0.071	0.065

Note:

Data sourced from https://aqhdr1.epa.gov/aqswb/aqstmp/airdata/download_files.html#Annual



Table 9.1-5. Yearly Local PM2.5 Data for Illini Junior High Site

Location:	Liberty Street and County Road, Jersey County, Illinois		
Pollutants Monitored:	Active O3, PM _{2.5}		
Status:	Active		
Monitor ID:	17-083-1001		
Year	Daily Arithmetic Mean	Maximum Daily Mean	Fourth Daily Mean
2016 (through 6/7/16)	7.448	20.0	18.2
2015	7.714	28.7	16.6
2014	10.002	25.5	17.9

Note:

Data sourced from https://aqhdr1.epa.gov/aqsweb/aqstmp/airdata/download_files.html#Annual

9.1.3 Project Emissions

9.1.3.1 Construction Emissions

Construction activities will result in temporary increases in emissions of some pollutants due to the use of non-stationary equipment powered by diesel fuel or gasoline engines; the temporary generation of fugitive dust due to disturbance of the ground surface, vegetation clearing, and other dust generating actions; and indirect emissions attributable to activities associated with construction activities of the Project (e.g., workers commuting to and from work sites during construction, etc.).

These sources are not considered stationary sources and their impacts will generally be temporary and localized. Moreover, the emissions from construction activities are not expected to cause or significantly contribute to an exceedance of the NAAQS.

The installation and construction of the Project is estimated to begin in January 2018 with completion estimated by November 2018. To date, this Project has not been awarded to a contractor and the exact equipment to be used on-site for construction is not known. The equipment anticipated to be used on this Project and the operating hours for each piece of equipment was estimated based upon similar projects of similar size. As such, the emissions provided in Table 9.1-6 are believed to represent a conservative best available estimate of construction emissions for the Project. Actual emissions from the Project will vary by day and type of construction activity. An estimation of these individual activities (e.g., construction engine emissions and fugitive dust emissions) involving construction of the pipelines has been included in this analysis.



Table 9.1-6. Summary of Temporary Construction Emissions

Description	Criteria Pollutants (TPY)						GHGs ¹ (TPY)			CO ₂ e (metric tonnes) ¹
	PM ₁₀	PM _{2.5}	VOCs	CO	SO ₂	NO _x	CO ₂	N ₂ O	CH ₄	
Off-Road Engines - New Build	12.72	12.34	16.17	72.80	0.34	231.27	13,561.15	0.76	5.23	12,626.50
Off-Road Engines - North County Extension	2.14	2.07	2.97	12.80	0.02	41.92	1,244.72	0.07	0.48	1,158.93
Unpaved Roads - New Build	11.83	1.18	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Unpaved Roads - North County Extension	1.97	0.20	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Material Handling and Wind Erosion - New Build	1.03	0.51	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Material Handling and Wind Erosion - North County Extension	0.27	0.19	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total Project Pipeline Emissions	29.95	16.50	19.14	85.60	0.35	273.19	14,805.87	0.83	5.71	13,785.43
Total Emissions Metropolitan St. Louis Interstate Air Quality Control Region²	10.21	5.66	6.65	29.40	0.09	94.66	4,337.21	0.24	1.67	4,038.29
Total Emissions Jersey County, Illinois Maintenance Area²	6.96	3.82	4.40	19.80	0.09	62.90	3,688.08	0.21	1.42	3,433.90
Total Emissions non-attainment and Maintenance Areas²	17.16	9.48	11.05	49.20	0.18	157.56	8,025.30	0.45	3.10	7,472.18

- Notes:
- ¹ Greenhouse gas emissions were adjusted for global warming potential (“GWP”), using GWP factors of 298 for N₂O and 25 for methane (“CH₄”). Additionally, greenhouse gas emissions were converted from short tons to metric tonnes.
 - ² All of the North County Extension is located in the Metropolitan St. Louis Interstate Air Quality Control Region, while 13.5 miles of the 24-inch pipeline is located in the Metropolitan St. Louis Interstate Air Quality Control Region; moreover, 16.1 miles of the 24-inch pipeline is located within Jersey County, Illinois which is a maintenance area for ozone. Therefore, emissions for the 24-inch pipeline in these areas are adjusted for this mileage.



Table 9.1-6(a). Equipment Type and Fuel Consumptions

Equipment	Type	Fuel Consumption	24-Inch Pipeline Quantity	North County Extension	M&R Facilities (each)
Excavator	CAT 336	5 to 8 Gallons/Hour	30	5	1
Side Boom Tractor	CAT 573	2 to 5 Gallons/Hour	30	5	
Bulldozers	CAT D7 or CAT D8	5 to 10 Gallons/Hour	20	3	1
Low Boy Trucks	200 HP	6 Miles/Gallon	5	4	2
Contractor Trucks	½-Ton Pickup Truck	14 Miles/Gallon	30	5	12
Inspector Trucks	½-Ton Pickup Truck	14 Miles/Gallon	20	3	
Surveyor Trucks	½-Ton Pickup Truck	14 Miles/Gallon	5	2	
Welder Rigs	1-Ton	8 Miles/Gallon (truck) and 1.1-Gallon/Hour (welder)	10	3	1
Boom Trucks	5-Ton	6 Miles/Gallon	3	1	
Fuel Trucks	5-Ton	6 Miles/Gallon	2	1	
Water Trucks	5-Ton	6 Miles/Gallon	2	1	
Water Pumps	5 HP	0.5-Gallon/Hour	10	3	
Air Compressors	25 HP	0.5-Gallon/Hour	10	3	1
Portable Light Plant	25 HP	1 Gallon/Hour	10	3	
Employee Vehicles	½-Ton Pickup Trucks and Cars	14 mpg and 20 mpg	75	12	
Pipe Stringing Trucks	200 HP	6 Miles/Gallon	5	2	
HDD Rig	600 HP	25 Gallons/Hour	2	2	
Mud Pumps	25 HP	10 Gallons/Hour	4	2	
R/W Mowing Tractors	75 HP	5 Gallons/Hour	5		
Tree Cutting Hot Saw	200 HP	5 to 8 Gallons/Hour	2	1	
Crane	Grove 300T Hydraulic (550HP)	18 to 20 Gallons/Hour			1
Carry Deck Loader	15-ton	3 Gallons/Hour			1
Generator	10 HP	1 Gallon/Hour			2
Backhoe	CAT 416F, 90 HP	5 Gallons/Hour			1
Mini Excavator	25 HP	1 Gallon/Hour			2
Dump Trucks	16 Yard Bed, 300 HP	1 Gallon/Hour			2

9.1.3.2 Construction Engine Emissions

Construction related emission estimates are based on a typical construction equipment list, hours of operation, and vehicle miles traveled by the construction equipment and supporting vehicles for the Project. This is a conservative estimate based on worst-case assumptions, Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, NR-009c (EPA420-P-04-009), April 2004 (Tables 9A-1 and 9A-2 in Appendix 9-A), and the USEPA and Intergovernmental Panel on Climate Change (“IPCC”) emission factors



(Tables 9A-7 and 9A-8 in Appendix 9-A). Nevertheless, the estimated air emissions from construction of the Project is expected to be transient in nature, with negligible impact on the baseline regional air quality. Construction equipment will be properly maintained and operated only on an as-needed basis to minimize the construction engine emissions. There will also be some emissions attributable to vehicles delivering materials to the construction sites. For the purposes of this estimate, it was assumed that all non-road engines were either Tier 2 (2001 through 2006) or Tier 3 (2006 through 2008), except for Side Booms, Water Trucks, and horizontal directional drill (“HDD”) rigs which are assumed to be Tier 0, with relation to emissions standards.

Table 9A-1 and Table 9A-2 in Appendix 9-A summarize the estimated emissions of criteria pollutants from construction equipment and PM emissions from material transfers and road traffic, respectively. Emissions from non-road construction equipment engines used during construction were estimated based on the anticipated types of non-road equipment and their associated levels of use. Emission factors in grams per HP-hour were obtained from Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition. Greenhouse gas emissions were estimated using emission factors from IPCC Guidelines for National Greenhouse Gas Inventories and are summarized in Tables 9A-7 and 9A-8 (IPCC 2006).

9.1.3.3 Fugitive Dust Emissions

Fugitive dust will result from land clearing, grading, excavation, concrete work, and vehicle traffic on paved and unpaved roads. The majority of particulate air emissions produced during construction activities will be PM₁₀ and PM_{2.5} in the form of fugitive dust. The amount of dust generated will be a function of construction activity, soil type, soil moisture content, wind speed, precipitation, vehicle traffic, vehicle types, and roadway characteristics. Emissions will be greater during dry periods and in areas of fine textured soils subject to surface activity. Potential PM emissions from material transfers, wind erosion, and unpaved/paved road were estimated using USEPA’s AP-42 emissions factors. An estimation of fugitive emissions for the Project is provided in Tables 9A-3 through 9A-6 provided in Appendix 9-A of this report.

Spire will employ proven construction-related practices to control and limit releases of fugitive dust, including the application of water or other commercially available dust control agents on unpaved areas subject to frequent vehicle traffic in accordance with the Fugitive Dust Control Plan for the Project in Appendix 9-E. In addition, construction equipment will only be operated on an as needed basis.

9.1.3.4 Open Burning Emissions

Spire is not proposing open burning as a means of disposing of land clearing waste during construction.

9.1.3.5 Stationary Source Emissions

Spire is proposing to install two 9.8 MMBtu/hr line heaters at the Laclede/Lange Delivery Station. Anticipated operational emissions for the line heaters can be estimated as shown in Table 9.1-7.



Table 9.1-7. Summary of Stationary Source Emissions

Source	Line Heater		
Number	2		
Rated Capacity (MMBtu/hour each)	9.80		
Rated Capacity (MMBtu/hour total)	19.60		
Heating Value (MMBtu/scf)	1,016		
Capacity (10⁶ scf/hour)	0.019291		
Potential Operating Hours	8,760		
Total Emissions			
Pollutant	Emission Factor¹ (lb/10⁶ scf)	Emissions	
		lb/hr	tpy
PM Total ²	7.6	0.147	0.642
NO _x	100	1.929	8.450
CO	84	1.620	7.098
VOC	5.5	0.106	0.465
CO ₂	120,000	2,314.961	10,139.528
CH ₄	2.3	0.044	0.194
N ₂ O	0.25	0.005	0.021
CH ₄ (as CO ₂ e)	2.3	1.109	4.859
NO (as CO ₂ e)	0.25	1.437	6.295

Notes:

Data sourced from USEPA (1998) AP-42: Compilation of Air Emission Factors, Chapter 1.4 Natural Gas Combustion.

¹ Assume PM₁₀ = PM Total.

² Tons CH₄ converted to Tons CO₂e by multiplying by 25 Under 10 CSR 10-6.061 Construction.

Permit Exemptions for Missouri, combustion equipment is exempt from requiring a permit under 10 CSR 10-6.060 if the following conditions met by:

- the equipment emits only combustion products, and the equipment produces less than 150 pounds per day of any air contaminant [10 CSR 10-6.061 (3)(A)(1)]; and



- combustion equipment using exclusively natural gas or liquefied petroleum gas or any combination of these with a capacity of less than 10 million British thermal units per hour heat input [10 CSR 10-6.061 (3)(A)(1)(A)]

Based on this section of 10 CSR 10-6.061, these units at 9.8 MMBTU/ea and firing exclusively natural gas would be exempted from requiring an air permit.

9.1.3.6 Fugitive Emissions of Methane

Conservatively, anticipated operational fugitive emissions for the proposed pipeline (24-inch pipeline, North County Extension, and new M&R Stations) of methane can be estimated as shown in Table 9.1-8.

Table 9.1-8. Methane to Carbon Dioxide Equivalent for Pipelines and Stations

Total Miles of Protected Steel Pipeline	65
Protected Steel Pipeline CH ₄ Emission Factor ³	358.7 scf CH ₄ /year/mile
Total Protected Steel Pipeline Fugitive CH ₄ Emissions/Year	0.6 tons
Total Protected Steel Pipeline Fugitive CO ₂ e Emissions/Year	15.4 tons
Number of Metering/Regulation/Pigging Stations	3
Station CH ₄ Emission Factor ¹	21.8 tons/year/station
Total Station Fugitive CH ₄ Emissions/Year	65.3 tons
Total Station Fugitive CO ₂ e Emissions/Year ²	1631.3 tons
Total Project Fugitive CH ₄ Emissions/Year	65.9 tons
Total Project Fugitive CO ₂ e Emissions/Year ⁴	1646.6 tons

Notes:

- ¹ American Petroleum Institute (2009) Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry: Table 5-26.
- ² USEPA (2014) Code of Federal Regulations, Title 40, Part 98, Chapter I, Subchapter C, Subpart A, Table A-1 - Global Warming Potentials.
- ³ American Petroleum Institute (2009) Compendium of Greenhouse Gas Emissions Methodologies for the Oil and Natural Gas Industry: Table C-24.
- ⁴ Tons CH₄ converted to Tons CO₂e by multiplying by 25.

These fugitive emissions come from a variety of sources including connections and line segment blowdowns.

For the Project, engineering design and operational measures will be evaluated to minimize fugitive and episodic CH₄ emissions. These measures represent the most efficient design with the least environmental impact while providing reliable pipeline operation. These measures include:



- pumping down the pressure of lines to as low a pressure as possible using inline compression prior to blowdown for maintenance; and
- installing low-leak fugitive components, where practicable

Spire is intending to participate in the USEPA's Methane Challenge Program.

9.1.3.7 Greenhouse Gas Mandatory Reporting Rule

The GHG Mandatory Reporting Rule, at 40 Code of Federal Regulations ("CFR") Part 98 (Subpart W), requires certain facilities that emit 25,000 metric tons or more of CO₂ per year to report annual emissions of specified GHGs from various processes within the facility and conduct associated monitoring. Onshore natural gas transmission pipeline industry segments are included in this requirement only if they emit 25,000 metric tons per year or more of emissions from activities under §98.232(m). This relates to pipeline blowdown CO₂ and CH₄ emissions from blowdown vent stacks.

Based on Table 9.1-8 in Section 9.1.3.6 of this report, this Project will not result in emissions equal to, or in excess of, this threshold. Therefore, the GHG Mandatory Reporting Rule does not apply.

9.1.3.8 Odorization Equipment

Odorization equipment will be located at one M&R station along the Project (Laclede/Lange Delivery Station). The potential for odorant release is very low during normal operations of a natural gas M&R facility. Industry accepted procedures and equipment will be utilized to minimize operational-required releases of odorized gas and fugitive emissions will be mitigated by filtering through activated charcoal filters. Additionally, the odorization equipment located at the M&R station will be regularly maintained to ensure proper functioning.

9.1.3.9 Leak Detection

Spire to perform leak detection and maintenance as described in Section 1.4 of Resource Report 1.

9.1.4 Regulatory Requirements for Air Quality

The provisions of the CAA that are potentially applicable to construction and operation of the new facilities associated with the Project are:

- New Source Performance Standards ("NSPS");
- State Regulations; and
- Conformity of General Federal Actions.

Provisions under the New Source Review ("NSR") permitting program National Emission Standards for Hazardous Air Pollutants, Greenhouse Gas Mandatory Reporting Rule, and the Title V Operating Permit program are not applicable to the Project. The following is a brief description of the potentially applicable regulations and their requirements.



9.1.4.1 NSPS

NSPS in 40 CFR Part 60 regulate emissions from new emissions sources from specific source categories. The majority of the source categories cover emission sources that are not associated with the equipment being installed as part of the Project; however, recent updates to Subpart OOOO - Crude Oil and Natural Gas Production (Transmission and Distribution) known as Subpart OOOOa do potentially apply.

Subpart OOOOa - Standards of Performance for Crude Oil and Natural Gas: Production, Transmission, and Distribution

On August 18, 2015, the USEPA proposed amendments to 40 CFR 60, Subpart OOOO and proposed an entirely new Subpart OOOOa, which was published to the Federal Register on September 18, 2015. On August 2, 2016 this new subpart went into effect; therefore, Subpart OOOOa will apply to oil and natural gas production, transmission, and distribution affected facilities that are constructed, reconstructed, and modified after the Federal Register date of September 18, 2015. The proposed NSPS Subpart OOOOa would establish standards for both VOC and CH₄. In all cases, natural gas is used as a surrogate for both CH₄ and VOC. Subpart OOOOa will affect additional sources at the proposed facilities beyond Subpart OOOO. Many of the requirements of this subpart are applicable to natural gas processing plants and compressor stations. Continuous bleed natural gas-driven pneumatic controllers that are located on a natural gas transmission systems are limited to natural gas bleed rates of six standard cubic feet per hour ("scfh"). However, the rule does allow for the use of a natural gas bleed rate greater than six scfh if it can be demonstrated that the functional needs of the control are required due to but not limited to response time, safety and positive actuation. For continuous bleed natural gas-driven pneumatic controllers that seek to make this justification there are tagging and recordkeeping requirements.

9.1.4.2 General Conformity

Section 176 of the 1990 CAA Amendments required the USEPA to promulgate rules to make certain federal actions conform to the applicable state implementation plan. These rules, known together as the General Conformity Rule (40 CFR 93, Subpart B), require any federal agency responsible for an action in a non-attainment or maintenance area for any criteria pollutant to determine if the action conforms with the applicable state implementation plan or is exempt from the General Conformity Rule requirements.

The USEPA amended the General Conformity rule in 2010 (Federal Register, Volume 75, Number 64, April 5, 2010). As amended, emissions regulated by a permit issued under minor or major NSR are exempted from a General Conformity applicability analysis. Previously, only major NSR permit emissions were excluded.

General Conformity currently applies to areas designated as non-attainment or maintenance for ozone under the 1997 and 2008 eight-hour ozone NAAQS. To remove the complexity of having to address requirements under two ozone NAAQS, the USEPA published the "Implementation of the 2008 NAAQS for Ozone: State Implementation Plan Requirements - Proposed Rule" in the Federal Register on June 6, 2013.

The proposed rule provides that all requirements, including General Conformity, will not apply to areas designated as non-attainment or maintenance for the 1997 ozone NAAQS when that NAAQS is revoked. The 1997 ozone NAAQS will be revoked upon publication of the final rule. The public comment period for the proposed rule ended



August 5, 2013 and the final rule has not been promulgated to date. Until the USEPA publishes the final rule, requirements to address General Conformity under the 1997 eight-hour ozone NAAQS continue to apply alongside the 2008 eight-hour ozone NAAQS.

A General Conformity analysis consists of two steps. The first step is an applicability analysis where estimated Project emissions from construction and operation (with emission sources covered by a permit excluded) are compared to de minimis thresholds defined in the General Conformity Rule. Step two, a General Conformity determination, is required for each pollutant where the total of direct and indirect emissions caused by a federal action (such as a FERC action) would equal or exceed de minimis levels as specified in 40 CFR Part 93.153 with the exceptions specified in 40 CFR Part 51.853(c), (d), or (e). General Conformity does not apply to federal actions in attainment areas or unclassifiable/attainment areas.

For ozone non-attainment areas, emissions of VOC and NO_x are evaluated because they are precursor pollutants to ozone formation. For PM_{2.5} non-attainment areas, emission of NO_x and SO₂ are evaluated (in addition to direct PM_{2.5}) because they are precursor pollutants to PM_{2.5} formation. Project activities in Counties belonging to the same non-attainment area or area under maintenance are assumed to contribute cumulatively to the non-attainment or maintenance area. During the applicability analysis, estimated emissions within non-attainment and maintenance areas are compared against preset threshold levels per 40 CFR Section 93.153. The applicability thresholds vary, depending on the severity of the non-attainment area. De minimis emissions are total direct and indirect emissions of a criteria pollutant caused by a federal action in a non-attainment or maintenance area at rates less than the specified applicability thresholds. These thresholds are presented in Table 9.1-9.

The emissions for the Project in designated non-attainment or maintenance areas are below these thresholds, as previously shown in Table 9.1-6. The St. Louis Interstate AQCR is designated as "Other ozone non-attainment areas outside an Ozone Transport Region" for Ozone, thus the General Conformity Thresholds for VOC and NO_x are 100 TPY. VOC emissions are 6.52 TPY and NO_x emissions are 92.71 TPY (Table 9.1-6) during construction, placing it below the General Conformity thresholds.

9.1.4.3 Air Quality Modeling Analysis

An air quality modeling analysis is not provided as part of this resource report.

9.1.4.4 State-Specific Air Regulations

Illinois and Missouri both have state-specific air quality regulations. Illinois regulations can be found in Title 35 of the Illinois Administrative Code, Subtitle B. Missouri regulations can be found in Division 10 of the Missouri Code of Regulations, Chapter 6. More detailed descriptions of potentially applicable Illinois and Missouri state-specific air regulations can be found in Appendices B and C, respectively.



Table 9.1-9. General Conformity Thresholds

Pollutant/Non-Attainment Area	TPY
Ozone (VOCs or NOx)	
Serious Non-Attainment Areas	50
Severe Non-Attainment Areas	25
Extreme Non-Attainment Areas	10
Other Ozone Non-Attainment Areas outside an Ozone Transport Region	100
Other Ozone Non-Attainment Areas inside an Ozone Transport Region	
VOC	50
NOx	100
CO ₂ (all non-attainment areas)	100
SO ₂ or NO ₂ (all non-attainment areas)	100
PM ₁₀	
Moderate Non-Attainment Areas	100
Serious Non-Attainment Areas	70
PM _{2.5}	
Direct Emissions	100
SO ₂	100
NOx (unless determined not to be a significant precursor)	100
VOC or Ammonia (if determined to be significant precursors)	100
Lead (all non-attainment areas)	25

Source: 40 CFR §93.153.

9.2 Noise Quality

The unit of noise measurement is the decibel (“dB”), which measures the energy of the noise. Because the human ear is not uniformly sensitive to noise frequencies, the "A" weighting frequency scale (“dBA”) was devised to correspond with the ear's sensitivity. The dBA uses specific weighting of a sound pressure level for the purpose of determining the human response to sound and the resulting unit of measure is the dBA.

Because noise levels can vary over a given time period, they are further quantified using the Equivalent Sound Level (“Leq”), Night Level (“Ln”), and Day-Night Level (“Ldn”). The Leq is an average of the time-varying sound energy for a specified time period. The Ln is an average of the time-varying sound energy for the time period between 10 p.m. and 7 a.m. local time. The Ldn is an average of the time-varying sound energy for one 24-hour period, with a 10 dB addition to the sound energy for the time period of 10 p.m. to 7 a.m. local time. If the sound



energy does not vary with time, the Ldn level will be equal to the Leq level plus 6.4 dBA due to 10 dBA penalty for nighttime noise sensitivity during the period of 10 p.m. to 7 a.m.

The Project includes the construction of three new M&R stations at interconnects with REX in Illinois and Enable MRT and LGC in Missouri. Spire conducted baseline noise surveys at each facility in December 2016.

The Project will also include the completion of four HDDs, each containing an entry/exit site in the following locations:

- Mississippi River North;
- Mississippi River South;
- Missouri River North;
- Missouri River South;
- Coldwater Creek West;
- Coldwater Creek East;
- Spanish Lake Park West; and
- Spanish Lake Park East.

Spire conducted baseline noise surveys at each of these sites in December 2016 and February 2017 which are presented in Table 9.2-1, and will conduct baseline noise surveys at the Spanish Lake Park location in April 2017.

9.2.1 Regulatory Requirements for Noise

9.2.1.1 Federal Noise Regulations

The USEPA has identified a noise level of 55 dBA as being the maximum sound level that will not adversely affect public health and welfare by interfering with speech or other activities in outdoor areas, with an adequate margin of safety (USEPA 1971). The FERC guidelines [18 CFR Part 157.206-(b)(5)(i) and (ii)] require that the noise attributable to new compressor engines or modification not exceed an Ldn of 55 dBA at the nearest noise sensitive area (“NSA”) (schools, hospitals, or residences) unless such NSAs are established after facility construction. In addition, the FERC typically requires that the noise attributable to the full-load operation of a compressor station, including the compressor unit addition, should not exceed the previously existing noise levels produced by the compressor station at nearby NSAs that are above an Ldn of 55 dBA.

For HDD operations, the FERC guidelines [18 CFR Part 157.206-(b)(5)(iii)] require that the noise attributable to HDD not exceed an Ln of 55 dBA at the nearest NSAs unless such NSAs are established after facility construction.



Table 9.2-1. Measured Ambient Noise Levels

Location	Start	Stop	LAeq
Aboveground Facilities			
REX Receipt Station	12:45 PM	1:00 PM	53.7
	1:01 PM	1:16 PM	49.7
Laclede/Lange Delivery Station	8:07 AM	8:22 AM	54.5
	4:57 PM	5:13 PM	52.7
Chain of Rocks Station (western portion)	6:30 AM	6:46 AM	61.0
	5:52 PM	6:07 PM	54.7
Chain of Rocks Station (eastern portion)	6:12 AM	6:27 AM	62.9
	6:57 PM	7:12 PM	57.0
HDD Entry/Exit Locations			
Mississippi River North HDD Location ¹	11:19 AM	11:34 AM	58.3
	2:28 PM	2:43 PM	61.5
Mississippi River South HDD Location	10:09 AM	10:24 AM	40.0
	3:25 PM	3:40 PM	46.5
Missouri River North HDD Location	9:27 AM	9:42 AM	43.7
	5:03 PM	5:18 PM	58.9
Missouri River South HDD Location	8:56 AM	9:11 AM	50.2
	4:29 PM	4:44 PM	47.3
Coldwater Creek West HDD Location ²	7:08 AM	7:23 PM	53.5
	5:18 PM	5:32 PM	56.6
Coldwater Creek East HDD Location ²	8:02 AM	8:17 AM	50.0
	4:13 PM	4:28 PM	49.7
Spanish Lake Park West HDD Location ³	TBD	TBD	TBD
	TBD	TBD	TBD
Spanish Lake Park East HDD Location ³	TBD	TBD	TBD
	TBD	TBD	TBD

Notes:

- ¹ Due to restricted site access, ambient noise surveys were performed in the public right-of-way.
- ² Due to restricted site access, ambient noise surveys were performed on neighboring property.
- ³ TBD - To Be Determined. Ambient sound monitoring for these locations will be performed in April and data will be provided to FERC in May 2017.



9.2.1.2 State Noise Regulations

A preliminary review of local noise ordinances for the areas where the HDD operations and M&R facilities will be located has resulted in the following assessment of noise level regulations for the area. This review should not be considered exhaustive, constituting publicly available information on the websites of the counties in question.

9.2.1.3 Illinois/Missouri State Ordinances

No state-specific noise ordinances pertaining to HDD operations were found for either state.

9.2.1.4 Local/County Noise Regulations

Scott County, Illinois

The REX Receipt Station is proposed to be located in this county. Spire is coordinating with the county. No applicable noise regulations have been identified.

Jersey County, Illinois

There is a proposed HDD entry/exit location (Mississippi River North) located in this county. This location is to the north of the Mississippi River.

Spire is coordinating with the county. No applicable noise regulations have been identified.

St. Charles County, Missouri

There is a proposed HDD entry/exit location (Mississippi River South) located in this county to the south of the Mississippi River and a second HDD entry/exit location (Missouri River North) located in this county to the north of the Missouri River.

This county restricts noise levels from portable or motor vehicle audio equipment and public address systems. Spire is coordinating with the county. No applicable noise regulations have been identified.

St. Louis County, Missouri

There are five proposed HDD entry/exit sites located in this county:

- Missouri River South to the south of the Missouri River;
- Coldwater Creek West located to the West of Highway 367;
- Coldwater Creek East located to the East of Highway 367 and Coldwater Creek;
- Spanish Lake Park West to the west of Spanish Lake Park; and
- Spanish Lake Park East to the east of Spanish Lake Park.

Two proposed M&R facilities are located in this county:

- Laclede/Lange Delivery Station; and
- Chain of Rocks.



There is a general noise ordinance for St. Louis County, Missouri. This ordinance generally states that, “It is also unlawful to speak, shout, sing, or create any noise at a volume that disturbs the peace of another person.” Spire is coordinating with the county. No applicable noise regulations have been identified.

9.2.2 Noise Level Impacts

Although pipeline construction activities may cause some noise impact during construction, this impact will be limited to the relatively short period of active construction. The Project is not expected to result in a significant or long-term disturbance during construction of the pipeline in the Project area.

The Project will include eight proposed HDD entry/exit locations and three M&R facilities. A total of 33 locations are considered potentially impacted due to construction and/or operational noise. There are no new or modified compression facilities associated with this Project.

HDD operations generally consists of an HDD drilling rig and auxiliary support equipment, including mud pumps, portable generators, cranes, mud mixing and cleaning equipment, forklifts, loaders, trucks, and portable light sets. The sound level impacts at NSAs associated with the HDD entry/exit sites will depend on the drilling contractor and type of equipment used, the mode of operation of the equipment, the length of time the equipment is in use, the amount of equipment used simultaneously, and the distances between sound sources and sensitive sites. Noise analysis at the HDD sites was completed assuming that drilling may occur on either or both sides of the river.

The three M&R facilities will be new construction. The impacts of the construction and operation of the M&R stations have been evaluated and are included in Section 9.2.3.2 of this report. M&R stations typically include a fenced control building and a permanent access road. They also include a supply line and a discharge line from the associated pipeline, an emergency bypass line, and communication equipment for supervisory control.

The locations (distance and direction) of the NSAs preliminarily identified to the proposed HDD entry/exit locations and proposed M&R facilities are described below and are shown on the figures associated with each site in Appendix 9-D. The anticipated noise impacts from the HDD operations and M&R facilities were analyzed and where necessary, means to control construction noise from HDD operations and M&R facilities are presented. Spire performed a field reconnaissance of the HDD entry/exit locations, the proposed M&R facility locations, and the NSAs within a 0.5-mile radius of these locations, and conducted ambient sound level monitoring in the vicinity of the NSAs for each of the selected locations. Spire monitored sound level and established two sets of 15-minute averages at each location using a 3M SOUNDPRO Sound Level Meter (or equivalent).

An acoustical analysis was performed to determine the estimated noise contribution at each NSA using SoundPLAN® acoustical modeling software. Baseline noise survey results and noise impact calculation results are presented in Appendix 9-D.



9.2.3 Noise Impacts

9.2.3.1 Ambient/Existing Noise Surveys

Ambient noise surveys consisting of two 15-minute readings were conducted at each location determined to be potentially impacted by construction or operational noise during and after the Project.

These sites consisted of three M&R station locations. Six of the eight proposed HDD entry/exit locations have currently been monitored and ambient sound level recorded. The results of these ambient noise level surveys are included in Appendix 9-D of this report and are summarized in Table 9.2-1. Spire will conduct additional 15-minute readings at the Spanish Lake Park sites in April 2017 and provide FERC with this information in May 2017.

9.2.3.2 Operational and Construction Noise Level Models

For each site denoted in Section 9.2.3.1 of this report, a sound model was constructed for noise producing activities associated with its construction and/or operation. Construction noise models were performed for each of the four HDD entry/exit locations. Operational noise models were conducted for each of the proposed new M&R facilities.

The models were constructed and run using SoundPLAN® acoustical modeling software. The resultant noise model maps are provided in Appendix 9-D of this report.

REX Receipt Station (Operational Noise Model)

The REX Receipt Station was modeled to include the following equipment and structures with associated conservatively assumed sound pressure levels:

- proposed flow control with P.O.R. skid at 86.2 dBA;
- proposed meter skid at 86.2 dBA;
- proposed separation filter at 60.0 dBA;
- proposed liquid storage tank at 50 dBA; and
- proposed temporary pig launcher/receiver at 86.2 dBA.

Within one-half-mile of the site there are the following NSAs:

- NSA RE001 consists of single-family dwellings to the northeast, along Clay Hollow Road, located approximately 590 feet from the proposed REX Receipt Station.
- NSA RE002 consists of a single-family dwelling to the south, along 1215E, located approximately 985 feet from the proposed REX Receipt Station.
- NSA RE003 consists of a single-family dwelling to the northwest, along Clay Hollow Road, located approximately 1,145 feet from the proposed REX Receipt Station.
- NSA RE004 consists of a single-family dwelling to the southwest, off Manchester Aalsey Road, located approximately 2,250 feet from the proposed REX Receipt Station.



- NSA RE005 consists of a single-family dwelling to the southeast, off Manchester Alsey Road, located approximately 2,615 feet from the proposed REX Receipt Station.

The results of this model show the sound level impacts on the above-listed NSAs will be negligible or non-existent with a 55 dBA sound level or less at or near the facility's fence line. See Figures 9.2-1A and 9.2.1B in Appendix 9-D for modeling results and NSA location mapping.

Laclede/Lange Delivery Station (Operational Noise Model)

The Laclede/Lange Delivery Station was modeled to include the following equipment and structures with associated conservatively assumed sound pressure levels:

- two proposed indirect gas fired heaters at 86.2 dBA;
- proposed temporary pig receiver at 86.2 dBA;
- proposed temporary pig launcher at 86.2 dBA;
- proposed meter skid at 86.2 dBA;
- proposed flow control skid at 86.2 dBA; and
- proposed odorant tank at 50 dBA.

Within one-half-mile of the site there are the following NSAs near this location:

- NSA LL001 consists of single-family dwellings to the east located on the opposite side of Blue Spruce Lane and along Fort Bellefontaine Road, located approximately 240 feet from the proposed Laclede/Lange Delivery Station.
- NSA LL002 consists of single-family dwellings to the southeast of the proposed facility and on the opposite side of Blue Spruce Lane, located approximately 340 feet from the proposed Laclede/Lange Delivery Station.
- NSA LL003 consists of single-family dwellings to the northwest of the proposed Laclede/Lange Delivery Station and along Old Jamestown Road and Fort Bellefontane Road, located approximately 570 feet from the proposed Laclede/Lange Delivery Station.
- NSA LL004 consists of single-family dwellings to the northwest of the proposed Laclede/Lange Delivery Station on the west side of Old Jamestown Road, located approximately 1,300 feet from the proposed Laclede/Lange Delivery Station.
- NSA LL005 consists of single-family dwellings to the southwest of the proposed Laclede/Lange Delivery Station on the west side of Old Jamestown Road, located approximately 1,170 feet from the proposed Laclede/Lange Delivery Station.
- NSA LL006 consists of single-family dwellings to the south of the proposed Laclede/Lange Delivery Station to the north and south of Old Jamestown Road, located approximately 1,150 feet from the proposed Laclede/Lange Delivery Station.



- NSA LL007 consists of single-family dwellings to the southeast of the proposed Laclede/Lange Delivery Station and along the east side of Old Jamestown Road, located approximately 840 feet from the proposed Laclede/Lange Delivery Station.
- NSA LL008 consists of single-family dwellings to the north of the proposed Laclede/Lange Delivery Station and along Old Jamestown Road and Portage Road, located approximately 1,995 feet from the proposed Laclede/Lange Delivery Station.

The results of this model show the sound level impacts on the above-listed NSAs will be negligible or non-existent with a 55 dBA sound level or less at or near the facility's fence line. See Figures 9.2-2A and 9.2.2B in Appendix 9-D for modeling results and NSA location mapping.

Chain of Rocks Station (Operational Noise Model)

The Chain of Rocks Station is proposed on the North County Extension portion of this Project. A portion is located adjacent to the existing Enable MRT Chain of Rocks facility.

The facility was modeled to include the following equipment and structures with associated conservatively assumed sound pressure levels:

- proposed meter and flow control skid at 86.2 dBA;
- proposed O.P.P. skid at 86.2 dBA;
- proposed filter/separator at 60.0 dBA;
- proposed liquid storage tank at 50 dBA;
- proposed temporary pig launcher at 86.2 dBA; and
- and two temporary pig receivers at 86.2 dBA.

There are several NSAs near this location:

- NSA-MR001 consists of a convent to the north, located approximately 265 feet from the proposed location for Chain of Rocks and is bordered by Riverview Drive and Prigge Road.
- NSA-MR002 consists of a Nursing and Rehabilitation center to the south, located approximately 490 feet from the proposed Chain of Rocks along Prigge Road.
- NSA-MR003 consists of several single family dwellings to the east, located on approximately 810 feet from the proposed Chain of Rocks on the east side of Riverview Road.
- NSA-MR004 consists of several single family dwellings to the northeast, located approximately 975 feet from the proposed Chain of Rocks along the east side of Riverview Road. There is light commercial/industrial buildings to the east and abutting this NSA.
- NSA-MR005 consists of several single family dwellings to the southwest, located approximately 2,165 feet from the proposed Chain of Rocks along the north side of Coal Bank Road.



- NSA-MR006 consists of single family dwellings to the west, located approximately 1,100 feet from the proposed Chain of Rocks along the south side of Prigge Road and contains several minor streets including Mimeaux Drive, Briarbrae Drive, Briarbrae Court, and Petite Chalet Drive. There is also a school that is partially encompassed within the 0.5-mile radius in this NSA.
- NSA-MR007 consists of single family dwellings to the west, located approximately 660 feet from the proposed Chain of Rocks along the north side of Prigge Road and contains the minor street of Prigge Meadows Drive.
- NSA-MR008 consists of single family dwellings to the west, located approximately 1,285 feet from the proposed Chain of Rocks along the north side of Prigge Road and contains the minor street of Seager Lane.
- NSA-MR009 consists of single family dwellings to the northwest, located approximately 2,000 feet from the proposed Chain of Rocks along the minor streets of Rio Grande Drive, San Andreas Drive, and Laredo Avenue.

The results of this model show the sound level impacts on the above-listed NSAs will be negligible or non-existent with a 55 dBA sound level at or near the facility's fence line. See Figures 9.2-3A and 9.2.3B in Appendix 9-D for modeling results and NSA location mapping.

Mississippi River North HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location located north of the Mississippi River. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated three shifts of nighttime work during pullback.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.

There is one impacted NSA near this location:

- NSA MS002 consists of single-family dwellings to the southeast, located approximately 1,395 feet from the proposed Mississippi River North HDD entry/exit location.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 miles per hour ("MPH").

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors.

River Road is a major artery for traffic through the area and influences the sound environment. It has been included in the sound model.



Figures 9.2-4A and 9.2.4B in Appendix 9-D show the sound level contributions to the surrounding sound environment during operation on the site, as well as mapping of the NSA locations. The sound level impact at or near the property line is shown to be 55 dBA or less.

Table 9.2-2 shows the estimated sound levels (Ldn) for ambient/existing, HDD operations without mitigation, and HDD operations with mitigation considered during pullback operations when 24-hour operation at the site would occur.

Based on this analysis, the 55.0 dBA threshold would not be exceeded during these operating conditions. Spire commits to conducting all other drilling activities during daytime hours only.

Table 9.2-2. Noise Quality Analysis for HDD Bore at Mississippi River North Location^{1,2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MS002	0.26	East	42.0	42.3	0.3	42.0	0.0

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Mississippi River South HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location located south of the Mississippi River. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated three shifts of nighttime work during pullback.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.



There are two impacted NSAs near this location:

- NSA MS001 consists of single-family dwellings to the southeast, located approximately 1,175 feet from the proposed Mississippi River South HDD entry/exit; and
- NSA MS003 consists of single-family dwellings to the south, located approximately 2,100 feet from the proposed Mississippi River South HDD entry/exit.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors.

Figures 9.2-5 and 9.2.4B in Appendix 9-D show the sound level contributions to the surrounding sound environment during operation on the site, as well as mapping of the NSA locations. The sound level impact at or near the property line is shown to be 55 dBA or less.

Table 9.2-3 shows the estimated sound levels (Ldn) for ambient/existing, HDD operations without mitigation, and HDD operations with mitigation considered during pullback operations when 24-hour operation at the site would occur.

Table 9.2-3. Noise Quality Analysis for HDD Bore at Mississippi River South Location^{1,2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MS001	0.30	Southeast	41.7	46.3	4.6	44.7	3.0
NSA-MS003	0.44	Southeast	53.0	54.9	2.0	53.2	0.2

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Based on this analysis, the 55.0 dBA threshold would not be exceeded during these operating conditions. Spire commits to conducting all other drilling activities during daytime hours only.



Missouri River North HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location located north of the Missouri River. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated 3 shifts of nighttime work during pullback.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.

There is one NSA near this location:

- NSA MO002 consists of single-family dwellings to the north, along Minert Road, located approximately 2,335 feet from the proposed Missouri River North HDD entry/exit location.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors.

Figures 9.2-6A and 9.2.6B in Appendix 9-D show the sound level contributions to the surrounding sound environment during operation on the site, as well as mapping of the NSA locations. The sound level impact at or near the property line is shown to be 55 dBA or less.

Table 9.2-4 shows the estimated sound levels (Ldn) for ambient/existing, HDD operations without mitigation, and HDD operations with mitigation considered during pullback operations when 24-hour operation at the site would occur.

Based on this analysis, the 55.0 dBA threshold would not be exceeded during these operating conditions. Spire commits to conducting all other drilling activities during daytime hours only.

Missouri River South HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location within Central Stone's facility located south of the Missouri River. The proposed HDD entry/exit location is on the western edge of the property. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated three shifts of nighttime work during pullback.



Table 9.2-4. Noise Quality Analysis for HDD Bore at Missouri River North Location^{1,2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MO002	0.44	North	51.5	55.0	3.4	53.1	1.6

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.

There are five NSAs near this location:

- NSA MO001 consists of single-family dwellings to the northwest, located approximately 250 feet from the proposed Missouri River South HDD entry/exit location. An earthen barrier currently exists between the proposed HDD entry/exit location and the NSAs.
- NSA MO003 consists of single-family dwellings to the northwest, located approximately 1,545 feet from the proposed Missouri River South HDD entry/exit location.
- NSA MO004 consists of single-family dwellings to the west, located approximately 1,790 feet from the proposed Missouri River South HDD entry/exit location.
- NSA MO005 consists of single-family dwellings to the southwest, located approximately 1,980 feet from the proposed Missouri River South HDD entry/exit location.
- NSA MO006 consists of single-family dwellings to the south, located approximately 1,235 feet from the proposed Missouri River South HDD entry/exit location.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.



Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors.

Figures 9.2-7 and 9.2.6B in Appendix 9-D show the sound level contributions to the surrounding sound environment during operation on the site, as well as mapping of the NSA locations. The sound level impact at or near the property line is shown to be 55 dBA or less.

Table 9.2-5 shows the estimated sound levels (Ldn) for ambient/existing, HDD operations without mitigation, and HDD operations with mitigation considered during pullback operations when 24-hour operation at the site would occur.

Table 9.2-5. Noise Quality Analysis for HDD Bore at Missouri River South Location^{1, 2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MO001	0.03	West	50.7	52.9	2.2	51.0	0.3
NSA-MO003	0.26	Northwest	45.8	46.1	0.2	45.9	0.0
NSA-MO004	0.30	West	42.5	43.2	0.7	42.6	0.1
NSA-MO005	0.36	Southwest	39.1	39.3	0.2	39.1	0.0
NSA-MO006	0.28	South	52.5	52.6	0.1	52.5	0.0

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Based on this analysis, the 55.0 dBA threshold would not be exceeded during these operating conditions. Spire commits to conducting all other drilling activities during daytime hours only.

Coldwater Creek East HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location east of Highways 67/367 to the east of Coldwater Creek. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated 2 shifts of nighttime work during pullback.



The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.

There are eight NSAs near this location:

- NSA MO007 consists of single-family dwellings to the southwest, located approximately 470 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO008 consists of single-family dwellings to the east, located approximately 475 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO009 consists of single-family dwellings to the southeast, located approximately 610 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO010 consists of a school and single-family dwellings to the southwest, located approximately 715 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO011 consists of single-family dwellings to the west, located approximately 1,955 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO012 consists of single-family dwellings to the east, located approximately 1,780 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO013 consists of a church and single-family dwellings to the southeast, located approximately 1,495 feet from the proposed Coldwater Creek East HDD entry/exit location.
- NSA MO014 consists of single-family dwellings to the southeast, located approximately 1,865 feet from the proposed Coldwater Creek East HDD entry/exit location.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors.

Figures 9.2-8A and 9.2.8B in Appendix 9-D show the sound level contributions to the surrounding sound environment during operation on the site, as well as mapping of the NSA locations. The sound level impact at or near the property line is shown to be 55 dBA or less.



Table 9.2-6 shows the estimated sound levels (Ldn) for ambient/existing, HDD operations without mitigation, and HDD operations with mitigation considered during pullback operations when 24-hour operation at the site would occur.

Table 9.2-6. Noise Quality Analysis for HDD Bore at Coldwater Creek East^{1, 2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MO007	0.08	South	45.7	52.4	6.7	51.2	5.5
NSA-MO008	0.08	East	41.9	50.3	8.4	49.0	7.1
NSA-MO009	0.13	Southeast	44.7	52.3	7.6	51.1	6.4
NSA-MO010	0.19	Southwest	46.9	47.2	0.3	47.1	0.2
NSA-MO011	0.36	Southwest	69.0	69.0	0.0	69.0	0.0
NSA-MO012	0.36	East	58.3	58.3	0.1	58.3	0.1
NSA-MO013	0.36	South	50.4	50.6	0.1	50.5	0.1
NSA-MO014	0.42	Southeast	52.5	52.5	0.0	52.5	0.0

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Based on this analysis, the 55.0 dBA threshold would not be exceeded during these operating conditions for NSAs currently at or below 55.0 dBA. For NSAs with an estimated Ldn currently above 55.0 dBA, operation of the HDD at this location does not contribute to an increase of 10.0 dBA or greater at these locations based on this analysis.

Coldwater Creek West HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location west of Highways 67/367 to the west of Coldwater Creek. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated two shifts of nighttime work during pullback.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;



- three generators at 90 dBA; and
- separation plant at 100 dBA.

There are seven NSAs near this location:

- NSA MO015 consists of single-family dwellings to the west, located approximately 430 feet from the proposed Coldwater Creek West HDD entry/exit location.
- NSA MO016 consists of single-family dwellings to the west, located approximately 960 feet from the proposed Coldwater Creek West HDD entry/exit location.
- NSA MO017 consists of a school and single-family dwellings to the west, located approximately 1,440 feet from the proposed Coldwater Creek West HDD entry/exit location.
- NSA MO018 consists of single-family dwellings to the southwest, located approximately 910 feet from the proposed Coldwater Creek West HDD entry/exit location.
- NSA MO019 consists of single-family dwellings to the south, located approximately 1,435 feet from the proposed Coldwater Creek West HDD entry/exit location.
- NSA MSO20 consists of a church and single-family dwellings to the north, located approximately 710 feet from the proposed Coldwater Creek West HDD entry/exit location.
- NSA MSO21 consists of single-family dwellings to the northwest, located approximately 1,715 feet from the proposed Coldwater Creek West HDD entry/exit location.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors.

Figures 9.2-9 and 9.2.8B in Appendix 9-D show the sound level contributions to the surrounding sound environment during operation on the site, as well as mapping of the NSA locations. The sound level impact at or near the property line is shown to be 55 dBA or less.

Table 9.2-7 shows the estimated sound levels (Ldn) for ambient/existing, HDD operations without mitigation, and HDD operations with mitigation considered during pullback operations when 24-hour operation at the site would occur.

Based on this analysis, the 55.0 dBA threshold would not be exceeded during these operating conditions for NSAs currently at or below 55.0 dBA. For NSAs with an estimated Ldn currently above 55.0 dBA, operation of the HDD at this location does not contribute to an increase of 10.0 dBA or greater at these locations based on this analysis.



Table 9.2-7. Noise Quality Analysis for HDD Bore at Coldwater Creek West^{1, 2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MO015	0.03	South	58.7	58.9	0.3	58.7	0.0
NSA-MO016	0.15	South	65.4	65.4	0.0	65.4	0.0
NSA-MO017	0.19	Southwest	67.8	67.8	0.0	67.8	0.0
NSA-MO018	0.17	South	48.6	48.7	0.1	48.6	0.0
NSA-MO019	0.35	South	43.4	43.5	0.1	43.5	0.0
NSA-MO020	0.08	North	48.5	52.1	3.6	49.4	0.9
NSA-MO021	0.19	Northwest	48.6	48.8	0.2	48.7	0.1

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Spanish Lake Park East HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location east of Spanish Lake Park. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated two shifts of nighttime work during pullback.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.

There are potentially four NSAs near this location. These NSAs will be described in greater detail once the noise surveys at this location have been completed.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill,



existing geology, and other factors. Spire commits to conducting all other drilling activities during daytime hours only.

At this time, the HDD location at Spanish Lake Park has not been surveyed for ambient sound levels. Spire will be performing an ambient sound level survey for these locations in the near future once the location is finalized, as well as performing a sound level model analysis for the site based on a typical HDD boring rig arrangement.

At that time, Spire will provide supplemental information with the applicable information in Table 9.2-8 and update Appendix D to include Figure 9.2.10.

Table 9.2-8. Noise Quality Analysis for HDD Bore at Spanish Lake Park East^{1, 2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MO026	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO027	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO028	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO029	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Spanish Lake Park West HDD Site (Construction Noise Model)

Spire will operate HDD operations at a location west of Spanish Lake Park. It is anticipated that drilling operations at this location will not exceed 15 weeks with an estimated 2 shifts of nighttime work during pullback.

The HDD entry/exit location, when in operation, will preliminarily consist of the following equipment:

- large drill rig at 110 dBA;
- two mud pumps at 110 dBA;
- three generators at 90 dBA; and
- separation plant at 100 dBA.



There are potentially five NSAs near this location. These NSAs will be described in greater detail once the noise surveys at this location have been completed.

Vehicles will be used to access the site as well as perform work around the site. These vehicles are assumed to be limited in speed to less than 30 MPH.

Spire is planning on conducting HDD activities during daytime working hours, except for pull-back activities which will require 24-hour operations for a short timeframe. The drill times vary depending on the length of the drill, existing geology, and other factors. Spire commits to conducting all other drilling activities during daytime hours only.

At this time, the HDD location at Spanish Lake Park has not been surveyed for ambient sound levels. Spire will be performing an ambient sound level survey for these locations in April 2017, as well as performing a sound level model analysis for the site based on a typical HDD boring rig arrangement. This information will be provided to FERC in May 2017.

At that time, Spire will provide an update to this report with the applicable information in the Table 9.2-9 and update Appendix D to include Figure 9.2.11.

Table 9.2-9. Noise Quality Analysis for HDD Bore at Spanish Lake Park West^{1, 2}

NSA	Approximate Distance of NSA to Site Center (mile)	Direction of NSA from Site Center	Ambient Sound Level (Ldn)	Estimated Sound Level (Ldn) due to HDD Site Operations without Mitigation ³	Potential Noise Increase without Mitigation	Estimated Sound Level (Ldn) due to HDD Site Operations with Mitigation ⁴	Potential Noise Increase with Mitigation
NSA-MO022	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO023	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO024	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO025	TBD	TBD	TBD	TBD	TBD	TBD	TBD
NSA-MO026	TBD	TBD	TBD	TBD	TBD	TBD	TBD

Notes:

- ¹ Ldn sound levels estimated Using SoundPLAN® V7.4 Acoustical Modeling Software.
- ² This HDD location will potentially operate 24 hours per day (e.g., during pullback operations).
- ³ Without noise reduction countermeasures (most conservative case).
- ⁴ For the purpose of estimating sound levels with mitigation, a conservative reduction of 10 db was applied to all potential sources prior to operational sound modeling. Specific noise mitigation measures have not been determined and noise mitigation measures were not included in operational sound modeling.

Expected Sound Levels

After evaluating ambient conditions and modeled sound level output, it is not anticipated that noise mitigation will be required at any of the M&R Stations or HDD locations. Therefore, total the expected Ldn at each NSA can



be found in Tables 9.2-2 through 9.2-9, under the column titled “Estimated Sound Level (Ldn) due to HDD site operations without mitigation”.

9.2.3.3 Blasting

Blasting activities are proposed to occur at two locations during pipeline construction, between mileposts 44.94 and 44.95 and 58.24 through 58.62. Blasting activities would only occur during daytime hours, specifically between the hours of 9:00 a.m. to 3:00 p.m. in accordance with Spire’s Blasting Plan (Resource Report 6, Appendix 6-C). All blasting activities will be performed in accordance with local and state regulations by a qualified blasting contractor.

9.2.4 Noise Mitigation

For diesel equipment used during construction of the Project, if it is found to be necessary to mitigate noise, it is anticipated that common construction mitigation measures such as vibration control, mufflers, etc. would be utilized for the Project.

HDD noise impacts determined in Section 9.2.3, Noise Impacts, may be mitigated as determined necessary through measures such as installing noise barriers, enclosing the drill rig fully or partially, and/or offering to temporarily relocate affected NSAs during short periods of elevated noise.

Construction activity and associated noise levels for the pipeline and aboveground facility installation will vary depending on the phase of construction in progress at any one time. These construction phases include site grading, clearing/grubbing, and pipeline and aboveground facility installation. The highest level of construction noise is assumed to occur during earthwork.

For M&R stations and mainline valves associated with the Project, the site construction noise associated with the installation of the new equipment should have a negligible impact on nearby NSAs, noting that construction will be limited to weekday daytime hours. The most prevalent sound source during construction will be the internal combustion engines used to power the construction equipment.

Pipeline construction noise-related impacts from the Project are expected to be short in duration at any given location and, therefore, have minimal impact. People at nearby residences and buildings will hear the construction noise but the overall impact will have a short duration and be insignificant. Construction will not result in the generation of, or exposure of persons to, excessive noise or vibration levels for lengthy periods.

Noise mitigation measures to be employed during construction include ensuring that sound muffling devices that are provided as standard equipment by the construction equipment manufacturer are kept in good working order.

The nature of construction of a pipeline dictates that construction activities and associated noise levels will move along the corridor and that no single NSA will be exposed to significant noise levels for an extended period. Some discrete activities like hydrostatic testing, tie-ins, and purging and packing the pipeline, may require 24-hour activity for limited periods (from one to three days). These 24-hour activities require only a few overnight construction personnel and do not result in significant noise generation.



There will be locations where pipeline construction will occur within 50 feet of residences of the North County Extension. Noise and vibration generated during construction at this distance will not be unusual in nature and will be similar to that which would occur during public works type projects (e.g., paving, trenching). This work will only occur for a few days or less at any location and impacts will be temporary. This work will only occur during weekday daytime hours in order to minimize impacts.

Work along the pipeline and at aboveground facilities will be performed in accordance with local noise ordinances.

Appendix 9-D provides detailed analysis of methodology, source sound level data, and proposed noise control treatments for each noise study.

9.3 References

- Intergovernmental Panel on Climate Change. 2006. *IPCC Guidelines for National Greenhouse Gas Inventories, Volume 2 Energy, Chapter 3 Mobile Combustion*. Accessed September 2016 from <http://www.ipcc-nggip.iges.or.jp/public/2006gl/>.
- Midwest Research Institute. 1998. *Emission Factor Documentation for AP-42 Section 13.2.2 Unpaved Roads Final Report*. Accessed September 2016 from <https://www3.epa.gov/ttnchie1/ap42/ch13/bgdocs/b13s02-2.pdf>.
- National Oceanic and Atmospheric Administration, National Centers for Environmental Information. 2015. *Local Climatological Data Annual Summary with Comparative Data - ST Louis, Missouri (KSTL)*. Accessed September 2016 from <http://www1.ncdc.noaa.gov/pub/orders/IPS/IPS-B1F4E70E-0021-4CD0-BE03-497DE74557CD.pdf>.
- National Oceanic and Atmospheric Administration, National Centers for Environmental Information. 1981-2010. *Three-decade Averages of Climatological Variables for St. Charles County Airport, Missouri*. Accessed September 2016 from <http://www.ncdc.noaa.gov/cdo-web/datatools/normals>.
- United States Environmental Protection Agency. 2016. *Annual Summary Data*. Accessed December 2016 from https://aqsdr1.epa.gov/aqsweb/aqstmp/airdata/download_files.html#Annual.
- United States Environmental Protection Agency. 2016. *Green Book Nonattainment Areas*. Accessed September 2016 from <https://www3.epa.gov/airquality/greenbook/>.
- United States Environmental Protection Agency. 2006. *AP 42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources Chapter 13.0 - Introduction to Miscellaneous Sources*. Accessed September 2016 from <https://www3.epa.gov/ttn/chief/ap42/ch13/index.html>.
- United States Environmental Protection Agency. 2004. *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition, NR-009c (EPA420-P-04-009)*. April 2004. Accessed September 2016 from <https://www3.epa.gov/otaq/models/nonrdmdl/nonrdmdl2004/420p04009.pdf>.



APPENDIX 9-A
Emission Estimates

Table 9A-1

Equipment Type	HP	Estimated Operating Hours				Emission Factors (g/hp-hr) ¹					Estimated Emissions (tons/yr)					
		24-Inch Pipeline				HC ³	CO	SO ₂ ⁴	NO _x	Particulates ⁵	VOC	CO	SO ₂	NO _x	PM ₁₀	PM _{2.5}
		Number	Months at Project	% Utilization	Total Hours ²											
Cranes																
Crane: 150 ton (Tier 3)	425	0	0.00	50%	0	0.1669	0.8425	4.86E-03	2.5	0.15	0.00	0.00	0.00E+00	0.00	0.00	0.00
Earthwork/Concrete Equipment																
Excavator (CAT 336) (Tier 3)	300	30	4.16	50%	24,960	0.1836	0.7475	4.86E-03	2.5	0.15	1.52	6.17	4.01E-02	20.64	1.24	1.20
Side Boom (CAT 573) (Tier 0)	225	30	4.16	50%	24,960	0.68	2.7	4.86E-03	8.38	0.402	4.21	16.72	3.01E-02	51.89	2.49	2.41
Dozer (CAT D8) (Tier 3)	325	20	4.16	50%	16,640	0.1669	0.8425	4.86E-03	2.5	0.15	1.00	5.02	2.90E-02	14.91	0.89	0.87
Vehicles																
Low Boy Truck (Tier 3)	200	5	4.48	50%	4,480	0.1836	0.7475	4.86E-03	2.5	0.15	0.18	0.74	4.80E-03	2.47	0.15	0.14
Contractor Truck (1/2 ton pickup) (Tier 3)	350	30	4.16	50%	24,960	0.1669	0.8425	4.86E-03	2.5	0.15	1.61	8.11	4.68E-02	24.08	1.44	1.40
Inspector Trucks (1/2 ton Pickup) (Tier 3)	350	20	4.16	50%	16,640	0.1669	0.8425	4.86E-03	2.5	0.15	1.07	5.41	3.12E-02	16.05	0.96	0.93
Surveyor Trucks (1/2 ton Pickup) (Tier 3)	350	5	4.16	50%	4,160	0.1669	0.8425	4.86E-03	2.5	0.15	0.27	1.35	7.80E-03	4.01	0.24	0.23
Welder Rig (Tier 2)	350	10	4.16	50%	8,320	0.1669	0.8425	4.86E-03	4.3351	0.1316	0.54	2.70	1.56E-02	13.92	0.42	0.41
Boom Truck (5 Tons) (Tier 2)	400	3	3.20	50%	1,920	0.1669	0.8425	4.86E-03	4.3351	0.1316	0.14	0.71	4.12E-03	3.67	0.11	0.11
Fuel Truck (5 ton) (Tier 3)	400	2	3.20	50%	1,280	0.1669	0.8425	4.86E-03	2.5	0.15	0.09	0.48	2.74E-03	1.41	0.08	0.08
Water Truck (5 ton) (Tier 0)	400	2	3.20	50%	1,280	0.68	2.7	4.86E-03	8.38	0.402	0.38	1.52	2.74E-03	4.73	0.23	0.22
Employee Vehicles (1/2 pickups) (Tier 3)	350	40	4.80	50%	38,400	0.1669	0.8425	4.86E-03	2.5	0.15	2.47	12.48	7.20E-02	37.04	2.22	2.16
Employee Vehicles (cars) (Tier 3)	150	35	4.80	50%	33,600	0.1836	0.8667	4.86E-03	2.5	0.22	1.02	4.82	2.70E-02	13.89	1.22	1.19
Pipe Stinging Truck (Tier 3)	200	5	3.20	50%	3,200	0.3085	0.7475	4.86E-03	4	0.1316	0.22	0.53	3.43E-03	2.82	0.09	0.09
R/W Mowing Tractors (Tier 2)	75	5	1.60	50%	1,600	0.3672	2.3655	4.86E-03	4.7	0.24	0.05	0.31	6.43E-04	0.62	0.03	0.03
Air Compressors																
Air Compressor (Tier 2)	50	10	3.84	50%	7,680	0.2789	1.5323	4.86E-03	4.7279	0.3389	0.12	0.65	2.06E-03	2.00	0.14	0.14
Miscellaneous Equipment																
Water Pumps (Tier 2)	5	10	3.20	50%	6,400	0.5508	4.1127	4.86E-03	4.3	0.5	0.02	0.15	1.72E-04	0.15	0.02	0.02
Mud Pumps (Tier 2)	25	4	3.20	50%	2,560	0.438	2.161	4.86E-03	4.4399	0.2665	0.03	0.15	3.43E-04	0.31	0.02	0.02
Tree Cutting Hot Saw (Tier 2)	200	2	2.05	50%	820	0.3085	0.7475	4.86E-03	4	0.1316	0.06	0.14	8.79E-04	0.72	0.02	0.02
Boring Machine (Tier 0)	600	2	3.20	50%	1,280	0.68	2.7	4.86E-03	8.38	0.402	0.58	2.29	4.12E-03	7.10	0.34	0.33
Carry Deck Loader	400	2	3.75	50%	1,500	0.1669	0.8425	4.86E-03	4.3351	0.1316	0.11	0.56	3.22E-03	2.87	0.09	0.08
Generator	10	4	3.75	50%	3,000	0.5508	4.1127	4.86E-03	4.3	0.5	0.02	0.14	1.61E-04	0.14	0.02	0.02
Backhoe (CAT 416F)	90	2	3.75	50%	1,500	0.3672	2.3655	4.86E-03	4.7	0.24	0.05	0.35	7.24E-04	0.70	0.04	0.03
Mini Excavator	25	4	3.75	50%	3,000	0.438	2.161	4.86E-03	4.4399	0.2665	0.04	0.18	4.02E-04	0.37	0.02	0.02
Dump Trucks	300	4	3.75	50%	3,000	0.3085	0.7475	4.86E-03	4	0.1316	0.31	0.74	4.82E-03	3.97	0.13	0.13
Total Estimated Project Emissions (Tons/Project/Year)											VOC	CO	SO₂	NO_x	PM₁₀	PM_{2.5}
											16.17	72.80	0.34	231.27	12.72	12.34
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year)											3.69	16.60	0.08	52.74	2.90	2.81
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year)											4.40	19.80	0.09	62.90	3.46	3.35
Total Estimated Emissions non-attainment and maintenance areas											8.08	36.40	0.17	115.63	6.36	6.17

Notes:

⁵ VMT per Day for 24-inch Pipeline:

2 Assume 100 hour work weeks and 4 weeks per month.

³ Assume Hydrocarbon(HC) approximately equal to VOCs.

⁴ Assumes Ultra Low Sulfur Diesel Fuel of 15ppm sulfur.

⁵ Per the *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition*, all PM emissions are assumed to be smaller than 10 microns (PM₁₀) and 97% of the PM is assumed to be smaller than 2.5 microns (PM_{2.5}) and all emissions are based on the assumption that all non-road engines will be either Tier 0, Tier 2, or Tier 3 Compliant (as noted). For the purpose of this estimate, all emissions sources are conservatively assumed to be diesel powered.

Table 9A-2

Equipment Type	HP	Estimated Operating Hours				Emission Factors (g/hp-hr) ¹					Estimated Emissions (tons/yr)					
		North County Extension				HC ³	CO	SO ₂ ⁴	NO _x	Particulates ⁵	VOC	CO	SO ₂	NO _x	PM ₁₀	PM _{2.5}
		Number	Months at Project	% Utilization	Total Hours ²											
Cranes																
Crane: 150 ton (Tier 3)	425	0	0.00	50%	0	0.1669	0.8425	1.50E-03	2.5	0.15	0.00	0.00	0.00E+00	0.00	0.00	0.00
Earthwork/Concrete Equipment																
Excavator (CAT 336) (Tier 3)	300	5	3.15	50%	3,150	0.1836	0.7475	1.50E-03	2.5	0.15	0.19	0.78	1.56E-03	2.60	0.16	0.15
Side Boom (CAT 573) (Tier 0)	225	5	3.15	50%	3,150	0.68	2.7	1.50E-03	8.38	0.402	0.53	2.11	1.17E-03	6.55	0.31	0.30
Dozer (CAT D8) (Tier 3)	325	3	3.15	50%	1,890	0.1669	0.8425	1.50E-03	2.5	0.15	0.11	0.57	1.02E-03	1.69	0.10	0.10
Vehicles																
Low Boy Truck (Tier 3)	200	4	2.94	50%	2,352	0.1836	0.7475	1.50E-03	2.5	0.15	0.10	0.39	7.78E-04	1.30	0.08	0.08
Contractor Truck (1/2 ton pickup) (Tier 3)	350	5	2.73	50%	2,730	0.1669	0.8425	1.50E-03	2.5	0.15	0.18	0.89	1.58E-03	2.63	0.16	0.15
Inspector Trucks (1/2 ton Pickup) (Tier 3)	350	3	2.73	50%	1,638	0.1669	0.8425	1.50E-03	2.5	0.15	0.11	0.53	9.48E-04	1.58	0.09	0.09
Surveyor Trucks (1/2 ton Pickup) (Tier 3)	350	2	2.73	50%	1,092	0.1669	0.8425	1.50E-03	2.5	0.15	0.07	0.36	6.32E-04	1.05	0.06	0.06
Welder Rig (Tier 2)	350	3	2.73	50%	1,638	0.1669	0.8425	1.50E-03	4.3351	0.1316	0.11	0.53	9.48E-04	2.74	0.08	0.08
Boom Truck (5 Tons) (Tier 2)	400	1	2.10	50%	420	0.1669	0.8425	1.50E-03	4.3351	0.1316	0.03	0.16	2.78E-04	0.80	0.02	0.02
Fuel Truck (5 ton) (Tier 3)	400	1	2.10	50%	420	0.1669	0.8425	1.50E-03	2.5	0.15	0.03	0.16	2.78E-04	0.46	0.03	0.03
Water Truck (5 ton) (Tier 0)	400	1	2.10	50%	420	0.68	2.7	1.50E-03	8.38	0.402	0.13	0.50	2.78E-04	1.55	0.07	0.07
Employee Vehicles (1/2 pickups) (Tier 3)	350	8	3.15	50%	5,040	0.1669	0.8425	1.50E-03	2.5	0.15	0.32	1.64	2.92E-03	4.86	0.29	0.28
Pipe Stinging Truck (Tier 3)	200	2	2.10	50%	840	0.3085	0.7475	1.50E-03	4	0.1316	0.06	0.14	2.78E-04	0.74	0.02	0.02
Air Compressors																
Air Compressor (Tier 2)	50	3	2.52	50%	1,512	0.2789	1.5323	1.50E-03	4.7279	0.3389	0.02	0.13	1.25E-04	0.39	0.03	0.03
Miscellaneous Equipment																
Water Pumps (Tier 2)	5	3	3.20	50%	1,920	0.5508	4.1127	1.50E-03	4.3	0.5	0.01	0.04	1.59E-05	0.05	0.01	0.01
Portable Light Plant (Tier 2)	25	3	3.20	50%	1,920	0.438	2.161	1.50E-03	4.4399	0.2665	0.02	0.11	7.94E-05	0.23	0.01	0.01
Mud Pumps (Tier 2)	25	2	3.20	50%	1,280	0.438	2.161	1.50E-03	4.4399	0.2665	0.02	0.08	5.29E-05	0.16	0.01	0.01
Tree Cutting Hot Saw (Tier 2)	200	1	2.05	50%	410	0.3085	0.7475	1.50E-03	4	0.1316	0.03	0.07	1.36E-04	0.36	0.01	0.01
Boring Machine (Tier 0)	600	2	3.20	50%	1,280	0.68	2.7	1.50E-03	8.38	0.402	0.58	2.29	1.27E-03	7.10	0.34	0.33
Carry Deck Loader	400	1	3.75	50%	750	0.1669	0.8425	1.50E-03	4.3351	0.1316	0.06	0.28	4.96E-04	1.43	0.04	0.04
Generator	10	2	3.75	50%	1,500	0.5508	4.1127	1.50E-03	4.3	0.5	0.01	0.07	2.48E-05	0.07	0.01	0.01
Backhoe (CAT 416F)	90	1	3.75	50%	750	0.3672	2.3655	1.50E-03	4.7	0.24	0.03	0.18	1.12E-04	0.35	0.02	0.02
Mini Excavator	25	2	3.75	50%	1,500	0.438	2.161	1.50E-03	4.4399	0.2665	0.02	0.09	6.20E-05	0.18	0.01	0.01
Dump Trucks	300	2	3.75	50%	1,500	0.3085	0.7475	1.50E-03	4	0.1316	0.15	0.37	7.44E-04	1.98	0.07	0.06
Total Estimated Project Emissions (Tons/Project/Year)											VOC	CO	SO₂	NO_x	PM₁₀	PM_{2.5}
											2.97	12.80	0.02	41.92	2.14	2.07
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year)											2.97	12.80	0.02	41.92	2.14	2.07
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year)											0.00	0.00	0.00	0.00	0.00	0.00
Total Estimated Emissions non-attainment and maintenance areas											2.97	12.80	0.02	41.92	2.14	2.07

Notes:

⁵ VMT per Day for North County Extension:

2 Assume 100 hour work weeks and 4 weeks per month.

³ Assume Hydrocarbon(HC) approximately equal to VOCs.

⁴ Assumes Ultra Low Sulfur Diesel Fuel of 15ppm sulfur.

⁵ Per the *Exhaust and Crankcase Emission Factors for Nonroad Engine Modeling - Compression-Ignition*, all PM emissions are assumed to be smaller than 10 microns (PM₁₀) and 97% of the PM is assumed to be smaller than 2.5 microns (PM_{2.5}) and all emissions are based on the assumption that all non-road engines will be either Tier 0, Tier 2, or Tier 3 Compliant (as noted). For the purpose of this estimate, all emissions sources are conservatively assumed to be diesel powered.

Table 9A-3

Equipment Type	HP	Estimated Operating Hours				Total Hours	Information		Emission Factors ¹		Estimated Emissions		
		24-Inch Pipeline					W: mean vehicle Wt (tons) ²	Surface material Silt Content (%) ³	E: based on PM ₁₀ (lb/VMT)	E: based on PM _{2.5} (lb/VMT)	VMT: Vehicle Miles Traveled (mi per project)	Fugitive Particulate PM ₁₀ (tons per project)	Fugitive Particulate PM _{2.5} (tons per project)
		Number	Months at Project	% Utilization									
Cranes													
Crane: 150 ton (Tier 3)	425	0	0	0.5	0	150	8.5%	6.40	0.64	0	0.00	0.00	
Earthwork/Concrete Equipment													
Excavator (CAT 336) (Tier 3)	300	30	4.16	0.5	24,960	24	8.5%	2.80	0.28	895	1.26	0.13	
Side Boom (CAT 573) (Tier 0)	225	30	4.16	0.5	24,960	35	8.5%	3.32	0.33	895	1.49	0.15	
Dozer (CAT D8) (Tier 3)	325	20	4.16	0.5	16,640	40	8.5%	3.53	0.35	895	1.58	0.16	
Vehicles													
Low Boy Truck (Tier 3)	200	5	4.48	0.5	4,480	7	8.5%	1.61	0.16	964	0.78	0.08	
Contractor Truck (1/2 ton pickup) (Tier 3)	350	30	4.16	0.5	24,960	7	8.5%	1.61	0.16	895	0.72	0.07	
Inspector Trucks (1/2 ton Pickup) (Tier 3)	350	20	4.16	0.5	16,640	7	8.5%	1.61	0.16	895	0.72	0.07	
Surveyor Trucks (1/2 ton Pickup) (Tier 3)	350	5	4.16	0.5	4,160	7	8.5%	1.61	0.16	895	0.72	0.07	
Welder Rig (Tier 2)	350	10	4.16	0.5	8,320	7	8.5%	1.61	0.16	895	0.72	0.07	
Boom Truck (5 Tons) (Tier 2)	400	3	3.2	0.5	1,920	7	8.5%	1.61	0.16	689	0.55	0.06	
Fuel Truck (5 ton) (Tier 3)	400	2	3.2	0.5	1,280	7	8.5%	1.61	0.16	689	0.55	0.06	
Water Truck (5 ton) (Tier 0)	400	2	3.2	0.5	1,280	7	8.5%	1.61	0.16	689	0.55	0.06	
Employee Vehicles (1/2 pickup) (Tier 3)	350	40	4.8	0.5	38,400	18.0	8.5%	2.46	0.25	1033	1.27	0.13	
Employee Vehicles (cars) (Tier 3)	150	35	4.8	0.5	33,600	18.0	8.5%	2.46	0.25	1033	1.27	0.13	
Pipe Stinging Truck (Tier 3)	200	5	3.2	0.5	3,200	7	8.5%	1.61	0.16	689	0.55	0.06	
R/W Mowing Tractors (Tier 2)	75	5	1.6	0.5	1,600	0.83	8.5%	0.62	0.06	344	0.11	0.01	
Air Compressors													
Air Compressor (Tier 2)	50	10	3.84	0.5	7,680	1.1	8.5%	0.69	0.07	827	0.29	0.03	
Miscellaneous Equipment													
Water Pumps (Tier 2)	5	10	3.2	0.5	6,400	15	8.5%	2.27	0.23	689	0.78	0.08	
Portable Light Plant (Tier 2)	25	10	3.2	0.5	6,400	7	8.5%	1.61	0.16	689	0.55	0.06	
Mud Pumps (Tier 2)	25	4	3.2	0.5	2,560	7	8.5%	1.61	0.16	689	0.55	0.06	
Tree Cutting Hot Saw (Tier 2)	200	2	2.05	0.5	820	7	8.5%	1.61	0.16	441	0.36	0.04	
Boring Machine (Tier 0)	600	2	3.2	0.5	1,280	7	8.5%	1.61	0.16	689	0.55	0.06	
Carry Deck Loader	400	2	3.75	0.5	1,500	15	8.5%	2.27	0.23	807	0.92	0.09	
Generator	10	4	3.75	0.5	3,000	7	8.5%	1.61	0.16	807	0.65	0.06	
Backhoe (CAT 416F)	90	2	3.75	0.5	1,500	7	8.5%	1.61	0.16	807	0.65	0.06	
Mini Excavator	25	4	3.75	0.5	3,000	7	8.5%	1.61	0.16	807	0.65	0.06	
Dump Trucks	300	4	3.75	0.5	3,000	15	8.5%	2.27	0.23	807	0.92	0.09	
Total Estimated Project Emissions (Tons/Project/Year) Uncontrolled											19.72	1.97	
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year) - Uncontrolled											4.50	0.45	
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year) - Uncontrolled											5.36	0.54	
Total Estimated Emissions non-attainment and maintenance areas - Uncontrolled											9.86	0.99	
Total Estimated Project Emissions (Tons/Project/Year) Controlled											11.83	1.18	
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year) - Controlled											2.56	0.26	
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year) - Controlled											3.22	0.32	
Total Estimated Emissions non-attainment and maintenance areas - Controlled											5.78	0.58	
Estimated Travel Distances:													
VMT per Day for 24-inch Pipeline: ⁵	7.175	mi.											
Water Spray Control Efficiency ⁶	0.4	%											

Notes:

¹ Calculations based EPA's AP 42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources Chapter 13.0 – Introduction to Miscellaneous Sources, Section 13.2 – Introduction to Fugitive Dust Sources Final Section of 13.2.2 Unpaved Roads (November 2006) 13.2.2. Unpaved Roads

² Mean Vehicle Weight for equipment engines obtained from Dataquest, 2006 and public sources (Caterpillar home page and Internet).

³ Surface Material Silt Content estimated based on similar projects and data from AP-42, Chapter 13.2.2 Table 13.2-1 Construction Sites.

⁴ Boring Machine is moved into place and does not move on a daily basis; therefore, emissions are not calculated for this piece of equipment.

⁵ Assumed that each piece of equipment travels a length of 25% of the ROW spread on a daily basis.

⁶ Based on low end of test data range of 40% to 70% for PM-10 from, obtained from background Document Emission Factor Documentation for AP-42, Section 13.2.2 Unpaved Roads Final Report (September 1998).

Table 9A-4

Equipment Type	HP	Estimated Operating Hours				Information		Emission Factors ¹		Estimated Emissions		
		North County Extension			Total Hours	W: mean vehicle Wt (tons) ²	material Silt Content (%) ³	E: based on PM ₁₀ (lb/VMT)	E: based on PM _{2.5} (lb/VMT)	Vehicle Miles Traveled (mi per project)	Particulate PM ₁₀ (tons per project)	Particulate PM _{2.5} (tons per project)
		Number	Months at Project	% Utilization								
Cranes												
Crane: 150 ton (Tier 3)	425	0	0	0.5	0	150	8.5%	6.40	0.64	0	0.00	0.00
Earthwork/Concrete Equipment												
Excavator (CAT 336) (Tier 3)	300	5	3.15	0.5	3,150	24	8.5%	2.80	0.28	148	0.21	0.02
Side Boom (CAT 573) (Tier 0)	225	5	3.15	0.5	3,150	35	8.5%	3.32	0.33	148	0.25	0.02
Dozer (CAT D8) (Tier 3)	325	3	3.15	0.5	1,890	40	8.5%	3.53	0.35	148	0.26	0.03
Vehicles												
Contractor Truck (1/2 ton pickup) (Tier 3)	350	5	2.73	0.5	2,730	7	8.5%	1.61	0.16	128	0.10	0.01
Inspector Trucks (1/2 ton Pickup) (Tier 3)	350	3	2.73	0.5	1,638	7	8.5%	1.61	0.16	128	0.10	0.01
Surveyor Trucks (1/2 ton Pickup) (Tier 3)	350	2	2.73	0.5	1,092	7	8.5%	1.61	0.16	128	0.10	0.01
Welder Rig (Tier 2)	350	3	2.73	0.5	1,638	7	8.5%	1.61	0.16	128	0.10	0.01
Boom Truck (5 Tons) (Tier 2)	400	1	2.1	0.5	420	7	8.5%	1.61	0.16	98	0.08	0.01
Fuel Truck (5 ton) (Tier 3)	400	1	2.1	0.5	420	7	8.5%	1.61	0.16	98	0.08	0.01
Water Truck (5 ton) (Tier 0)	400	1	2.1	0.5	420	7	8.5%	1.61	0.16	98	0.08	0.01
Employee Vehicles (1/2 pickups) (Tier 3)	350	8	3.15	0.5	5,040	7	8.5%	1.61	0.16	148	0.12	0.01
Employee Vehicles (cars) (Tier 3)	150	4	3.15	0.5	2,520	18.0	8.5%	2.46	0.25	148	0.18	0.02
Pipe Stinging Truck (Tier 3)	200	2	2.1	0.5	840	18.0	8.5%	2.46	0.25	98	0.12	0.01
Air Compressors												
Air Compressor (Tier 2)	50	10	3.84	0.5	7,680	1.1	8.5%	0.69	0.07	180	0.06	0.01
Miscellaneous Equipment												
Water Pumps (Tier 2)	5	10	3.2	0.5	6,400	15	8.5%	2.27	0.23	150	0.17	0.02
Portable Light Plant (Tier 2)	25	10	3.2	0.5	6,400	7	8.5%	1.61	0.16	150	0.12	0.01
Mud Pumps (Tier 2)	25	4	3.2	0.5	2,560	7	8.5%	1.61	0.16	150	0.12	0.01
Tree Cutting Hot Saw (Tier 2)	200	2	2.05	0.5	820	7	8.5%	1.61	0.16	96	0.08	0.01
Boring Machine (Tier 0)	600	2	3.2	0.5	1,280	7	8.5%	1.61	0.16	150	0.12	0.01
Carry Deck Loader	400	2	3.75	0.5	1,500	15	8.5%	2.27	0.23	176	0.20	0.02
Generator	10	4	3.75	0.5	3,000	7	8.5%	1.61	0.16	176	0.14	0.01
Backhoe (CAT 416F)	90	2	3.75	0.5	1,500	7	8.5%	1.61	0.16	176	0.14	0.01
Mini Excavator	25	4	3.75	0.5	3,000	7	8.5%	1.61	0.16	176	0.14	0.01
Dump Trucks	300	4	3.75	0.5	3,000	15	8.5%	2.27	0.23	176	0.20	0.02
Total Estimated Project Emissions (Tons/Project/Year) - Uncontrolled											3.28	0.33
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year) - Uncontrolled											0.75	0.07
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year) - Uncontrolled											0.89	0.09
Total Estimated Emissions non-attainment and maintenance areas - Uncontrolled											1.64	0.16
Total Estimated Project Emissions (Tons/Project/Year) - Controlled											1.97	0.20
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year) - Controlled											0.45	0.04
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year) - Controlled											0.53	0.05
Total Estimated Emissions non-attainment and maintenance areas - Controlled											0.97	0.10
Estimated Travel Distances:												
VMT per Day for 24-inch Pipeline: ⁵	1.5625	mi.										
Water Spray Control Efficiency ⁶	0.4	%										

Notes:

¹ Calculations based on equation (1a) [Emission Factor (lb/VMT): E = k*[(s/12)^a]*(W/3)^b] from EPA's AP 42 Fifth Edition Compilation of Air Pollutant Emission Factors, Volume 1: Stationary Point and Area Sources Chapter 13.0 – Introduction to Miscellaneous Sources, Section 13.2 – Introduction to Fugitive Dust Sources Final Section of 13.2.2 Unpaved Roads (November 2006) 13.2.2. Unpaved Roads. Empirical constants used in this equation k, a, b where obtained from Table 13.2.2-2.

² Mean Vehicle Weight for equipment engines obtained from Dataquest, 2006 and public sources (Caterpillar home page and Internet).

³ Surface Material Silt Content estimated based on similar projects and data from AP-42, Chapter 13.2.2 Table 13.2-1 Construction Sites.

⁴ Boring Machine is moved into place and does not move on a daily basis; therefore, emissions are not calculated for this piece of equipment.

⁵ Assumed that each piece of equipment travels a length of 25% of the ROW spread on a daily basis.

⁶ Based on low end of test data range of 40% to 70% for PM-10 from, obtained from background Document Emission Factor Documentation for AP-42, Section 13.2.2 Unpaved Roads Final Report (September 1998).

**Table 9A-5
Material Handling Emission Calculation Basis Data (24-inch Pipeline, North County Extension)**

Project Aspect	Parameter	units	24-Inch	North County Extension
All Aspects	Pipe Length	miles	59.2	6.0
	Pipe Length	yards	104,192	10,560
	Pipe Length	feet	312,576	31,680
	Length in Agricultural Use ¹	miles	53	5
	Length in Agricultural Use	Yards	93,773	9,504
	Length in Agricultural Use	Feet	281,318	28,512
Trench Spoil Pile	Pipe Diameter	inches	24.0	24.0
	Max Trench Bottom Width ²	feet	4.0	4.0
	Max Trench Top Width	feet	15	15
	Max Trench Width @ Top Soil Spoil Interface	feet	12,938	12,938
	Total - Max Trench Depth Removed	feet	8	8
	Total - Trench Cross Sectional Area ³	ft^2	76.00	76.00
	Total - Trench Cross Sectional Area ³	yd^2	8.44	8.44
	Total - Volume of Soil Material Moved	yd^3	879,380	89,126
	Spoil - Max Depth of Removed	feet	6.5	6.5
	Spoil - Cross Sectional Area	ft^2	55.05	55.05
	Spoil - Cross Sectional Area	yd^2	6.12	6.12
	Spoil - Volume of Material Moved	yd^3	637,655	64,627
	Spoil - Pile height	feet	5.2	5.2
	Spoil - Pile base (width)	feet	10.5	10.5
	Spoil - Pile Face	feet	7.4	7.4
Spoil - Pile Surface Area ⁴	ft^2	2,319,179	235,052	
Spoil - Pile Surface Area ⁴	yd^2	257,687	26,117	
Trench Top Soil Pile	Top Soil - Max Depth of Topsoil Removed ⁵	feet	1.5	1.5
	Top Soil - Cross Sectional Area from Trench ³	ft^2	20.95	20.95
	Top Soil - Cross Sectional Area from Trench ³	yd^2	2.33	2.33
	Top Soil - Width of Top Soil Removed In Workspace ⁶	feet	31.49	31.49
	Top Soil - Cross Sectional Area	ft^2	45.69	45.69
	Top Soil - Cross Sectional Area	yd^2	5.08	5.08
	Top Soil - Volume of Material Moved	yd^3	528,980	53,613
	Top Soil - Pile height	feet	4.6	4.6
	Top Soil - Pile base (width)	feet	9.2	9.2
	Top Soil - Pile Face	feet	6.5	6.5
	Top Soil - Pile Surface Area ⁴	ft^2	674,437	68,355
	Top Soil - Pile Surface Area ⁴	yd^2	74,937	7,595
Agricultural Top Soil Removed	Top Soil - Max Depth of Topsoil Removed ⁵	feet	1.5	1.5
	Top Soil - Width of Extra Topsoil removed in Ag areas ⁷	feet	50	50
	Top Soil - Additional Cross Sectional Area for Ag lands	ft^2	75	75
	Top Soil - Additional Cross Sectional Area for Ag lands	yd^2	8.33	8.33
	Top Soil - Additional Volume of Material Moved in Ag Lands	yd^3	781,440	79,200
	Top Soil - Pile height for Additional Ag Soil Pile	feet	8.7	8.7
	Top Soil - Pile base (width) for Additional Ag Soil Pile	feet	17.3	17.3
	Top Soil - Pile Face for Additional Ag Soil Pile	feet	12.2	12.2
	Top Soil - Pile Surface Area for Additional Ag Soil Pile ⁴	ft^2	3,445,433	349,199
	Top Soil - Pile Surface Area for Additional Ag Soil Pile ⁴	yd^2	382,826	38,800

Notes:

¹ Assumed 90% of land in IL and 40% in MO was in agricultural use.

² Assumed one foot of space between walls and each side of pipe.

³ Trench is a shape of a trapezoid.

⁴ Assume pile is a triangular mound, with 45 degree slopes, that runs the length of open trench, that base of pile equals Max Trench Top Width, and that shape of the end of pile is ignored.

⁵ Used 1.5 feet as topsoil depth due to deeper topsoil layers anticipated in IL.

⁶ Equal to width of trench plus width of base of spoil pile and 6 foot buffer.

⁷ Assumed top soil removed in the agricultural areas is equal to two 25 foot travel lanes for 24" pipeline and one 15 foot travel lane for the North County Extension.

Table 9A-6

Material Handling & Wind Erosion Emission Calculation Basis Data (24-inch Pipeline, North County Extension)

Site and Material Specific Information			
Parameters	Units	Value	
		24-Inch	North County Extension
Mean Wind Speed (U) ¹	mph	9.1	
Volume of Spoil Material Moved ²	yd^3	1,275,310	129,254
Volume of Top Soil Material Moved ²	yd^3	2,620,841	265,626
Density of Soil ³	lb/yd^3	2,241.79	
Mass of Spoil Material Moved	tons	1,429,489	144,881
Mass of Top Soil Material Moved	tons	2,937,687	297,739
Working Surface Area of Spoil Piles ⁴	yd^2	13,058	13,058
Working Surface Area of Top Soil Piles ⁴	yd^2	23,197	23,197
Length of open trench/dig site ⁵	miles	3	3
Material Moisture Content - Spoil (M) ⁶	%	7.4	
Material Moisture Content - Top Soil (M) ⁷	%	12.0	

Site and Material Specific Information							
Parameters	Units	24-Inch			North County Extension		
		TSP	PM ₁₀	PM _{2.5}	TSP	PM ₁₀	PM _{2.5}
Handling Particulate Size Multiplier (k) ⁸	--	0.74	0.35	0.053	0.74	0.35	0.053
Handling Emission Factor Spoil Material ⁹	lb/ton	8.26E-04	3.91E-04	5.92E-05	8.26E-04	3.91E-04	5.92E-05
Handling Emission Factor Top Soil Material ⁹	lb/ton	4.20E-04	1.99E-04	3.01E-05	4.20E-04	1.99E-04	3.01E-05
Wind Erosion Emission Factor ¹⁰	lb/yd^2	5.04E-02	2.52E-02	1.01E-02	5.04E-02	2.52E-02	1.01E-02
Handling Spoil Emissions	tons	0.59	0.28	0.04	0.060	0.028	0.0043
Handling Top Soil Emissions	tons	0.62	0.29	0.04	0.062	0.030	0.0045
Wind Erosion Spoil Pile Emissions	tons	0.33	0.16	0.07	0.329	0.164	0.066
Wind Erosion Top Soil Pile Emissions	tons	0.58	0.29	0.12	0.58	0.29	0.12
Total Emissions	tons	2.12	1.03	0.27	1.04	0.51	0.19
Total Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year)	tons	0.48	0.23	0.06	1.04	0.51	0.19
Total Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year)	tons	0.58	0.28	0.07	0.00	0.00	0.00
Total Emissions non-attainment and maintenance areas	tons	1.06	0.51	0.13	1.04	0.51	0.19

Notes:

¹ St. Louis, Missouri (KSTL) Local Climatological Data, Normals, Means, and Extremes.

² Volume doubled because material is removed and replaced.

³ Density from USDA, NRCS, *Soil Quality Indicators*, Medium textured soil 50% pore space.

⁴ Working Surface Area is the surface area of pile(s) adjacent to the open trench.

⁵ Assumed 3 miles of open trench on the 24" pipeline and 3 miles on the North County Extension.

⁶ Based on mean value listed in AP-42 Table 13.2.4-1, Municipal solid waste landfills, Sand.

⁷ Based on mean value listed in AP-42 Table 13.2.4-1, Municipal solid waste landfills, Cover.

⁸ Particle size multiplier obtained from values listed in AP-42 page 13.2.4-4.

⁹ Emission factor calculated using equation (1) in AP-42 Chapter 13.2.4, Emission Factor (lb/ton): $E = k \cdot 0.0032 \cdot [(U/5)^{1.3}] / [(M/2)^{1.4}]$

¹⁰ Emission factor calculated using questions in AP-42 Chapter 13.2.5 as detailed in Table 9A-6a.

**Table 9A-6a
Wind Erosion Emission Factor Calculation Basis Data (24-inch Pipeline)**

Basis for Calculations:

AP-42 Chapter 13.2.5 Industrial Wind Erosion

- EF = emission factor, g/m² (EF_c is for chronic conditions, EF_a is for acute conditions)
- k = particle size multiplier, dimensionless
- N = number of days of disturbances per year
- P_i = erosion potential for disturbed area, g/m² (Per AP-42, erosion potential is assumed to be 0 between disturbances and for undisturbed areas.)
- u* = friction velocity, m/s
- u* = threshold friction velocity m/s (From Table 13.2.5-2, u* ranges from 0.54 m/s for fine coal dust to 1.33 m/s for roadbed material; From Table 13.2.5-2, u* = 1.02 m/s for overburden at a coal mine)

- u₁₀⁺ = fastest mile of wind, m/s, at reference anemometer height of 10 m.
- A = disturbed area, m²
- E = emissions, grams/year

Equation (1): $u^* = 0.053 \cdot u_{10}^+$

Equation (2): $P_i = \frac{58 \cdot (u^* - u_t^*)^2 + 25 \cdot (u^* - u_t^*)}{N}$

Equation (3): $EF = k \cdot \sum P_i$

Equation (4): $E = EF \cdot A$

Meteorological Information:

VMT per Day for 24-inch Pipeline: ⁵

St. Louis, MO (KSTL)
Station: ¹ WBAN13994

Parameter	Value	Units
Anemometer Height (z) ²	10	meters
MAX 2-minute Wind Speed:	53	mph
MAX 2-minute Wind Speed:	23.69	m/s
Roughness Height: ³	0.005	meters

Emission Factor Calculation:

Variable	Both 24-Inch & North County Extension	
u ₁₀ ⁺	23.69	For St. Louis, MO (KSTL) WBAN13994 u+ = 53 mph (23.69 m/s) at 10 m
u*	1.256	Calculated using equation (1).
u _t [*]	1.02	Overburden from Table 13.2.5-2 was used
P _i	9.11	Calculated using Equation (2). Note: If u* < u _t [*] , then P _i = 0.
N	3	Assume stockpile are disturbed 3 times during construction

	PM =>	< 30 μm	< 15 μm	< 10 μm	< 2.5 μm
k ⁴		1.0	0.6	0.5	0.2
EF (g/m ²) ⁵		27.32	16.39	13.66	5.46
EF (lb/yd ²)		5.04E-02	3.02E-02	2.52E-02	1.01E-02

Notes:

¹ National Oceanic and Atmospheric Administration, National Centers for Environmental Information. 2015. Local Climatological Data Annual Summary with Comparative Data – ST Louis Missouri (KSTL).

² KSTL's Anemometer has been 10 meters since 1996, per the "anemometer_height__info" excel file found at the link below.

³ A typical roughness height of 0.5 cm (0.005 m) has been assumed. If a site a specific roughness height is available, it should be used.

⁴ Particle size multiplier obtained from values listed in AP-42 page 13.2.5-3.

⁵ Calculated using Equation (3) and daily condition variables.

<http://www.wcc.nrcs.usda.gov/ftpref/downloads/climate/windrose/>

**Table 9A-7
Potential Greenhouse Gas Emissions (24-inch Pipeline - 24-Inch)**

Equipment Type	HP	Estimated Operating Hours				Emission Factors (g/hp-hr) ¹			Estimated Emissions (tons/yr)		
		24-Inch				CO ₂	N ₂ O	CH ₄	CO ₂	N ₂ O	CH ₄
		Number	Months at Project	% Utilization	Total Hours ²						
Earthwork/Concrete Equipment											
Excavator (CAT 336) (Tier 3)	300	30	4.2	50%	24,960	199.1	0.0111	0.0768	1643.56	0.09205	0.63436
Side Boom (CAT 573) (Tier 0)	225	30	4.2	50%	24,960	199.1	0.0111	0.0768	1232.67	0.06904	0.47577
Dozer (CAT D8) (Tier 3)	325	20	4.2	50%	16,640	199.1	0.0111	0.0768	1187.02	0.06648	0.45815
Vehicles											
Contractor Truck (1/2 ton pickup) (Tier 3)	350	30	4.2	50%	24,960	199.1	0.0111	0.0768	1917.49	0.10739	0.74008
Inspector Trucks (1/2 ton Pickup) (Tier 3)	350	20	4.2	50%	16,640	199.1	0.0111	0.0768	1278.33	0.07159	0.49339
Surveyor Trucks (1/2 ton Pickup) (Tier 3)	350	5	4.2	50%	4,160	199.1	0.0111	0.0768	319.58	0.01790	0.12335
Welder Rig (Tier 2)	350	10	4.2	50%	8,320	199.1	0.0111	0.0768	639.16	0.03580	0.24669
Boom Truck (5 Tons) (Tier 2)	400	3	3.2	50%	1,920	199.1	0.0111	0.0768	168.57	0.00944	0.06506
Fuel Truck (5 ton) (Tier 3)	400	2	3.2	50%	1,280	199.1	0.0111	0.0768	112.38	0.00629	0.04337
Water Truck (5 ton) (Tier 0)	400	2	3.2	50%	1,280	199.1	0.0111	0.0768	112.38	0.00629	0.04337
Employee Vehicles (1/2 pickups) (Tier 3)	350	40	4.8	50%	38,400	199.1	0.0111	0.0768	2949.98	0.16522	1.13859
Employee Vehicles (cars) (Tier 3)	150	35	4.8	50%	33,600	199.1	0.0111	0.0768	1106.24	0.06196	0.42697
Pipe Stinging Truck (Tier 3)	200	5	3.2	50%	3,200	199.1	0.0111	0.0768	140.48	0.00787	0.05422
R/W Mowing Tractors (Tier 2)	75	5	1.6	50%	1,600	199.1	0.0111	0.0768	26.34	0.00148	0.01017
Air Compressors											
Air Compressor (Tier 2)	50	10	3.8	50%	7,680	199.1	0.0111	0.0768	84.29	0.00472	0.03253
Miscellaneous Equipment											
Water Pumps (Tier 2)	5	10	3.2	50%	6,400	199.1	0.0111	0.0768	7.02	0.00039	0.00271
Portable Light Plant (Tier 2)	25	10	3.2	50%	6,400	199.1	0.0111	0.0768	35.12	0.00197	0.01355
Mud Pumps (Tier 2)	25	4	3.2	50%	2,560	199.1	0.0111	0.0768	14.05	0.00079	0.00542
Tree Cutting Hot Saw (Tier 2)	200	2	2.1	50%	820	199.1	0.0111	0.0768	36.00	0.00202	0.01389
Boring Machine (Tier 0)	600	2	3.2	50%	1,280	199.1	0.0111	0.0768	168.57	0.00944	0.06506
Carry Deck Loader	400	2	3.8	50%	1,500	199.1	0.0111	0.0768	131.70	0.00738	0.05083
Generator	10	4	3.8	50%	3,000	199.1	0.0111	0.0768	6.58	0.00037	0.00254
Backhoe (CAT 416F)	90	2	3.8	50%	1,500	199.1	0.0111	0.0768	29.63	0.00166	0.01144
Mini Excavator	25	4	3.8	50%	3,000	199.1	0.0111	0.0768	16.46	0.00092	0.00635
Dump Trucks	300	4	3.8	50%	3,000	199.1	0.0111	0.0768	197.54	0.01106	0.07624
Total Estimated Project Emissions (Tons/Project/Year)									CO₂	N₂O	CH₄
									13,561.1	0.76	5.23
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year)									3,092.5	0.17	1.19
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year)									3,688.1	0.21	1.42
Total Estimated Emissions non-attainment and maintenance areas									6,780.6	0.38	2.62

Notes:

¹ Original Default Factors given in Kg/TJ for Diesel Off-Road Mobile Sources: 74,100 4.15 28.6 (in Kg/TJ)

² Assume 100 hour work weeks and 4 weeks per month.

**Table 9A-8
Potential Greenhouse Gas Emissions (North County Extension)**

Equipment Type	HP	Estimated Operating Hours				Total Hours ²	Emission Factors (g/hp-hr) ¹			Estimated Emissions (tons/yr)		
		North County Extension					CO ₂	N ₂ O	CH ₄	CO ₂	N ₂ O	CH ₄
		Number	Months at Project	% Utilization								
Earthwork/Concrete Equipment												
Excavator (CAT 336) (Tier 3)	300	5	3.2	50%	1,890	199.1	0.0111	0.0768	124.45	0.00697	0.04803	
Side Boom (CAT 573) (Tier 0)	225	5	3.2	50%	1,890	199.1	0.0111	0.0768	93.34	0.00523	0.03603	
Dozer (CAT D8) (Tier 3)	325	3	3.2	50%	1,134	199.1	0.0111	0.0768	80.89	0.00453	0.03122	
Vehicles												
Contractor Truck (1/2 ton pickup) (Tier 3)	350	5	2.7	50%	1,638	199.1	0.0111	0.0768	125.84	0.00705	0.04857	
Inspector Trucks (1/2 ton Pickup) (Tier 3)	350	3	2.7	50%	983	199.1	0.0111	0.0768	75.50	0.00423	0.02914	
Surveyor Trucks (1/2 ton Pickup) (Tier 3)	350	2	2.7	50%	655	199.1	0.0111	0.0768	50.33	0.00282	0.01943	
Welder Rig (Tier 2)	350	3	2.7	50%	983	199.1	0.0111	0.0768	75.50	0.00423	0.02914	
Boom Truck (5 Tons) (Tier 2)	400	1	2.1	50%	252	199.1	0.0111	0.0768	22.12	0.00124	0.00854	
Fuel Truck (5 ton) (Tier 3)	400	1	2.1	50%	252	199.1	0.0111	0.0768	22.12	0.00124	0.00854	
Water Truck (5 ton) (Tier 0)	400	1	2.1	50%	252	199.1	0.0111	0.0768	22.12	0.00124	0.00854	
Employee Vehicles (1/2 pickups) (Tier 3)	350	8	3.2	50%	3,024	199.1	0.0111	0.0768	232.31	0.01301	0.08966	
Employee Vehicles (cars) (Tier 3)	150	4	3.2	50%	1,512	199.1	0.0111	0.0768	49.78	0.00279	0.01921	
Pipe Stinging Truck (Tier 3)	200	2	2.1	50%	504	199.1	0.0111	0.0768	22.12	0.00124	0.00854	
Air Compressors												
Air Compressor (Tier 2)	50	3	2.5	50%	907	199.1	0.0111	0.0768	9.96	0.00056	0.00384	
Miscellaneous Equipment												
Water Pumps (Tier 2)	5	3	3.2	50%	1,152	199.1	0.0111	0.0768	1.26	0.00007	0.00049	
Portable Light Plant (Tier 2)	25	3	3.2	50%	1,152	199.1	0.0111	0.0768	6.32	0.00035	0.00244	
Mud Pumps (Tier 2)	25	2	3.2	50%	768	199.1	0.0111	0.0768	4.21	0.00024	0.00163	
Tree Cutting Hot Saw (Tier 2)	200	1	2.1	50%	246	199.1	0.0111	0.0768	10.80	0.00060	0.00417	
Boring Machine (Tier 0)	600	2	3.2	50%	768	199.1	0.0111	0.0768	101.14	0.00566	0.03904	
Carry Deck Loader	400	1	3.8	50%	450	199.1	0.0111	0.0768	39.51	0.00221	0.01525	
Generator	10	2	3.8	50%	900	199.1	0.0111	0.0768	1.98	0.00011	0.00076	
Backhoe (CAT 416F)	90	1	3.8	50%	450	199.1	0.0111	0.0768	8.89	0.00050	0.00343	
Mini Excavator	25	2	3.8	50%	900	199.1	0.0111	0.0768	4.94	0.00028	0.00191	
Dump Trucks	300	2	3.8	50%	900	199.1	0.0111	0.0768	59.26	0.00332	0.02287	
Total Estimated Project Emissions (Tons/Project/Year)									CO₂	N₂O	CH₄	
									1,244.7	0.07	0.48	
Total Estimated Emissions - Metropolitan St. Louis Air Quality Control Region (Tons/Project/Year)									1,244.7	0.07	0.48	
Total Estimated Emissions - Jersey County, Illinois maintenance area (Tons/Project/Year)									0.0	0.00	0.00	
Total Estimated Emissions non-attainment and maintenance areas									1,244.7	0.07	0.48	

Notes:

¹ Original Default Factors given in Kg/TJ for Diesel Off-Road Mobile Sources: 74,100 4.15 28.6 (in Kg/TJ)

² Assume 100 hour work weeks and 4 weeks per month.



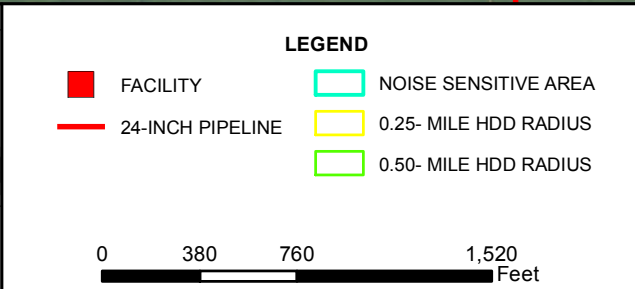
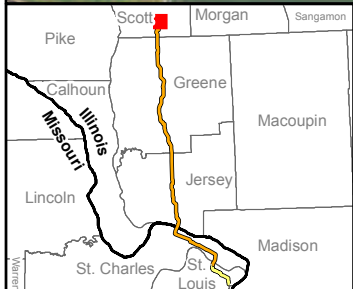
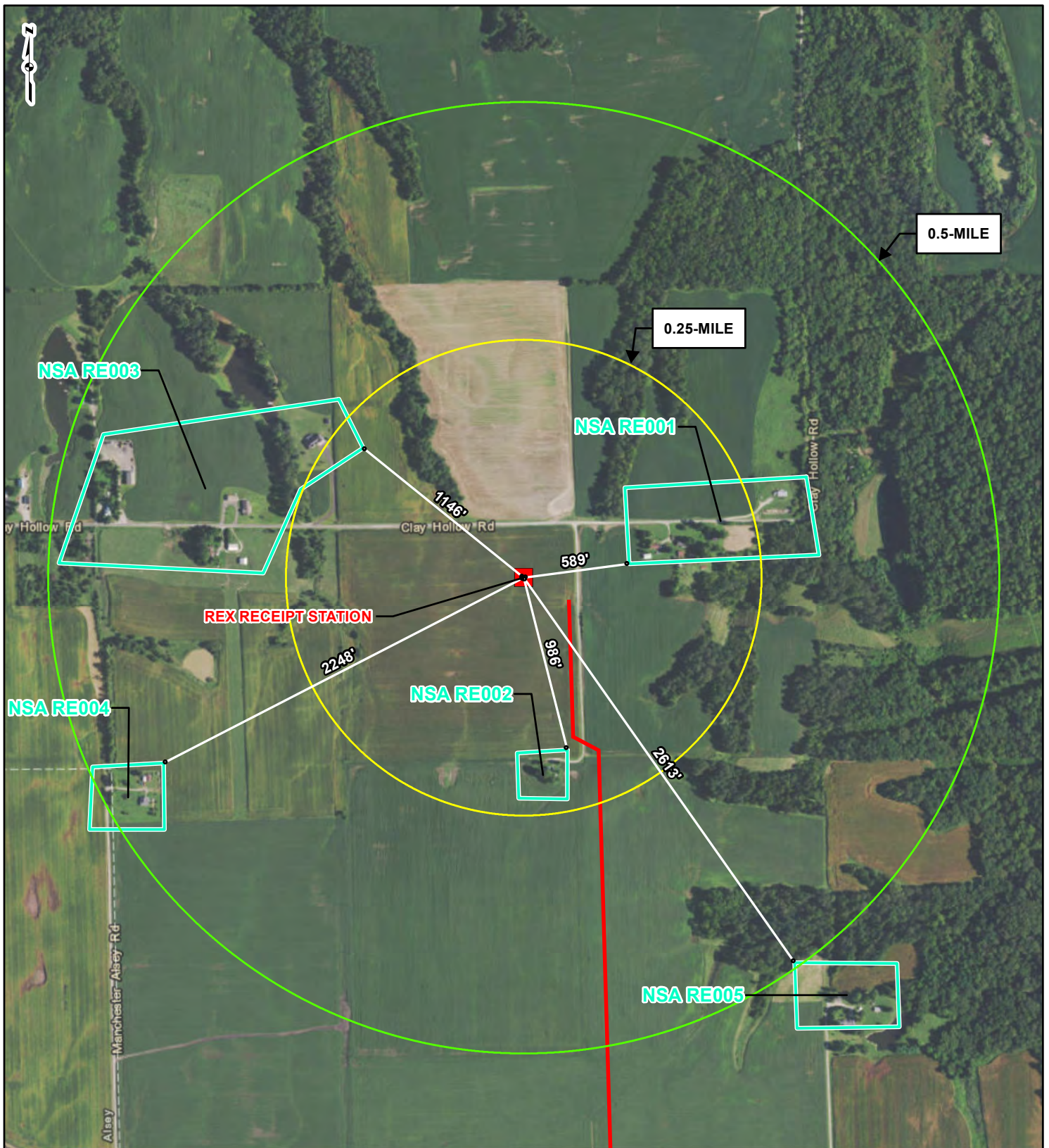
APPENDIX 9-B
Illinois Air Regulations



APPENDIX 9-C
Missouri Air Regulations



APPENDIX 9-D
Pre-Construction Noise Survey Data

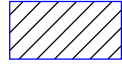



**FIGURE 9.2.1B
 NOISE SENSITIVE AREAS
 REX RECEIPT STATION**

**SPIRE STL
 PIPELINE
 PROJECT**

DRAWN BY: PMH DATE: 3/30/2017
 CHECKED: EFJ APPROVED: LMF

REFERENCE: ESRI WORLD IMAGERY AND TRANSPORTATION, NAIP, USDA FSA, 2014, ACCESSED 03/2017.

- Legend**
-  Road
 -  Building
 -  M&R Station

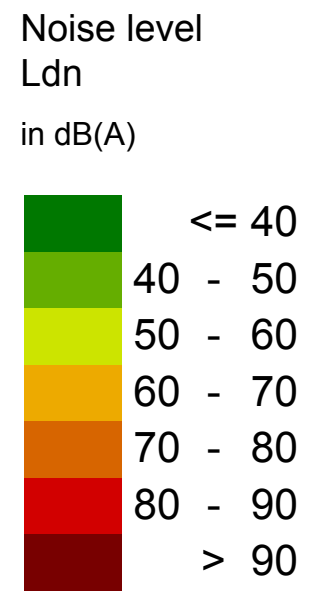
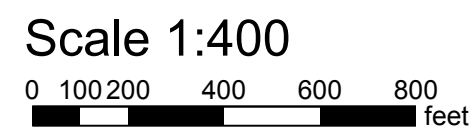


Figure: 9.2-1A
SPIRE Rex Receipt Station
Location
38°33'59.14"N 90°25'02.51"W

Prepared By: JJJ
Checked By: MTM
Approved By: _____



Project Location: REX M&R		Project Number: C160438.00
Client: SPIRE	Model Run: C132336.04 -001	
Field Staff: JJJ TL	Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling		
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation		
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____		
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____		
Approximate Study Area (sq mi):		0.79
Number of Monitoring Locations:		1
Monitoring Location:		
ID:	Location Description:	Type:
ML1	In right of way abutting proposed project site.	Handheld and Fixed ▼
		▼
		▼
		▼
		▼
		▼
		▼
		▼
Description of Surrounding Area (sketch, prominent sources of sound, etc.)		
See attached Figure for operational sound model results and area description		

Identified Sound Level Sources:			
ID:	Description:	Type:	Sound Levels
1	Clay Hollow Rd.	Line	Measured
2	1215E	Line	Measured
3	See Project Notes below for M&R Station Sources		Estimated
4	106 N/S	Line	Estimated

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Proposed Odorizer Room @ 50.0 dBA
- Proposed O.P.P. Skid @ 86.2 dBA
- Proposed Flow Control Skid @ 86.2 dBA
- Proposed Separation Filter @ 60.0 dBA
- Proposed Condensate Tank @ 50 dBA
- Proposed Pig Launcher/Receiver @ 86.2 dBA

2. Sound level contributions from Clay Hollow Rd, 106 N/S, and 1215E. derived from traffic counts taken during 15-minute sound level surveys.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: _____ Description: REX STATION

Done By: _____
 Meter: _____

Monitoring Data: AM Peak Off-Peak PM Peak
 Date: 12/6/15
 Start Time: 12:45
 End Time: 1:45
 Duration: 15 MIN MIN MIN
 LAeq: 53.7

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

--	--	--

Atmospheric data
Wind Speed (mph) <u>12 mph SSE</u>
Temp. (°F) <u>38</u>
Humidity (%) <u>77</u>
Cloud Cover <u>99%</u>

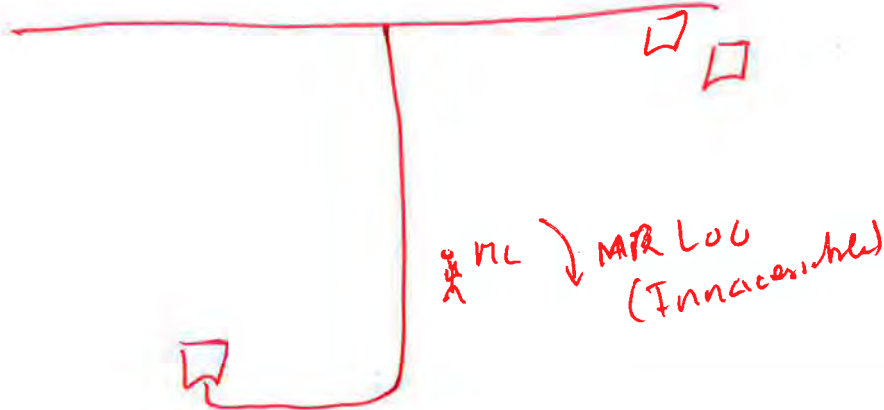
Notes:
 MAIL Truck drove by late in study
 LAFMin: 35.9 dB
 LAFMax: 80.3 dB
 LAFEQ: 53.7 dB
 LAF90: 38.7 dB

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details: _____

Plan View:

NORTH



Profile View:



Site Number: _____ Description: DEX STATION

Done By: _____
 Meter: _____

Monitoring Data:	AM Peak	Off-Peak	PM Peak
Date	<u>12/6/16</u>		
Start Time:	<u>13:01</u>		
End Time:	<u>13:16</u>		
Duration:	<u>15</u> MIN	MIN	MIN
L _{Aeq} :	<u>49.7</u>		

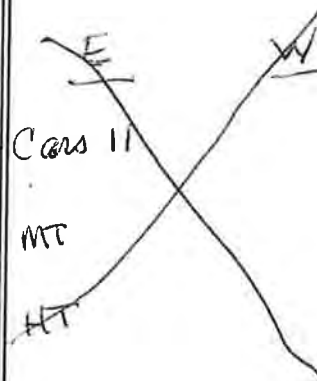
Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Atmospheric data
Wind Speed (mph) <u>12 mph SSE</u>
Temp. (°F) <u>38</u>
Humidity (%) <u>77</u>
Cloud Cover <u>99</u>

Notes:



LAFMin: 35.1 dB
 LAFMax: 64.0 dB
 LAFEQ: 49.7 dB
 LAF90: 39.2 dB

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

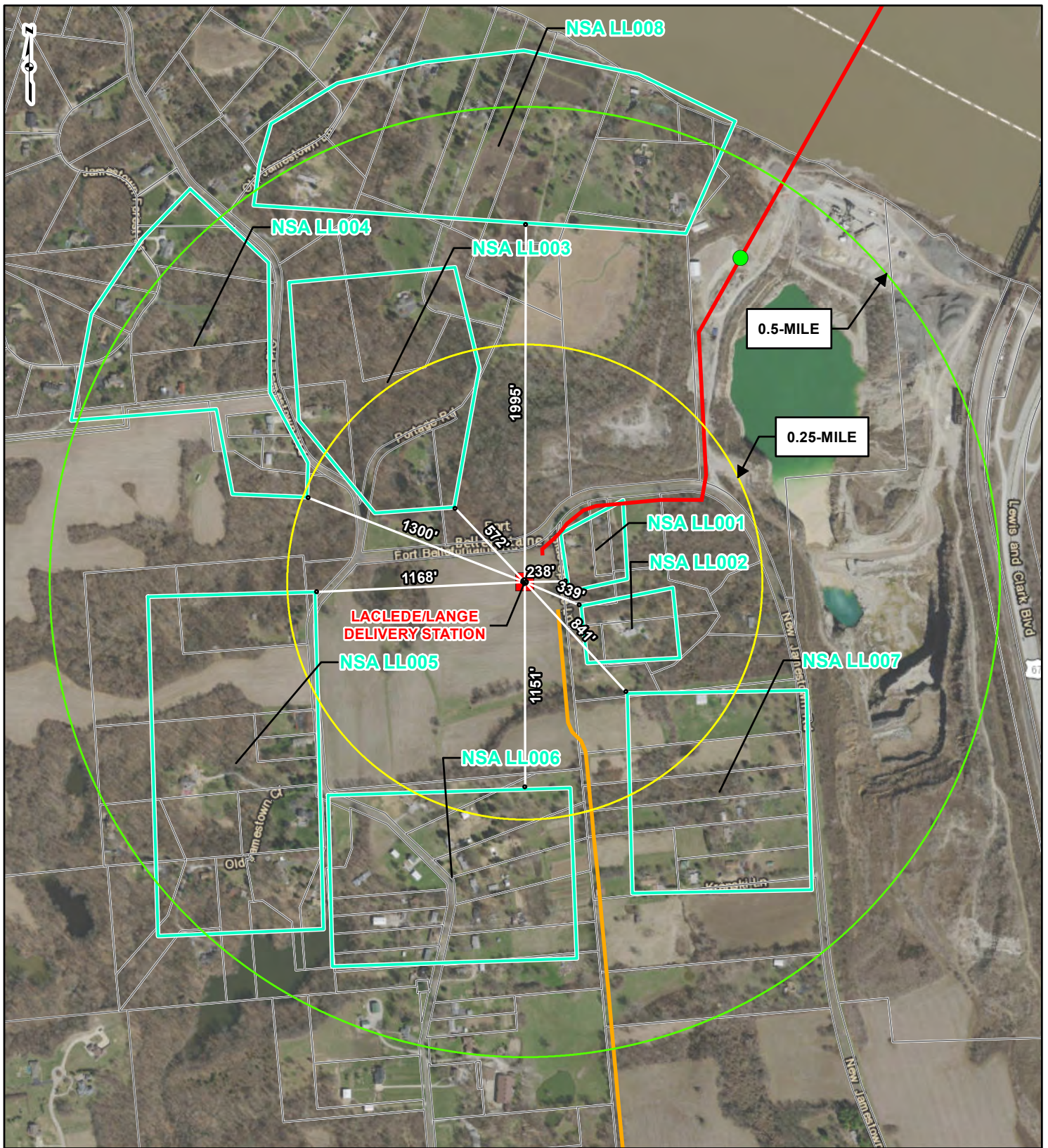
Calibration Details:

Plan View:

NORTH

See previous

Profile View:



LEGEND

- FACILITY
- HDD LOCATION
- 24-INCH PIPELINE
- NORTH COUNTY EXTENSION
- NOISE SENSITIVE AREA
- 0.25- MILE HDD RADIUS
- 0.50- MILE HDD RADIUS
- PARCEL BOUNDARY


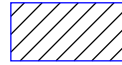

0 375 750 1,500
 Feet

FIGURE 9.2.2B
NOISE SENSITIVE AREAS
LACLEDE/LANGE DELIVERY STATION

SPIRE STL
PIPELINE
PROJECT

DRAWN BY: PMH DATE: 3/30/2017
 CHECKED: EFJ APPROVED: LMF

REFERENCE: ESRI WORLD IMAGERY AND TRANSPORTATION, NAIP, USDA FSA, 2014, ACCESSED 03/2017.

- Legend**
-  Road
 -  Building
 -  M&R Station

Noise level
Ldn
in dB(A)

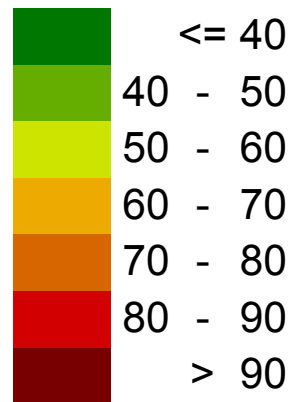


Figure: 9.2-2A
SPIRE Laclede/Lange Delivery Station
Location
38°50'13.75"N 90°14'54.22"W

Prepared By: JJJ
Checked By: MTM
Approved By: _____

Scale 1:400



Project Location: Laclede/Lange M&R		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -002	
Field Staff: JJJ TL		Document Originator: JJJ Checked: Approved:	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	In right of way abutting proposed project site.	Handheld and Fixed ▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:			
ID:	Description:	Type:	Sound Levels
	1 Fort Bellefontaine Rd.	Line	Measured
	2 Old Jamestown Rd.	Line	Estimated
	3 See Project Notes below for M&R Station Sources		Estimated
	4 US 67 N/S	Line	Estimated
	5 Jamestown Forest Drive	Line	Estimated
	6 Central Stone (Quarry Operations)	Area	Estimated

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Two Proposed Indirect Gas Fired Heaters @ 86.2 dBA
- Proposed Pig Reciever @ 86.2 dBA
- Proposed Pig Launcher/Reciever @ 86.2 dBA
- Proposed Separation Filter @ 60.0 dBA
- Proposed O.P.P. Skid @ 86.2 dBA
- Proposed Flow Control Skid @ 86.2 dBA
- Proposed Odorant Tank @ 50 dBA

2. Sound level contributions from Fort Bellefontaine Rd. derived from traffic counts taken during 15-minute sound level surveys.

3. Sound contributions from Old Jamestown Rd. conservatively estimated based on typical sound levels for similar roads.

Results Summary:

See attached Figure _____ for sound level map with deliniated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: Description: LACADELLE/LANOE BL & R

Done By:
 Meter:

Monitoring Data: AM Peak Off-Peak PM Peak
 Date: 12/6/16
 Start Time: 8:07
 End Time: 8:22
 Duration: 15 MIN MIN MIN
 LAeq: 54.5

Traffic Data

Roadway	<u> </u>	<u> </u>	<u> </u>
Direction	<u> </u>	<u> </u>	<u> </u>
Traffic Total	<u>2</u>	<u> </u>	<u> </u>
Cars	<u>1</u>	<u> </u>	<u> </u>
MT	<u>1</u>	<u> </u>	<u> </u>
HT	<u> </u>	<u> </u>	<u> </u>

Weather Conditions

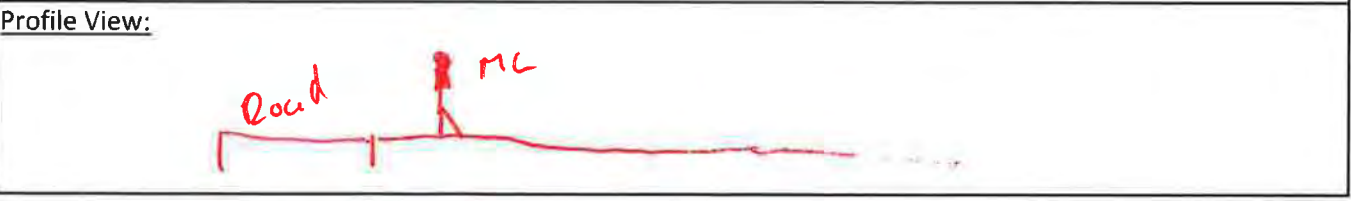
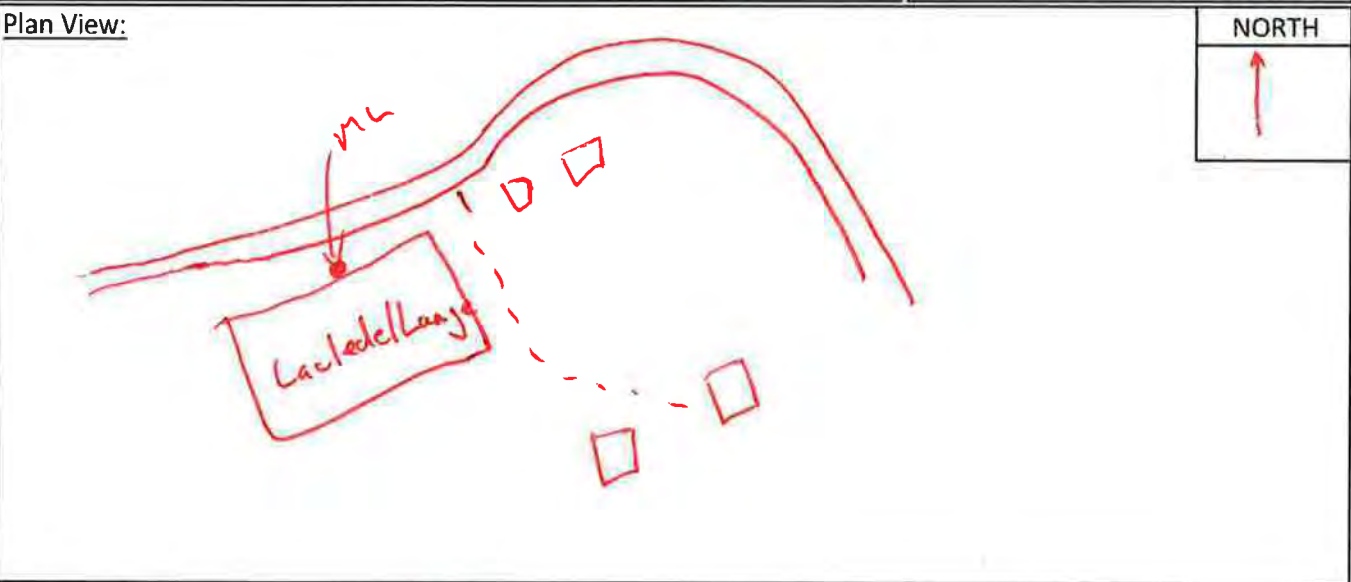
<u> </u>	<u> </u>	<u> </u>
-------------------	-------------------	-------------------

Atmospheric data
Wind Speed (mph) <u>12 mph to east</u>
Temp. (°F) <u>39</u>
Humidity (%) <u>74</u>
Cloud Cover <u>87%</u>

Notes:
TRAFFIC
CARS 1
MT 1
 LAFMin: 46.7 dB
 LAFMax: 72.4 dB
 LAFEQ: 54.5 dB
 LAF90: 49.2 dB

Site Data: Site Surphase (Alpha): Shielding Factor: Pavment Type:

Calibration Details:



Site Number: _____ Description: LACIEDEL LANGE MER

Done By: _____
Meter: _____

Monitoring Data:

AM Peak	Off-Peak	PM Peak
Date: <u>12/6/16</u>		
Start Time: <u>16:58</u>		
End Time: <u>17:13</u>		
Duration: <u>15</u> MIN	MIN	MIN
L _{Aeq} : <u>52.7</u>		

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Atmospheric data
Wind Speed (mph) <u>12 WNW</u>
Temp. (°F) <u>42</u>
Humidity (%) <u>62</u>
Cloud Cover <u>60%</u>

Notes:
LAFMin: 34.3 dB
LAFMax: 75.3 dB
LAFEQ: 52.7 dB
LAF90: 36.1 dB

Birds chirping

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

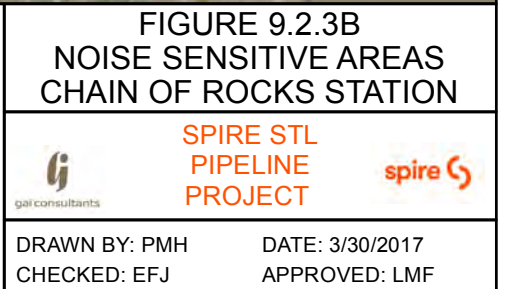
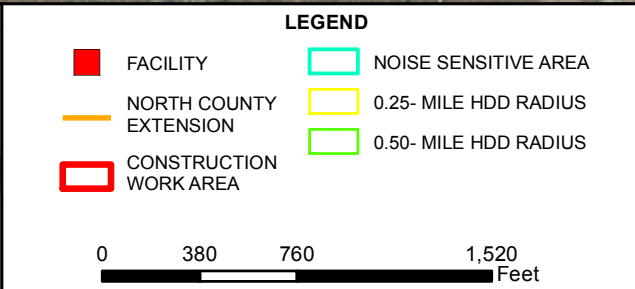
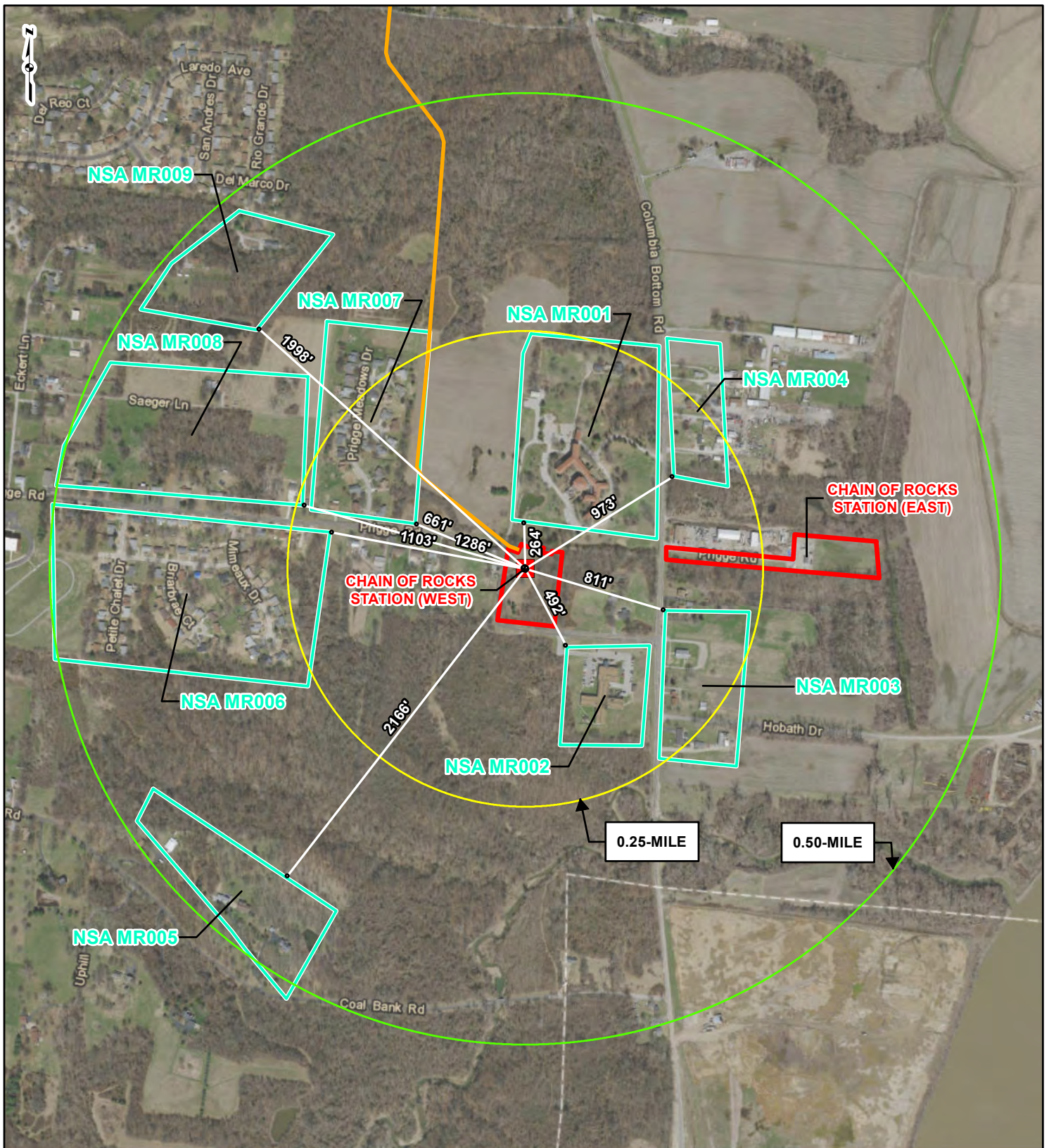
Calibration Details: _____

Plan View:

NORTH

see previous

Profile View:



REFERENCE: ESRI WORLD IMAGERY AND TRANSPORTATION, NAIP, USDA FSA, 2014, ACCESSED 04/2017.

- Legend**
-  Road
 -  Building
 -  M&R Station

Noise level
Ldn
in dB(A)

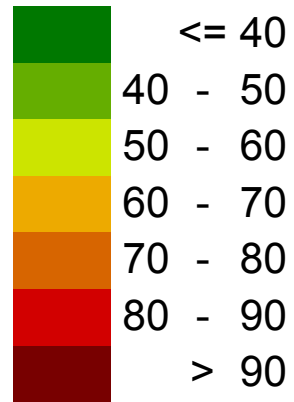
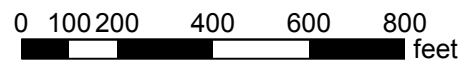


Figure: 9.2-3A
SPIRE Chain of Rocks M&R Station Location
38°46'42.82"N 90°11'03.08"W

Prepared By: JJJ
Checked By: MTM
Approved By:

Scale 1:400



**Sound Monitoring/Modeling
Data Forms**

Project Location: Chain of Rocks Station		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -003	
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	Fenceline of existing installation	Handheld and Fixed ▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:		
ID:	Description:	Type:
	1 Columbia Bottom Road	Line <input type="button" value="v"/>
	2 Prigge Rd	Line <input type="button" value="v"/>
	3 Hobarth Dr.	Line <input type="button" value="v"/>
	4 Prigge Meadows Drive	Line <input type="button" value="v"/>
	5 Petite Chalet Drive	Line <input type="button" value="v"/>
	6 Briarbrae Drive	Line <input type="button" value="v"/>
	7 Briarbrae Ct.	Line <input type="button" value="v"/>
	8 Mimeaux Dr.	Line <input type="button" value="v"/>
		<input type="button" value="v"/>

Sound Levels	
Estimated	<input type="button" value="v"/>
Measured	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>
Estimated	<input type="button" value="v"/>

Project Notes:

1. Sound levels emanating from light industrial/business use area adjacent to the existing MRT station were intermittent and not consistent.
2. Sound levels emanating from light industrial/business use area adjacent to NSA BD003 were not measured or quantified.
3. M&R Facility expansion conservatively modeled to include the following significant sources:
 - Proposed Regulator Skid @ 86.2 dBA
 - Proposed Meter Skid @ 86.2 dBA
 - Proposed Launcher/Receiver @ 86.2 dBA
4. Sound contributions from Columbia Bottom Rd. and Hobarth Rd. were conservatively estimated based on typical sound levels for similar roads.
5. Sound level contributions for Prigge Road and all side streets determined based on traffic count during 15-minute readings.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
 See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: _____ Description: Chain of Rocks Station

Done By: _____
Meter: _____

Monitoring Data: AM Peak Off-Peak PM Peak

Date: 2/6/16
Start Time: 6:30
End Time: 6:46
Duration: MIN MIN MIN
LAeq: (A) [] []

Traffic Data

Roadway	AM Peak	Off-Peak	PM Peak
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Atmospheric data
Wind Speed (mph)
Temp. (°F)
Humidity (%)
Cloud Cover

Notes:

LAFMin: 41.2 dB
LAFMax: 79.0 dB
LAFEQ: 61.0 dB
LAF90: 44.7 dB

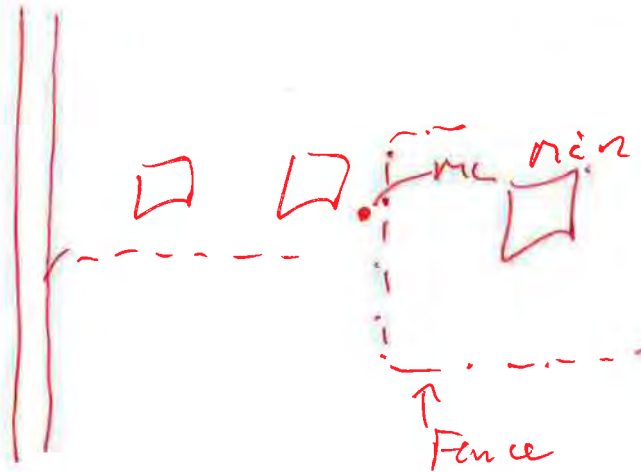
*Intermittent
Bumping*

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details:

Plan View:

NORTH



Profile View:



Site Number: _____ Description: Chain of Rocks Station

Done By: _____
Meter: _____

Monitoring Data:

	AM Peak	Off-Peak	PM Peak
Date	12/16/16		
Start Time	18:12		
End Time	18:27		
Duration	15 MIN	MIN	MIN
L _{Aeq}	48.3		

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details: _____

Notes:

LAFMin: 44.5 dB
LAFMax: 62.9 dB
LAFEQ: 48.3 dB
LAF90: 46.2 dB

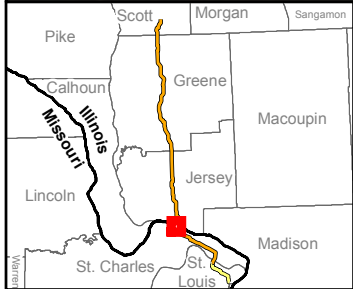
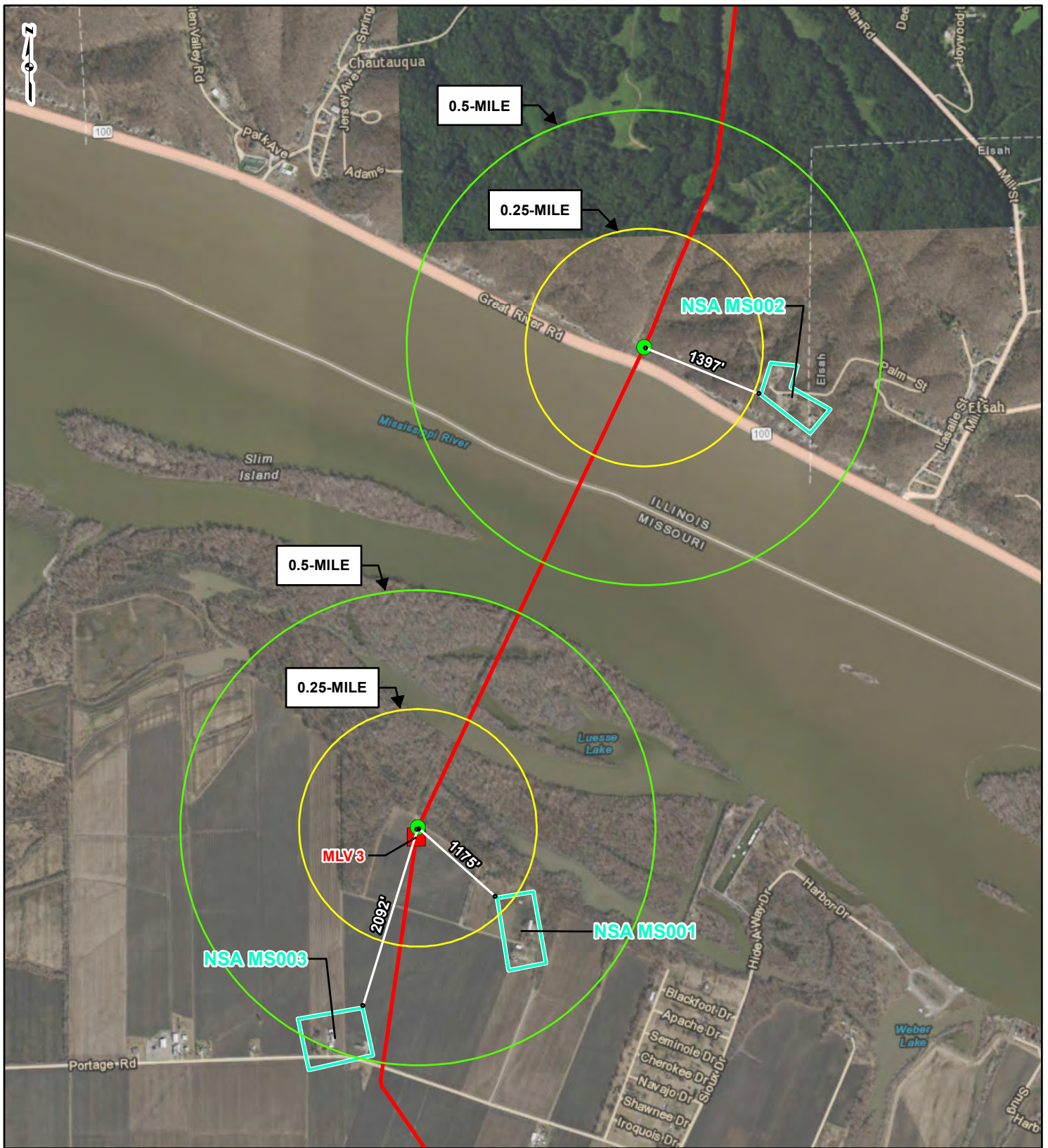
<u>Atmospheric data</u> <u>Wind Speed (mph)</u> 9 mph W
<u>Temp. (°F)</u> 42
<u>Humidity (%)</u> 67
<u>Cloud Cover</u> 40

Plan View:

NORTH

See previous

Profile View:



LEGEND

■ FACILITY	 NOISE SENSITIVE AREA
● HDD LOCATION	 0.25- MILE HDD RADIUS
— 24-INCH PIPELINE	 0.50- MILE HDD RADIUS

0 750 1,500 3,000
Feet

**FIGURE 9.2.4B
NOISE SENSITIVE AREAS
MISSISSIPPI RIVER HDD LOCATIONS**

**SPIRE STL
PIPELINE
PROJECT**

DRAWN BY: PMH DATE: 3/30/2017
CHECKED: EFJ APPROVED: LMF

REFERENCE: ESRI WORLD IMAGERY AND TRANSPORTATION, NAIP, USDA FSA, 2014, ACCESSED 03/2017.

Legend

-  Road
-  Building

Noise level
Ldn
in dB(A)

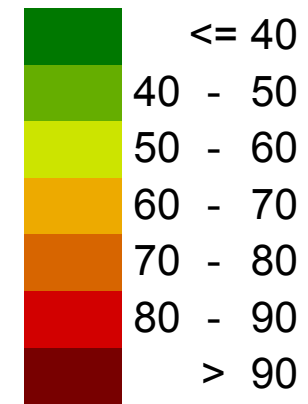
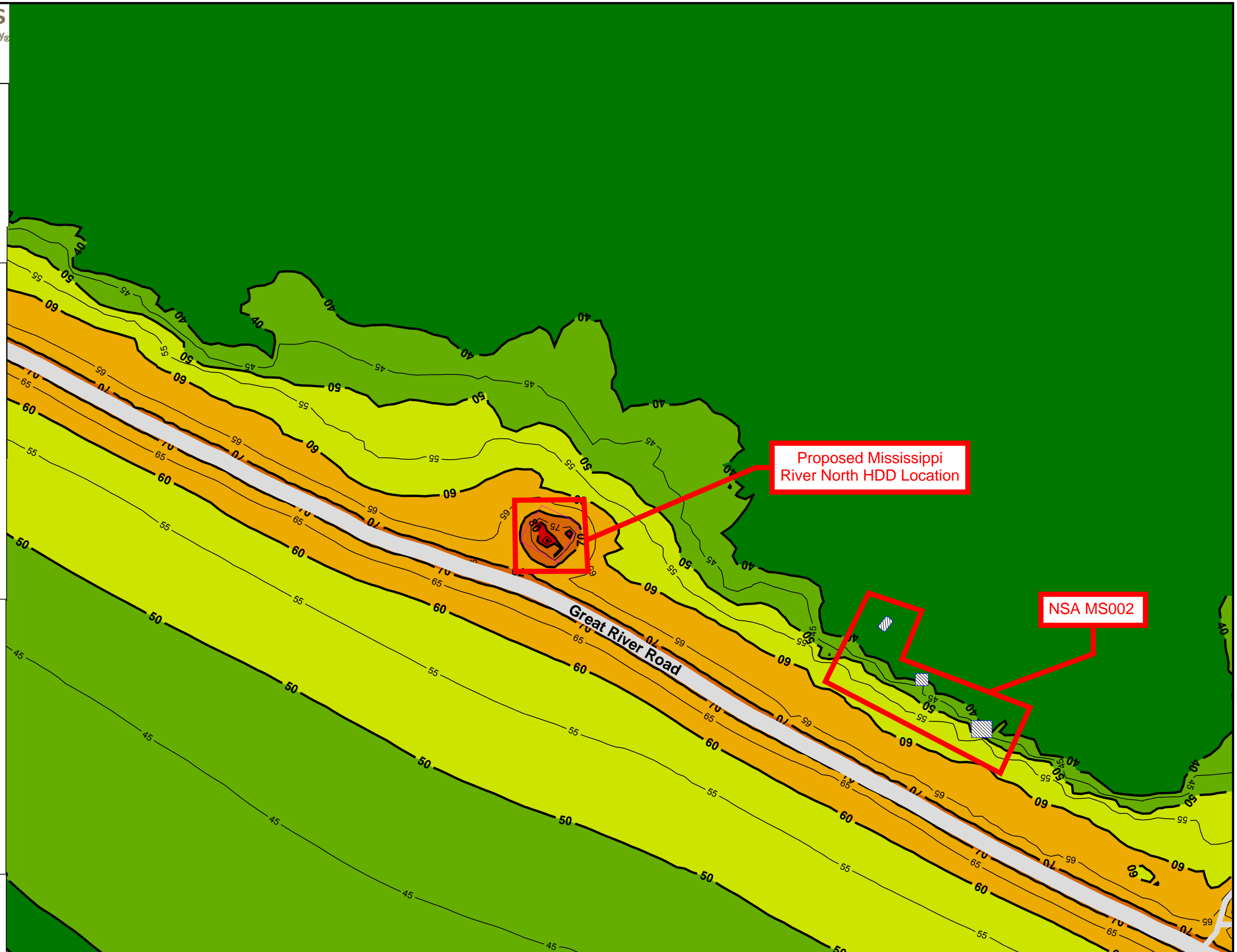
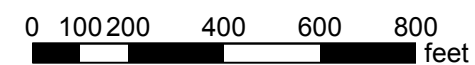


Figure: 9.2-4A
SPIRE Mississippi River North HDD
Location
38°57'24.67"N 90°22'14"W

Prepared By: JJJ
Checked By: MTM
Approved By:

Scale 1:400



Project Location: Mississippi River North HDD		Project Number: C160438.00
Client: SPIRE		Model Run: C132336.04 -004
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling		
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation		
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____		
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____		
Approximate Study Area (sq mi):		0.79
Number of Monitoring Locations:		1
Monitoring Location:		
ID:	Location Description:	Type:
ML1	In right of way near River Road (site access denied)	Handheld and Fixed ▼
		▼
		▼
		▼
		▼
		▼
		▼
		▼
Description of Surrounding Area (sketch, prominent sources of sound, etc.)		
See attached Figure for operational sound model results and area description		

Identified Sound Level Sources:			
ID:	Description:	Type:	Sound Levels
1	Great River Road	Line <input type="text"/>	Estimated <input type="text"/>
2	See Project Notes below for HDD Station Sources	<input type="text"/>	Estimated <input type="text"/>
		<input type="text"/>	<input type="text"/>
		<input type="text"/>	<input type="text"/>
3	Mill Street	Line <input type="text"/>	Estimated <input type="text"/>
4	Elm Street	Line <input type="text"/>	Estimated <input type="text"/>
		<input type="text"/>	<input type="text"/>
		<input type="text"/>	<input type="text"/>
		<input type="text"/>	<input type="text"/>

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Large Drill Rig @ 110 dBA
- Two Mud Pumps @ 110 dBA
- Three Generators @ 90 dBA
- Separation Plant @ 100 dBA

2. Sound level contributions from Mill Street and Elm Street conservatively estimated based on typical sound levels for similar roads.

3. Sound contributions Great River Road based on traffic counts and ambient sound level study results.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: _____ Description: Mississippi River North HDD

Done By: _____
 Meter: _____

Monitoring Data:

AM Peak	Off-Peak	PM Peak
Date: <u>12/6/16</u>		
Start Time: <u>12:19</u>		
End Time: <u>11:34</u>		
Duration: <u>15</u> MIN	MIN	MIN
LAeq: <u>58.3</u>		

Traffic Data

Roadway			
Direction	<u>E W</u>	<u>E W</u>	
Traffic Total	<u>14</u>	<u>13</u>	
Cars	<u>11</u>	<u>9</u>	
MT	<u>3</u>	<u>2</u>	
HT	<u>-</u>	<u>2</u>	

Weather Conditions

--	--	--

Atmospheric data

Wind Speed (mph)
14 From WNW

Temp. (°F)
41

Humidity (%)
75

Cloud Cover
100%

Notes:

TRAFFIC
E W
CARS 14 11 CARS 9 11
MT 3 2 MT 2 11
HT - 2 HT 11

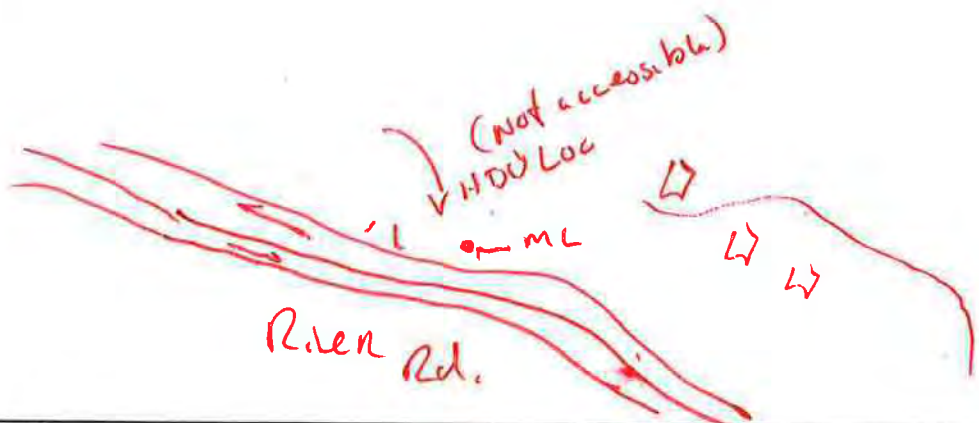
LAFMin: 32.3 dB
 LAFMax: 78.8 dB
 LAFEQ: 58.3 dB
 LAF90: 36.1 dB

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details: _____

Plan View:

NORTH



Profile View:



Site Number: Description: Mississippi North HDD

Done By:
 Meter:

Monitoring Data:

	AM Peak	Off-Peak	PM Peak
Date	12/6/16		
Start Time	14:28		
End Time	14:43		
Duration	15 MIN	MIN	MIN
LAeq	6.5		

Traffic Data

Roadway				
Direction	E	W		
Traffic Total	24	23		
Cars	10	10		
MT	12	12		
HT	2	1		

Weather Conditions

Site Data: Site Surphase (Alpha): Shielding Factor: Pavment Type:

Calibration Details:

Atmospheric data

Wind Speed (mph)	13 WNW
Temp. (°F)	41
Humidity (%)	68
Cloud Cover	96%

Notes:

~~E~~ E | W
 Cars |||| | ||||
 MT |||| | ||||
 HT || | 1

LAFMin: 31.8 dB
 LAFMax: 81.6 dB
 LAFEQ: 61.5 dB
 LAF90: 36.4 dB

Plan View:

NORTH

See previous

Profile View:

Legend

-  Road
-  Building

Noise level
Ldn
in dB(A)

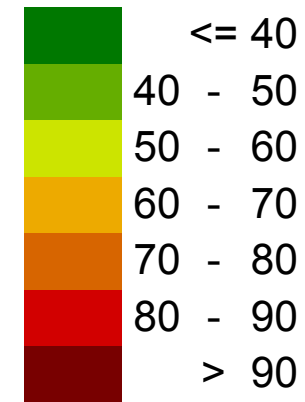
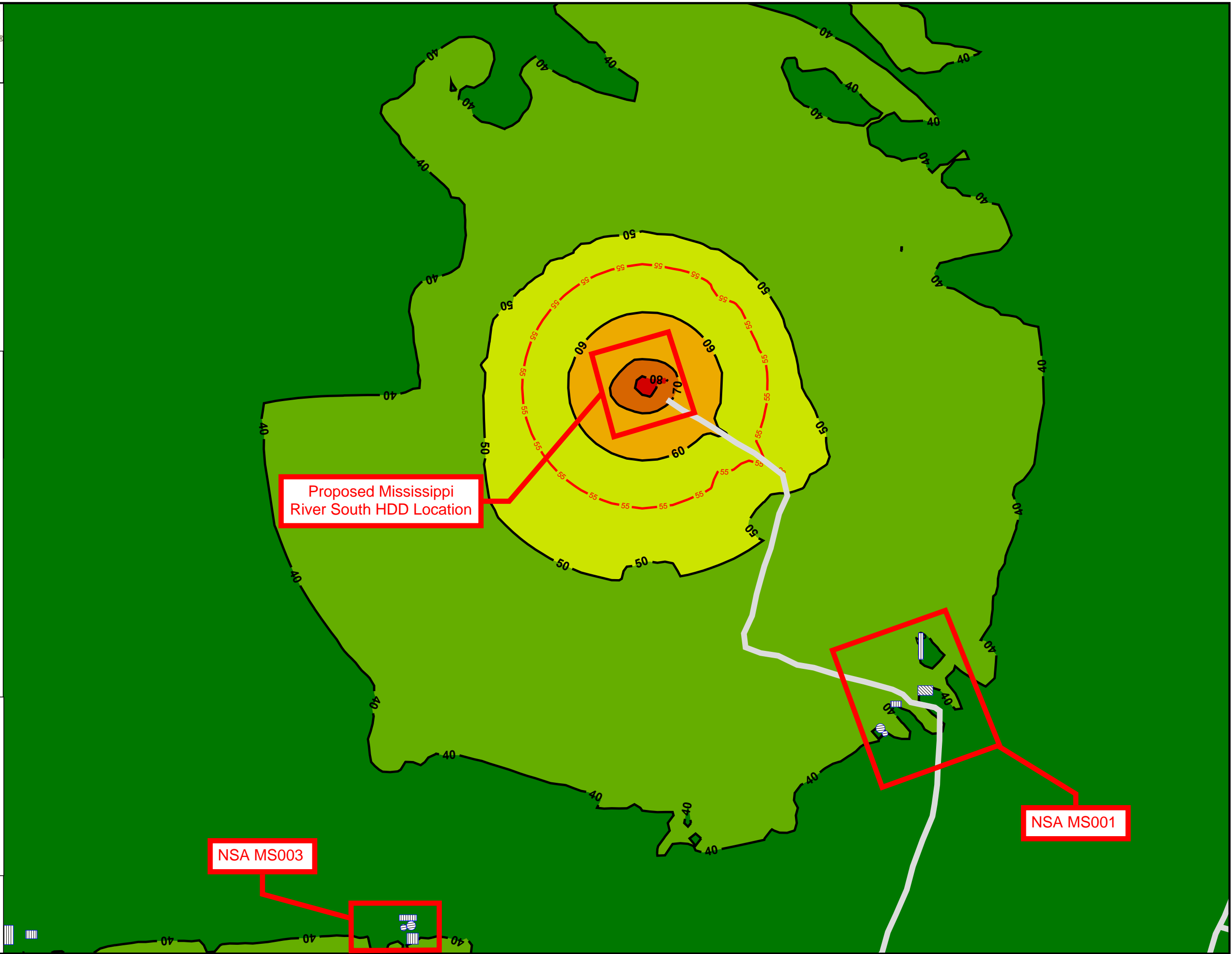
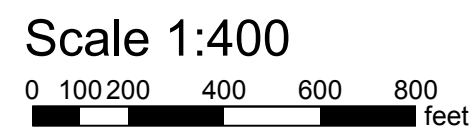


Figure: 9.2-5
SPIRE Mississippi River South HDD
Location
38°56'31.96"N 90°22'59.46"W

Prepared By: JJJ
Checked By: MTM
Approved By: _____



Project Location: Mississippi River South HDD		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -001	
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	At roadway property gate of proposed HDD site	Handheld and Fixed ▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:			
ID:	Description:	Type:	Sound Levels
1	Portage Rd	Line	Estimated
2	See Project Notes below for HDD Station Sources		Estimated

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Large Drill Rig @ 110 dBA
- Two Mud Pumps @ 110 dBA
- Three Generators @ 90 dBA
- Separation Plant @ 100 dBA

2. Sound level contributions from nearby Portage Rd Estimated

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: _____ Description: Mississippi River South HDD

Done By: _____
 Meter: →

Monitoring Data:	AM Peak	Off-Peak	PM Peak
Date	<u>12/6/16</u>		
Start Time:	<u>10:09</u>		
End Time:	<u>10:24</u>		
Duration:	<u>15</u> MIN	MIN	MIN
LAeq:	<u>40.0</u>		

Traffic Data			
Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions _____

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details: _____

Atmospheric data
Wind Speed (mph) <u>10 mph From NW</u>
Temp. (°F) <u>41</u>
Humidity (%) <u>75%</u>
Cloud Cover <u>100%</u>

Notes:
 LAFMin: 33.9 dB
 LAFMax: 59.2 dB
 LAFEQ: 40.0 dB
 LAF90: 46.9 dB



Site Number: Description: Mississippi River South

Done By:
Meter: →

Monitoring Data: AM Peak Off-Peak PM Peak

Date: 12/6/16
Start Time: 16:25 15:25
End Time: 15:40
Duration: 15 MIN MIN MIN
LAeq: 46.5

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Site Data: Site Surphase (Alpha): Shielding Factor: Pavment Type:

Calibration Details:

Notes:

LAFMin: 32.6 dB
LAFMax: 67.7 dB
LAFEQ: 46.5 dB
LAF90: 37.2 dB

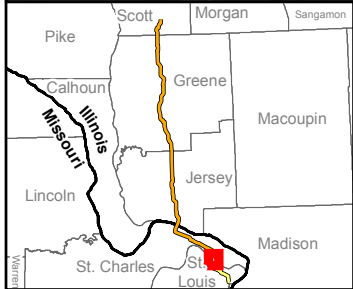
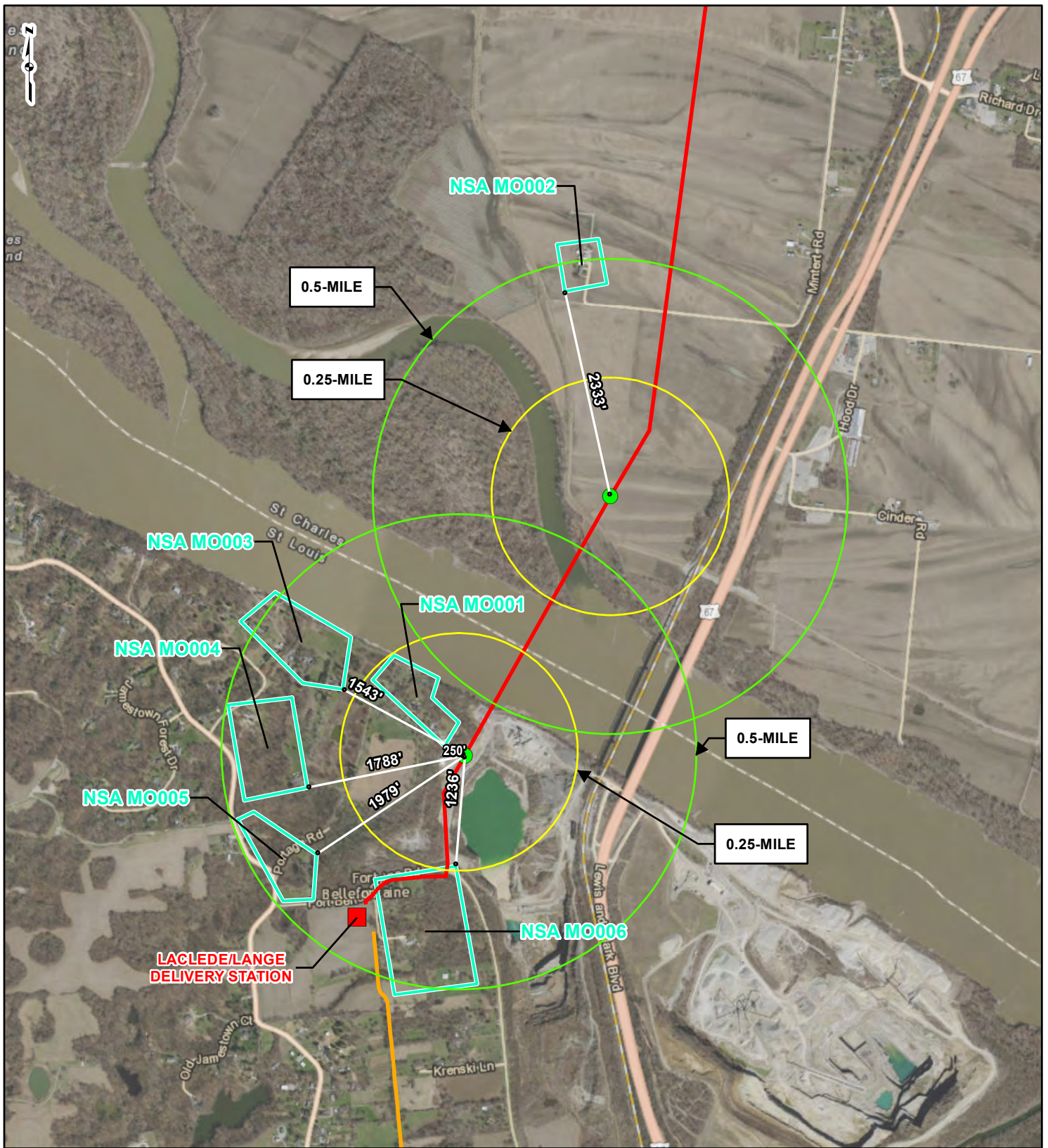
Atmospheric data
Wind Speed (mph) <u>9 mph ESE</u>
Temp. (°F) <u>42</u>
Humidity (%) <u>87</u>
Cloud Cover <u>100%</u>

Plan View:

NORTH

See previous

Profile View:




LEGEND


■ FACILITY	 NOISE SENSITIVE AREA
● HDD LOCATION	 0.25- MILE HDD RADIUS
— 24-INCH PIPELINE	 0.50- MILE HDD RADIUS
— NORTH COUNTY EXTENSION	

0 750 1,500 3,000
Feet

FIGURE 9.2.6B
NOISE SENSITIVE AREAS
MISSOURI RIVER HDD LOCATIONS



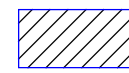
SPIRE STL
PIPELINE
PROJECT



DRAWN BY: PMH DATE: 3/30/2017
CHECKED: EFJ APPROVED: LMF

REFERENCE: ESRI WORLD IMAGERY AND TRANSPORTATION, NAIP, USDA FSA, 2014, ACCESSED 03/2017.

Legend

-  Road
-  Building

Noise level

Ldn

in dB(A)

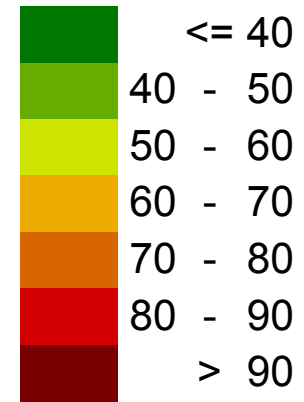
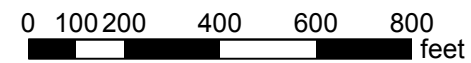


Figure: 9.2-6A
SPIRE Missouri River North HDD
Location
38°50'59.16"N 90°14'13.14"W

Prepared By: JJJ
Checked By: MTM
Approved By: _____

Scale 1:400



Project Location: Missouri River North HDD		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -006	
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	At roadway north of proposed HDD bore location and near closest NSA	Handheld and Fixed	▼
			▼
			▼
			▼
			▼
			▼
			▼
			▼
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:		
ID:	Description:	Type:
1	Minert Rd.	Line
2	US Rt 67	Line
3	See Project Notes below for HDD Station Sources	
4	Red School Road	Line
5	Hood Drive	Line
6	Cinder Road	Line

Sound Levels	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Large Drill Rig @ 110 dBA
- Two Mud Pumps @ 110 dBA
- Three Generators @ 90 dBA
- Separation Plant @ 100 dBA

2. Sound level contributions from nearby US Rt 67 Estimated

3. Sound level contribution from Minert Rd, Red School Road, Hood Drive, and Cinder Road estimated based on traffic count performed during 15-minute sound level readings.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: _____ Description: Missouri North HDD

Done By: _____
Meter: _____

Monitoring Data: AM Peak Off-Peak PM Peak
Date: 12/6/16
Start Time: 9:27
End Time: 9:42
Duration: 15 MIN MIN MIN
LAeq: 43.7

Traffic Data

Roadway	AM Peak	Off-Peak	PM Peak
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Atmospheric data
Wind Speed (mph) <u>14 From NNW</u>
Temp. (°F) <u>40</u>
Humidity (%) <u>72</u>
Cloud Cover <u>90%</u>

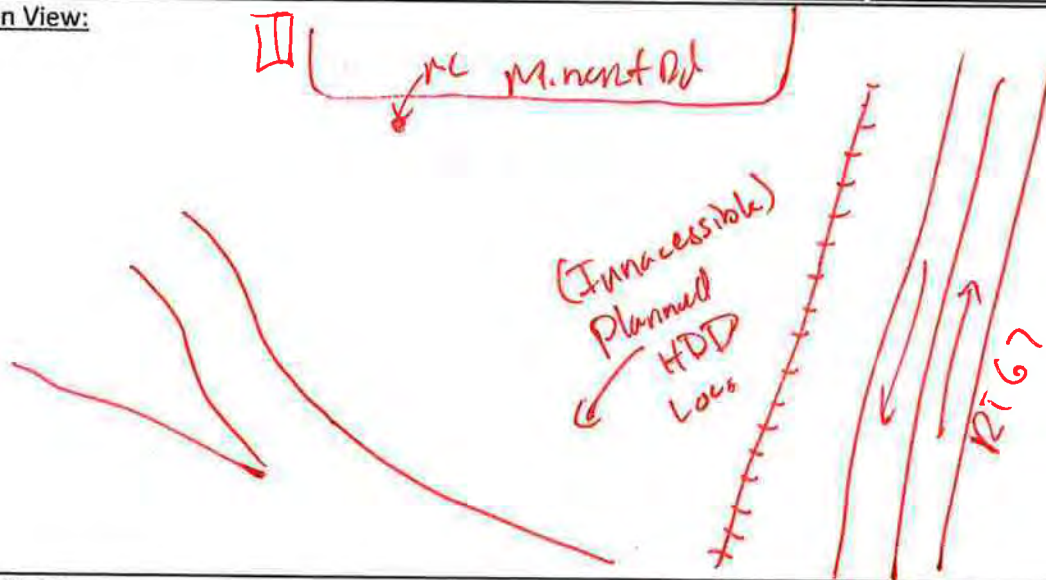
Notes:

LAFMin: 37.5 dB
LAFMax: 56.9 dB
LAFEQ: 43.7 dB
LAF90: 40.0 dB

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details:

Plan View:



Profile View:



Site Number: Description: MISSOURI RIVER North HDD

Done By:
Meter:

Monitoring Data: AM Peak Off-Peak PM Peak

Date: 12/6/16
Start Time: 16:03
End Time: 16:18
Duration: 15 MIN MIN MIN
LAeq: 58.9

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Site Data: Site Surphase (Alpha): Shielding Factor: Pavment Type:

Calibration Details:

Atmospheric data Wind Speed (mph) <u>14 mph WNW</u>
Temp. (°F) <u>41</u>
Humidity (%) <u>79</u>
Cloud Cover <u>35%</u>

Notes:


LAFMin: 34.4 dB
LAFMax: 80.0 dB
LAFEQ: 58.9 dB
LAF90: 38.5 dB

Plan View:

NORTH

See previous

Profile View:

Legend
 Road
 Building

Noise level
Ldn
 in dB(A)








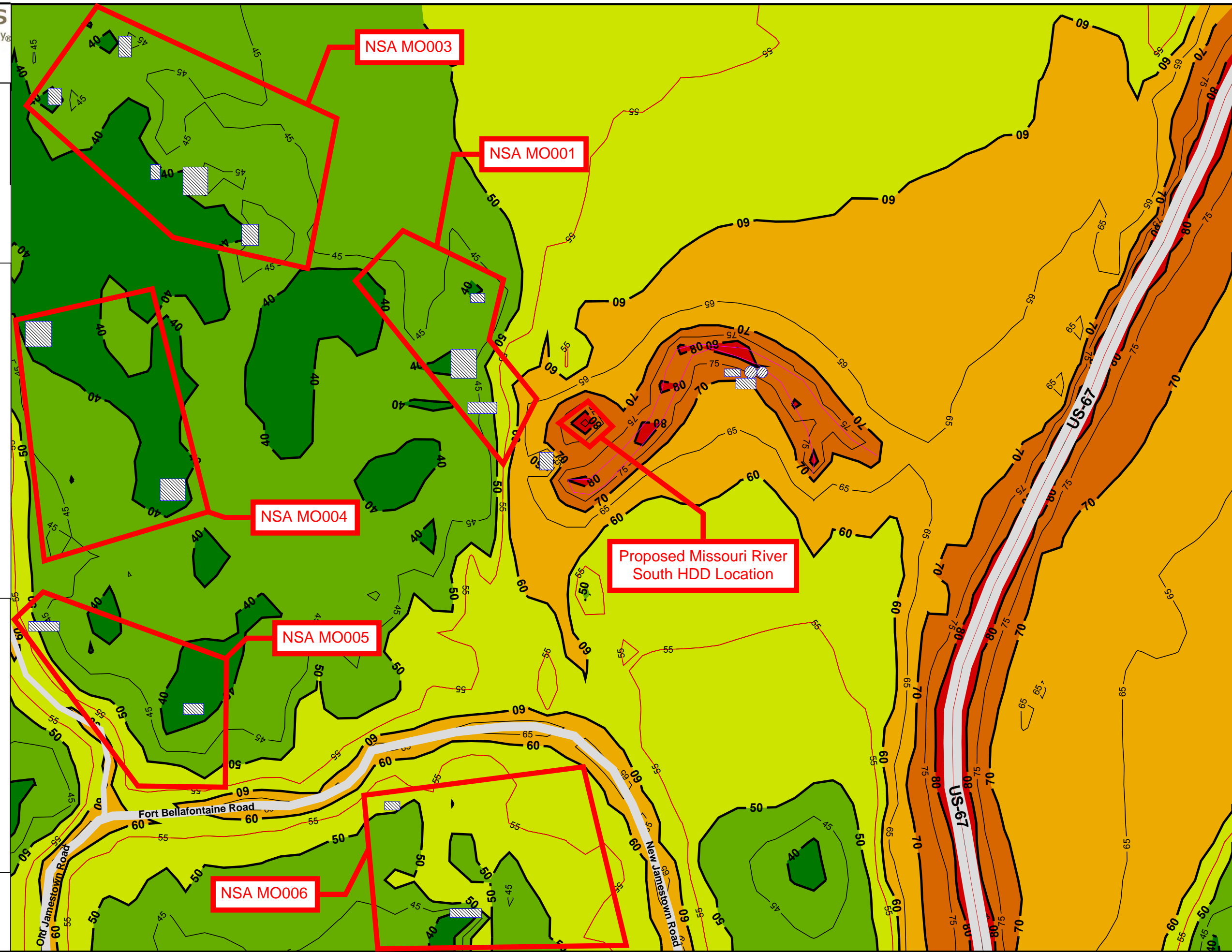
	<= 40
	40 - 50
	50 - 60
	60 - 70
	70 - 80
	80 - 90
	> 90

Figure: 9.2-7
SPIRE Missouri River South HDD Location
 38°50'31.06"N 90°14'34.42"W

Prepared By: JJJ
 Checked By: MTM
 Approved By: _____

Scale 1:400
 0 100 200 400 600 800 feet



Project Location: Missouri River South HDD		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -007	
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	At proposed HDD location	Handheld and Fixed ▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:		
ID:	Description:	Type:
1	Existing Stone Handling Operations	Line
2	See Project Notes below for HDD Station Sources	
3	US 67	Line
4	Fort Bellefontaine Rd.	Line
5	Old Jamestown Rd	Line

Sound Levels	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Large Drill Rig @ 110 dBA
- Two Mud Pumps @ 110 dBA
- Three Generators @ 90 dBA
- Separation Plant @ 100 dBA

2. Sound level contributions from nearby existing material/rock handling operation (Central Stone) were estimated

3. Sound levels from US 67, Fort Bellefontaine Rd, and Old Jamestown Road are estimated based on traffic counts during 15-minute noise surveys and/or conservative estimates based on similar roadways.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: _____ Description: Central Stone - Missouri South

Done By: _____
 Meter: _____

Monitoring Data: AM Peak Off-Peak PM Peak
 Date: 12/6/16
 Start Time: 8:56
 End Time: 9:11
 Duration: 15 MIN MIN MIN
 LAeq: 50.2

Traffic Data

Roadway	AM Peak	Off-Peak	PM Peak
Direction			
Traffic Total			
Cars			
MT			
HT			

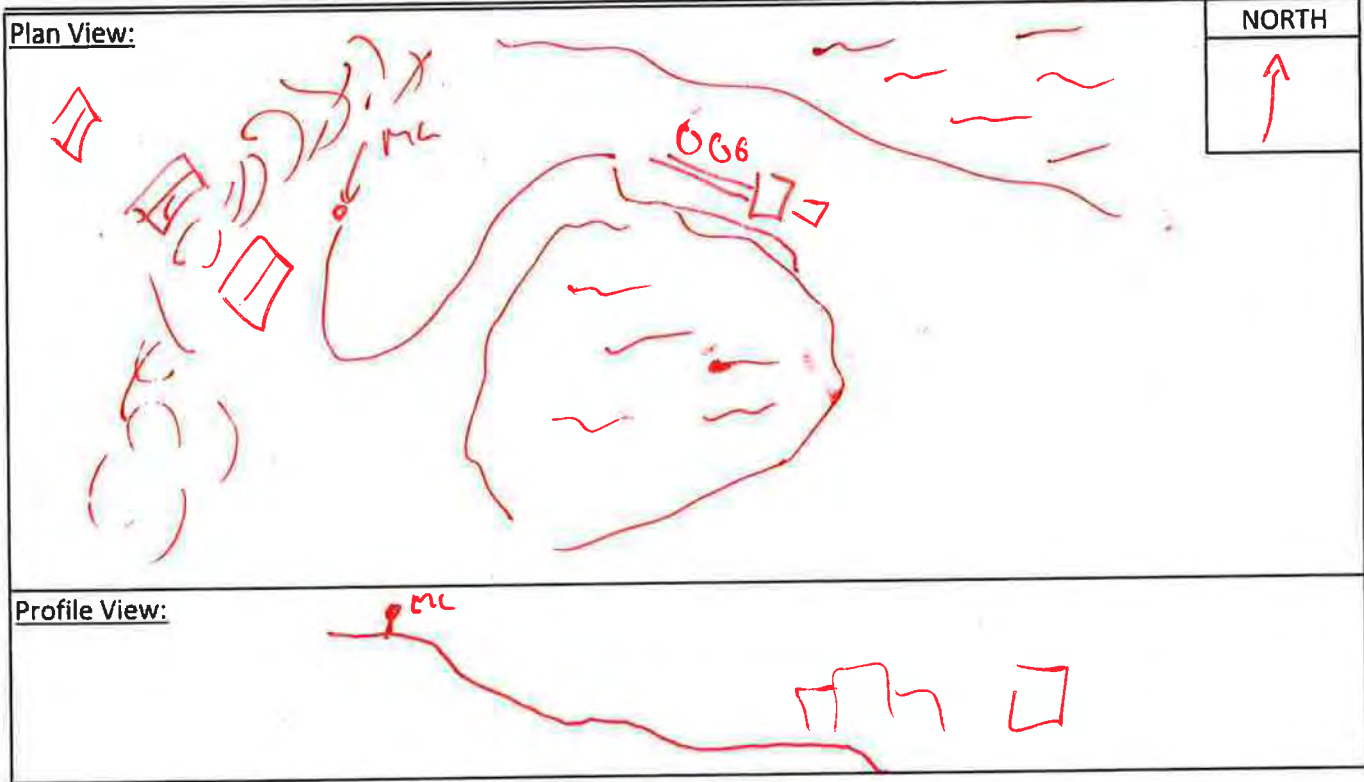
Weather Conditions

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____
Calibration Details: _____

Atmospheric data

<u>Wind Speed (mph)</u> 10 mph ESE
<u>Temp. (°F)</u> 39°
<u>Humidity (%)</u> 73
<u>Cloud Cover</u> 78%

Notes:
 LAFMin: 46.4 dB
 LAFMax: 62.8 dB
 LAFEQ: 50.2 dB
 LAF90: 48.7 dB



Central Stone
Missouri River South

Site Number: _____

Description:

Done By: _____

Meter: _____

Notes:

Monitoring Data:

	AM Peak	Off-Peak	PM Peak
Date	12/6/16		
Start Time:	16:30		
End Time:	16:45		
Duration:	15 MIN	MIN	MIN
LAeq:	47.3		

Atmospheric data	
Wind Speed (mph)	
12	WNW
Temp. (°F)	
42	
Humidity (%)	
62	
Cloud Cover	
60%	

LAFMin: 34.9 dB
LAFMax: 70.3 dB
LAFEQ: 47.3 dB
LAF90: 37.1 dB

Traffic Data

Roadway	AM Peak	Off-Peak	PM Peak
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

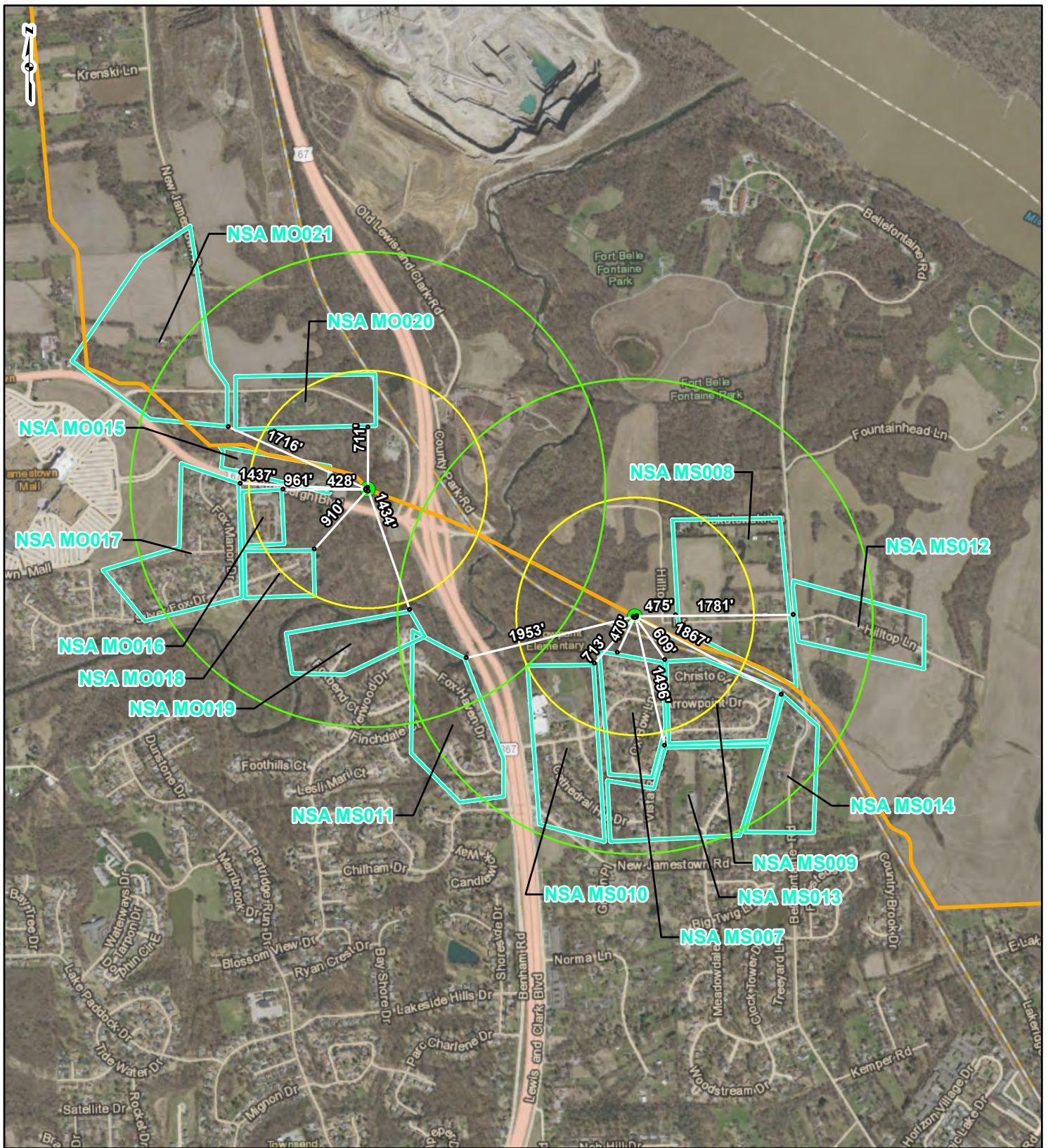
Calibration Details:

Plan View:

NORTH

see previous

Profile View:



LEGEND

- HDD LOCATION
- NORTH COUNTY EXTENSION
- NOISE SENSITIVE AREA
- 0.25- MILE HDD RADIUS
- 0.50- MILE HDD RADIUS

0 750 1,500 3,000
Feet

FIGURE 9.2.8B
NOISE SENSITIVE AREAS
COLDWATER CREEK HDD LOCATIONS

SPIRE STL
PIPELINE
PROJECT

DRAWN BY: PMH DATE: 3/30/2017
CHECKED: EFJ APPROVED: LMF

REFERENCE: ESRI WORLD IMAGERY AND TRANSPORTATION, NAIP, USDA FSA, 2014, ACCESSED 03/2017.

Legend

-  Road
-  Building

**Noise level
Ldn
in dB(A)**

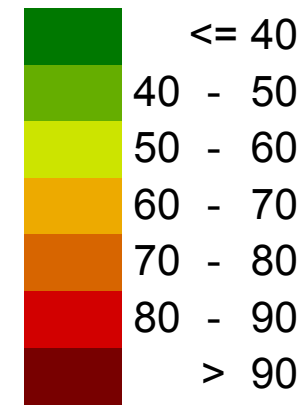
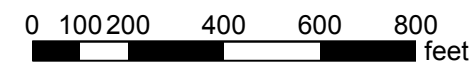


Figure: 9.2-8A
SPIRE Coldwater Creek East HDD
Location
38°48'54.94"N 90°13'24.55"W

Prepared By: JJJ
Checked By: MTM
Approved By:

Scale 1:400



Project Location: Mississippi River North HDD		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -008	
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	In field on adjacent property. Site access denied.	Handheld and Fixed ▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:		
ID:	Description:	Type:
1	Bellafontaine Rd.	Line
2	See Project Notes below for HDD Station Sources	
3	US 67 N/S	Line
4	Arrowpoint Dr.	Line
5	Vista Ridge Lane and Meadowdale Drive	Line
6	Cowington Gardens Drive	Line
7	Ox Bow Lane and Cathedral Hill Drive	Line

Sound Levels	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Large Drill Rig @ 110 dBA
- Two Mud Pumps @ 110 dBA
- Three Generators @ 90 dBA
- Separation Plant @ 100 dBA

2. Sound level contributions from all streets and side streets conservatively estimated based on typical sound levels for similar roads.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: 68 Description: MMID 68 - 2-28-17 Morning

Done By: JMC / JJJ
 Meter: →

Monitoring Data: AM Peak Off-Peak PM Peak
 Date: 2-28-17
 (LST) Start Time: 8:02 A
 (LST) End Time: 8:17 A
 Duration: 15 MIN MIN MIN
 LAeq: 50.0

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

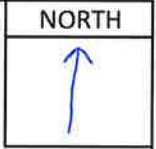
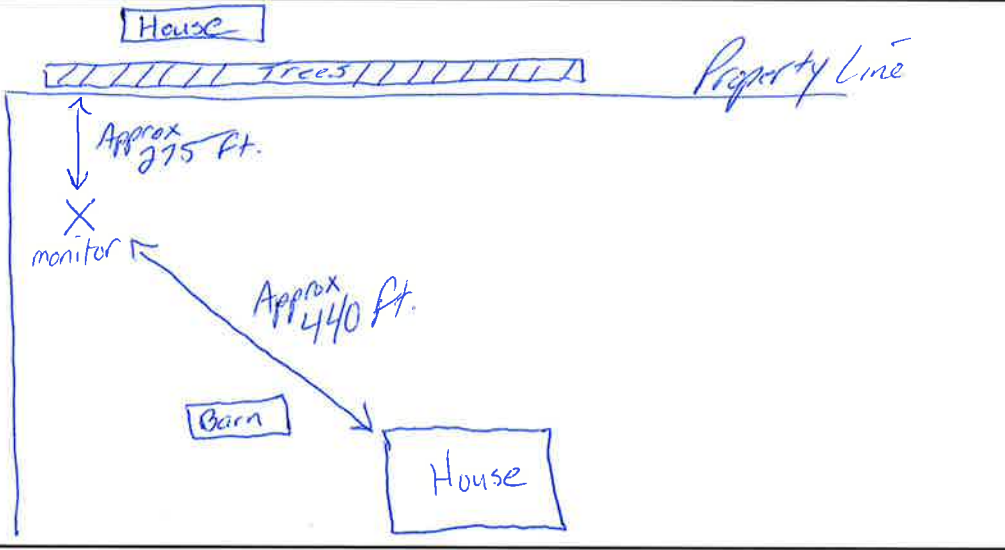
Atmospheric data
Wind Speed (mph) <u>2 mph</u>
Temp. (°F) <u>60 °F</u>
Humidity (%) <u>80 %</u>
Cloud Cover <u>Overcast</u>

Notes:
 Monitor Located in old Ag. Field. Approx. 275 ft from property line of nearest house.
 LaFmin - 44.7 dB
 LaFmax - 65.6 dB
 LaF90 - 47.4 dB

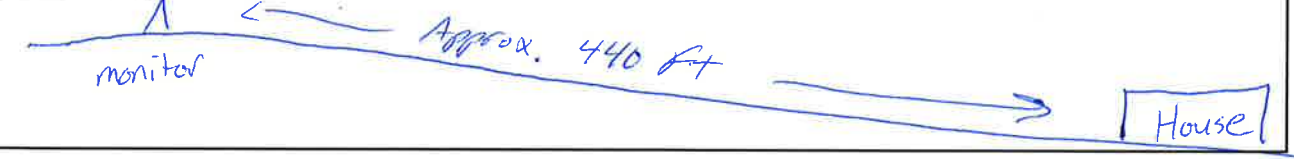
Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details:
4:30 pm (EST) 2-27-17
Calibrator - 114 dB Monitor - 114 dB
Calibrator - 94 dB Monitor - 94 dB

Plan View:



Profile View:



Site Number: 68 Description: MMIO 68 - 2-27-17 Evening

Done By: JMC / JJJ
 Meter: →

Monitoring Data: AM Peak Off-Peak PM Peak

Date: 2/27/17
 (CST) Start Time: 4:13p
 (CST) End Time: 4:28p
 Duration: MIN MIN 15 MIN
 LAeq: 49.7

Traffic Data

Roadway			
Direction			
Traffic Total			
Cars			
MT			
HT			

Weather Conditions

Atmospheric data
Wind Speed (mph) <u>5-10 mph</u>
Temp. (°F) <u>64°F</u>
Humidity (%) <u>75%</u>
Cloud Cover <u>Sunny-No clouds</u>

Notes:

Monitor located in old Ag. Field. Approx 275 ft from property line of nearest house.

LaFmin - 35.1 dB
LaFmax - 64.0 dB
LaF90 - 39.2 dB

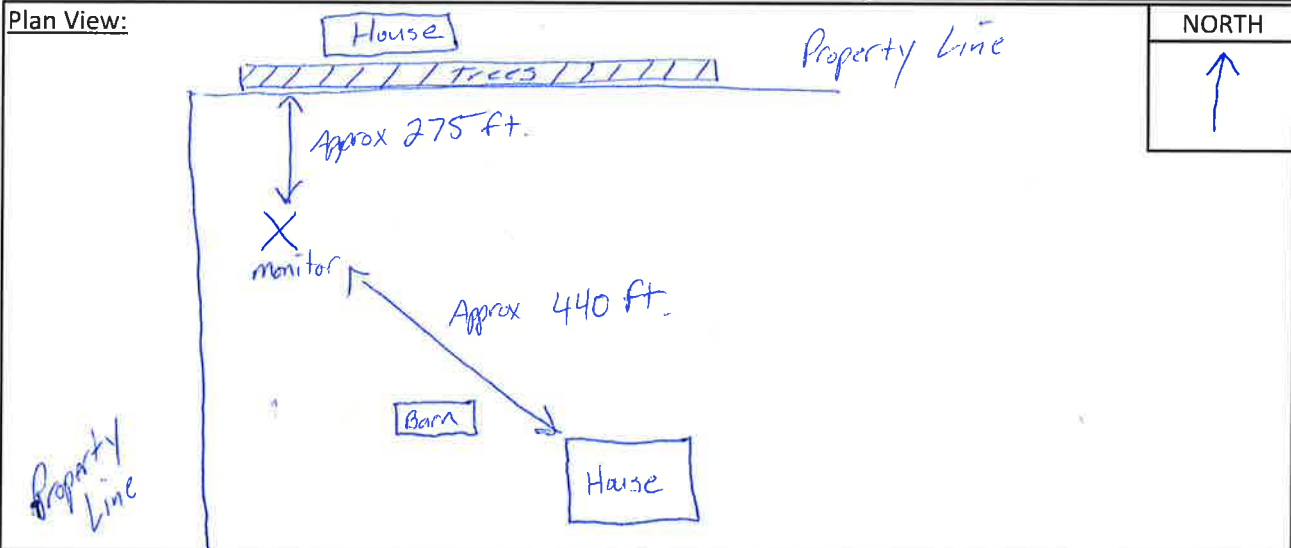
Train passing nearby from 4:22 - 4:25pm

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details:


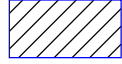
4:30 pm (EST) 2-27-17
Calibrator - 114 dB Monitor - 114 dB
Calibrator - 94 dB Monitor - 94 dB

Plan View:



Profile View:



Legend
 Road
 Building

Noise level
 Ldn
 in dB(A)








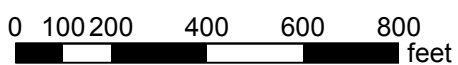
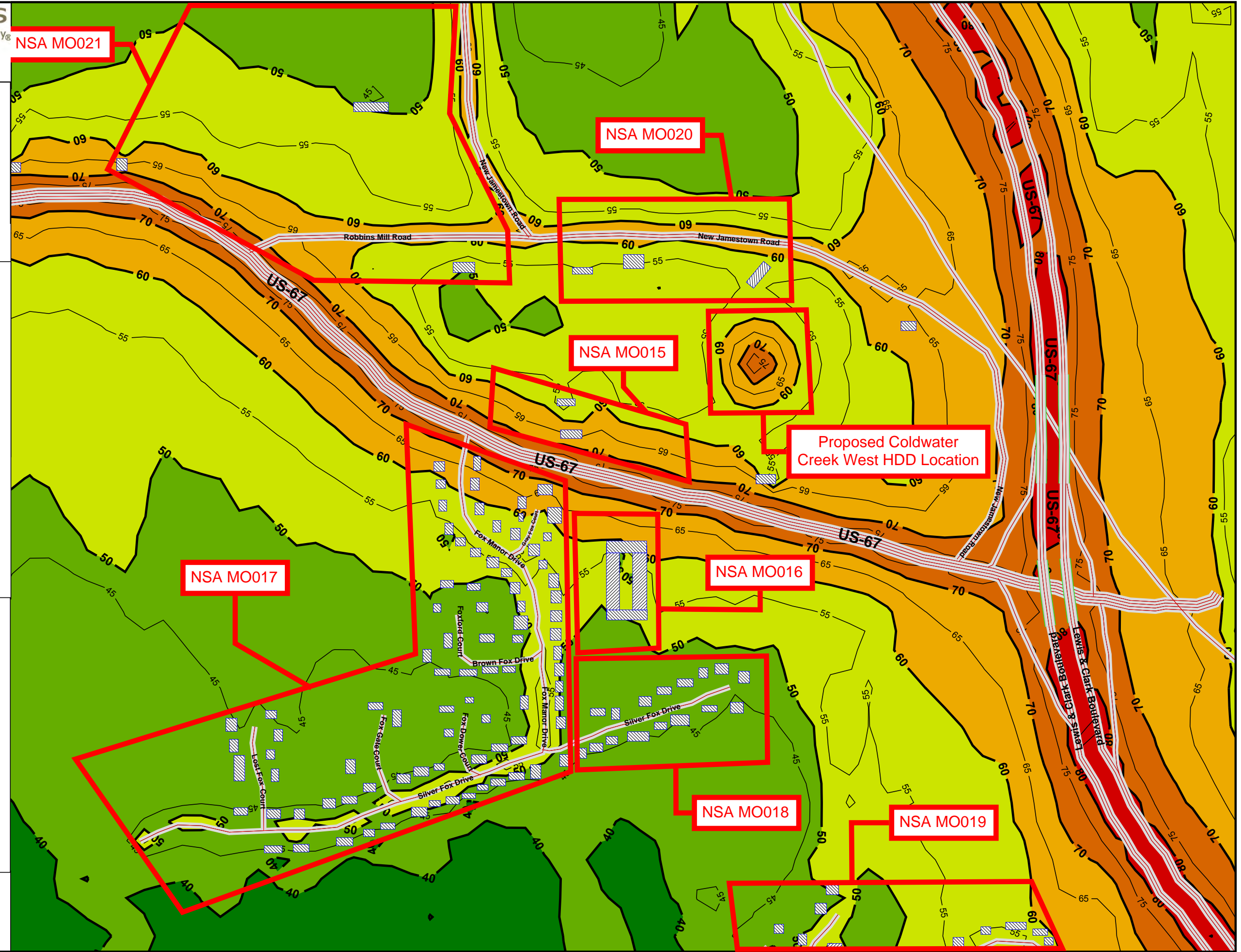
	<= 40
	40 - 50
	50 - 60
	60 - 70
	70 - 80
	80 - 90
	> 90

Figure: 9.2-9
SPIRE Coldwater Creek West HDD
 Location
 38°49'15.49"N 90°14'11.57"W

Prepared By: JJJ
 Checked By: MTM
 Approved By: _____

Scale 1:400

Project Location: Mississippi River North HDD		Project Number: C160438.00	
Client: SPIRE		Model Run: C132336.04 -009	
Field Staff: JJJ TL		Document Originator: JJJ Checked: MTM Approved: JWW	
Type of Work/Study Performed: <input checked="" type="checkbox"/> Sound Level Monitoring <input checked="" type="checkbox"/> Sound Level Modeling			
Type of Study: <input checked="" type="checkbox"/> Ambient <input checked="" type="checkbox"/> Construction <input type="checkbox"/> Post Construction <input checked="" type="checkbox"/> Operation			
Duration: <input type="checkbox"/> Spot <input checked="" type="checkbox"/> 15-minute <input type="checkbox"/> 1 hour <input type="checkbox"/> 24 hour <input type="checkbox"/> 48 hour <input type="checkbox"/> 72 hour <input type="checkbox"/> Other _____			
Data Collected: <input checked="" type="checkbox"/> LAeq <input checked="" type="checkbox"/> LAFmax <input checked="" type="checkbox"/> LAFmin <input checked="" type="checkbox"/> LAF90 <input type="checkbox"/> LAF10 <input type="checkbox"/> Low Frequency <input type="checkbox"/> Other _____			
Approximate Study Area (sq mi):		0.79	
Number of Monitoring Locations:		1	
Monitoring Location:			
ID:	Location Description:	Type:	
ML1	In right of way along New Jamestown Rd./Robbins Mill Rd	Handheld and Fixed ▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
		▼	
Description of Surrounding Area (sketch, prominent sources of sound, etc.)			
See attached Figure for operational sound model results and area description			

Identified Sound Level Sources:		
ID:	Description:	Type:
1	New Jamestown Road	Line
2	See Project Notes below for HDD Station Sources	
3	US 67	Line
4	Robbins Mill Road	Line
5	Lindbergh Blvd.	Line
6	Fox Manor/Silver Fox Dr.	Line
7	Fox Haven Dr.	Line

Sound Levels	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	
Estimated	

Project Notes:

1. M&R Facility expansion conservatively modeled to include the following significant sources:

- Large Drill Rig @ 110 dBA
- Two Mud Pumps @ 110 dBA
- Three Generators @ 90 dBA
- Separation Plant @ 100 dBA

2. Sound level contributions from all streets and side streets conservatively estimated based on typical sound levels for similar roads.

Results Summary:

See attached Figure _____ for sound level map with delineated NSAs within 1/2 mile.
See attached sound monitoring report sheets for results of 15-minute sound level surveys.

Site Number: 67 Description: AMID 67 West 2-28-17 Morning

Done By: JMC / JJJ

Meter: _____

Monitoring Data: AM Peak Off-Peak PM Peak

Date 2-28-17

(LST) Start Time: 7:08a

(LST) End Time: 7:23a

Duration: 15 MIN _____ MIN _____ MIN

LAeq: 53.5 _____ _____

Traffic Data

Roadway _____

Direction _____

Traffic Total _____

Cars _____

MT _____

HT _____

Weather Conditions

Site Data: Site Surphace (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details:

4:30 pm (EST) 2-27-17
Calibrator - 114 dB Monitor - 114 dB
Calibrator - 94 dB Monitor - 94 dB

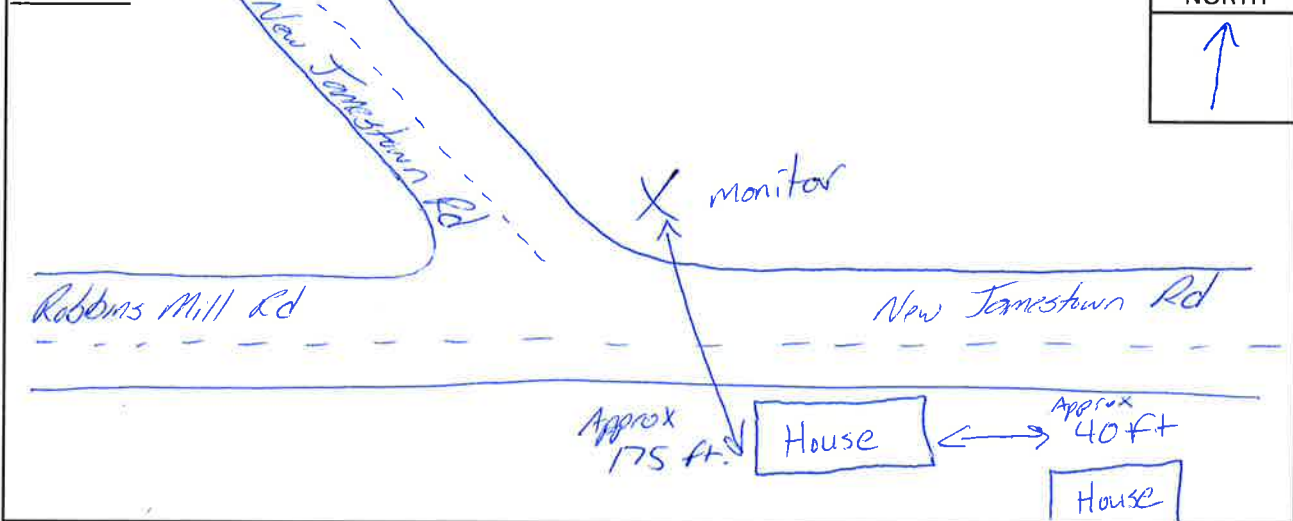
Notes:

Located @
 corner of
 New Jamestown Rd
 and Robbins Mill Rd
Light Traffic

LaFmin - 48.8 dB
LaFmax - 58.9 dB
LaF90 - 51.2 dB

Atmospheric data	
Wind Speed (mph)	<u>2 mph</u>
Temp. (°F)	<u>60 °F</u>
Humidity (%)	<u>80 %</u>
Cloud Cover	<u>overcast</u>

Plan View:



Profile View:



Site Number: 67 Description: MMIO 67 West 2-27-17 Evening

Done By: JMC/JJJ
 Meter: →

Monitoring Data:

	AM Peak	Off-Peak	PM Peak
Date	<u>2-27-17</u>		
(LST) Start Time:	<u>5:18 p</u>		
(LST) End Time:	<u>5:35 p</u>		
Duration:	MIN	MIN	<u>15</u> MIN
LAeq:			<u>56.6</u>

Traffic Data

Roadway	Direction	Traffic Total	Cars	MT	HT

Weather Conditions

Atmospheric data
Wind Speed (mph) <u>5-10 mph</u>
Temp. (°F) <u>64°F</u>
Humidity (%) <u>75%</u>
Cloud Cover <u>Sunny-No low</u>

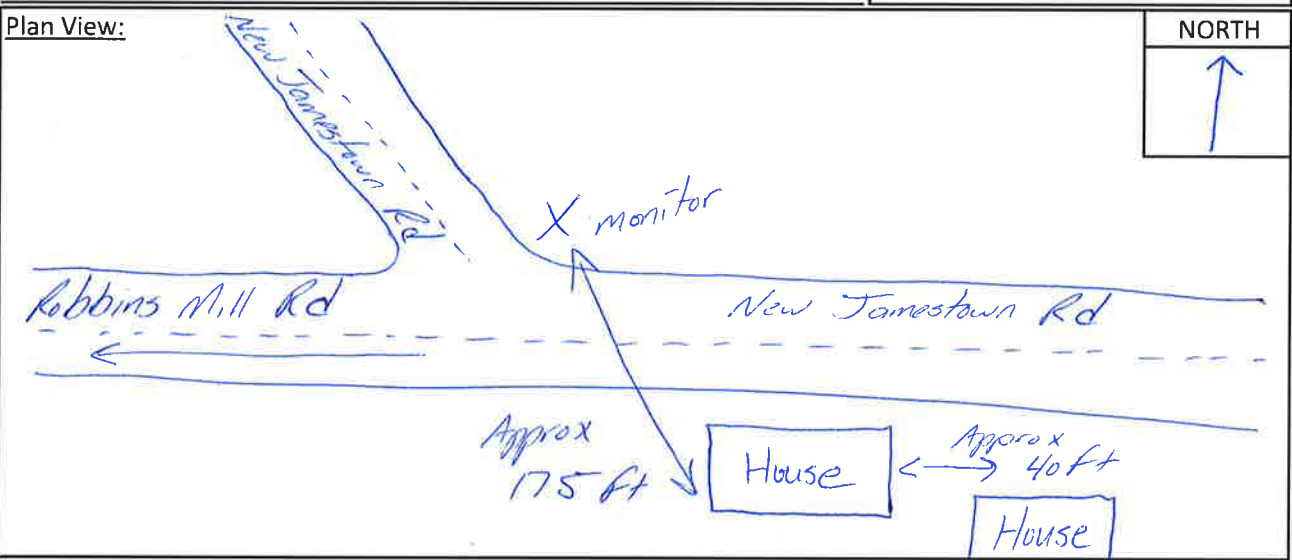
Notes:
 Located @ corner of New Jamestown Rd and Robbins Mill Rd
 Light Traffic

LaFmin - 47.9 dB
 LaFmax - 77.8 dB
 LaF90 - 50.1 dB

Site Data: Site Surphase (Alpha): _____ Shielding Factor: _____ Pavment Type: _____

Calibration Details:

<u>4:30 pm (EST) 2-27-17</u>
Calibrator - <u>114 dB</u> Monitor - <u>114 dB</u>
Calibrator - <u>94 dB</u> Monitor - <u>94 dB</u>





APPENDIX 9-E
Fugitive Dust Control Plan