

APPENDIX E

NOISE

The relationship of noise to the human environment is complex and highly technical. The following information is a simplified summary of noise, some of its descriptors, and some human response to varying levels of noise. Elements of this summary were used in the EA to describe the affected environment and the environmental consequences related to noise.

Noise is generally defined as unwanted sound that disrupts normal activities or that diminishes the quality of the environment. It is usually caused by human activity that adds to the natural acoustic setting of a locale. Various descriptors are used to describe sound and noise levels. These include the A-weighted decibel scale (dBA); sound level equivalents (Leq), day-night average sound levels (Ldn), and percentile levels.

The most common measurement of sound and environmental noise is the A-weighted decibel scale (dBA). This is a logarithmic scale that ranges from 0 dBA to about 140 dBA and approximates the range of human hearing. The threshold of human hearing is about 0dBA; less than 30 dBA is very quiet; 30 -60 dBA is quiet; 60-90 dBA is moderately loud; 90-110 dBA is very loud; and 110-130 is uncomfortably loud. A 10-decibel increase in sound levels is perceived as a doubling of the loudness. However, due to the logarithmic nature of the decibel scale, the sound levels for different noise sources cannot be added directly for a combined sound level. For example, two adjacent sound sources with the same sound level have a composite noise level only 3 decibels greater than either source; two adjacent sound sources with sound levels that differ by 10 decibels have a composite noise level only 0.4 decibels greater than the louder source.

Table E-1: Comparison of Common Sound Levels¹

Source(s)	Sound Levels ² (dBA)	Notes
Shotgun Rifle Handgun Fireworks (at 3 ft.)	≥ 160	Impulse sounds
Jet engine (taking off) Artillery fire (at 500 ft.)	150	
Airplane (taking off)	140	Harmfully loud
Stock car races Jet takeoff (at 100-200 ft.)	130	Threshold of pain
Heavy machinery Chainsaw Jet plane (at ramp) Band Concert	120	Threshold of sensation or feeling
Car horn Symphony concert Baby crying	110	Regular exposure of more than 1 minute risks permanent hearing loss. Physical discomfort. Maximum vocal effort.
Snowmobile Garbage truck Jet takeoff (at 2000 ft.) School dance	100	≥ 95 dBA- no more than 15 minutes/day unprotected exposure recommended; 1 hr/day risks hearing loss.

Heavy truck (at 50 ft.) Motorcycle (operator) Power lawnmower Jet ski Pleasure motorboat Shouted conversation	90	Very annoying
Heavy traffic Many industrial workplaces Electric razor	85	Level at which hearing damage begins with 8 hour exposure.
Ringing telephone Average city noise Freight train (at 50 ft.)	80	Annoying; interferes with conversation
Freeway traffic (at 50 ft.) Urban housing on major avenue (Ldn) Inside a car TV audio	70	Interferes with telephone conversation. EPA Ldn for lifetime exposure without hearing loss.
Normal conversation Sewing machine	60	Intrusive Interference with human speech begins at about 60 dBA
Rainfall Refrigerator Wooded residential (Ldn) Light auto traffic (at 100 ft.)	50	Quiet Comfortable Sleep disturbance may occur at less than 50 dBA.
Quiet office, library Quiet residential area Rural Residential (Ldn)	40	
Soft whisper (at 15 ft.)	30	Very Quiet
Normal breathing	10	Just audible
	0	Threshold of hearing

¹ Adapted from several web sites, including: League for the Hard of Hearing, www.lhh.org; The Canadian Hearing Society, www.chs.ca

² These are typical levels and some may be approximate averages of ranges; actual levels may depend on several factors, including distance from the sound source.

Sound level equivalents (Leq) are used to measure time-varying sound levels over various periods of time. They are an average noise level over a given length of time and generally use A-weighted sound-level measurements. Typical time frames are 1, 8, and 24 hours. They may include weighting factors for annoyance potential due to time of day or other considerations.

The day-night average sound level is a 24-hour sound level equivalent with an adjustment for the nighttime period (10 p.m. to 7 a. m.). This figure is calculated from hourly Leq rates with nighttime Leq values increased by 10 dB to reflect the greater disturbance potential from nighttime noise.

Percentile levels are used to describe the sound level that is exceeded during a given percentage of a measurement period. For example, L10 is the sound level exceeded 10% of the time. L1, L10, L50, and L90 are commonly used levels. L1 generally corresponds to the maximum sound level during the measurement period. L50 is the median noise level and L90 is usually considered to represent the ambient sound level.

Noise Characteristics

Sound is characterized by its intensity, frequency, and duration. Intensity is the physical measurement of sound in decibels, which is perceived as loudness. Frequency is a physical measurement of sound in cycles per second (Hertz), which is perceived as pitch (high and low sounds). Duration is the length of time that a sound continues.

Between a noise source and a receptor, the perceived loudness or intensity may change as a result of distance, topography, vegetation, water bodies, and structures. These changes may increase or decrease the perceived loudness. The closer a receptor is to a noise source the louder the noise seems; for every doubling of distance from a source the intensity drops by about 6 dB over land and about 5 dB over water. Topography, vegetation, and structures can change noise intensity through reflection, absorption, or deflection; reflection tends to increase the intensity, while absorption and deflection tend to decrease the intensity.

Traffic noise from highways and other roads is never constant and depends on 1) the volume of traffic, 2) the speed of the traffic, and 3) the number of trucks in traffic flow. Traffic noise generally increases with heavier traffic volume, higher speeds and greater numbers of trucks. Vehicle noise is a combination of noise produced by the engine, exhaust, and tires, and can be increased by faulty equipment. Highway noise is usually described as a single number; most commonly L10 or Leq. Peak sound levels for freeway traffic at 50 feet may be about 70 dBA, while light auto traffic may be about 53 dBA. The L10 or Leq would generally be less. Since traffic noise is a linear noise source, its loudness generally drops about 3 dBA for every doubling of distance from the highway or road, so 70 dBA at 50 feet would be only 67 dBA at 100 feet.

Recreational noise also is not constant and depends on the type of activities, the number of people, and types of vehicles or vessels used. Recreational sources at Navajo include motorized vessels including personal water craft, human voices, mechanized trash collection, motorized vehicles, audio equipment, and generator noise. Noise levels and patterns at the developed recreation areas and the more frequently and heavily used informal use areas are typical of campground and day use recreation areas. These heavy recreational use areas could be compared to residential areas with an Ldn range of about 50 dBA (quiet suburb, not close to major roads, and little nighttime activity) to about 65 dBA (relatively noisy residential area).

Outside of the developed and heavy use areas, the most conspicuous recreational noise producers are power boats and personal water craft (jet skis) on the reservoir. While power boats and jet skis may both have an average sound level of about 90 dBA, how they are operated can change their sound levels. Like vehicles, increased vessel speed increases noise levels. At 60 mph, a jet ski's sound level can exceed 115 dBA and during radical maneuvers its sound level may reach 95 dBA. Radical maneuvers (wake jumping, turning doughnuts, etc.) also create constantly changing sounds due to engine pitch changes, loss of the muffling effect of water during jumps, and the "whump" of the landing after a jump.

Noise from oil and gas development, and natural gas compressors, in particular, has been identified as a major issue for the area. Such noise comes from site construction, drilling, production, transportation, and site rehabilitation activities and the associated equipment (heavy machinery, heavy equipment, vehicles, generators, compressors, etc.) and standard operating procedures (well venting, gas flaring, etc.). Many of these noises are loud, but vary in duration and timing. Some, like well venting, may occur suddenly and without notice but are of relatively short duration. The noise associated with coalbed methane fracturing operations, including flaring of gas, has been likened to a jet plane taking off. Compressors may emit a more constant and long-term low frequency humming or rumble.

Some peak noise level ranges for sources within, or adjacent to the reservoir area are shown in Table E-2.

Table E-2 Approximate Maximum A-weighted Sound Levels for Various Noise Sources at 50'¹

Activity	Range	Timing Pattern
Site construction and rehabilitation (earth moving and agricultural equipment)	93 -108	<ul style="list-style-type: none"> ▪ Intermittent ▪ Fluctuating sound levels ▪ Typically day operations only
Oil/gas drilling/workover	100 - 130	<ul style="list-style-type: none"> ▪ Intermittent ▪ Fluctuating sound levels ▪ 24 hour/day operations ▪ 1 week to several months duration
Oil/gas fracturing operation	100 - 145	<ul style="list-style-type: none"> ▪ Intermittent ▪ Fluctuating sound levels ▪ Venting/flaring operations are loudest and most continuous, but last only 1-2 days. ▪ 24 hour/day operations ▪ 1 -2 weeks duration
Oil/gas operations	62-87	<ul style="list-style-type: none"> ▪ Long term, continuous sound levels ▪ 24 hours/day, 7 days/week, year round operations
Natural gas compressors	62-87	<ul style="list-style-type: none"> ▪ Long term, continuous sound levels ▪ 24 hours/day, 7 days/week, year round operations ▪ Low pitched sound
Highway traffic	80-100	<ul style="list-style-type: none"> ▪ Intermittent ▪ Fluctuating sound levels ▪ Generally heavier use during daylight hours
Developed recreational areas (Ldn)	50 - 65	<ul style="list-style-type: none"> ▪ Intermittent ▪ Fluctuating sound levels ▪ Generally more activity during summer daylight hours
Motor boating (including jet skis)	70 - 115	<ul style="list-style-type: none"> ▪ Intermittent ▪ Fluctuating sound levels ▪ Generally heavier use during daylight hours

¹ Ranges were computed from various sound level listings using a 6 dB attenuation/amplification for each doubling/halving of distance from/to the noise source to approximate the noise level at 50 feet. This is a very simplified description of some typical noise levels that may occur within the reservoir area.

Environmental Consequences

In 1974 EPA identified outdoor and indoor noise levels to protect public health and welfare. A 24-hour exposure level (Leq(24)) of 70 decibels was identified as the level of environmental noise which will prevent any measurable hearing loss over a lifetime. An Ldn of 55 decibels outdoors and an Ldn of 45 decibels indoors were identified as preventing activity interference or annoyance. These levels are not “peak” levels, but are 24-hour averages over several years. Occasional high levels of noise may occur. Also, these levels are not regulatory goals or requirements. (EPA, 1974)

Table E-4 Yearly Sound Levels That Protect Public Health/Safety with a Margin of Safety

EFFECT	LEVEL (dBA)	EPA AREA	RESERVOIR AREA CORRELATION
Hearing	Leq(24) < 70	All areas (at the ear)	All
Outdoor activity interference/annoyance	Ldn < 55	Outdoors in residential areas and farms and other outdoor areas where people spend widely varying amounts of time and other places where quiet is a basis for use.	Developed recreation areas- Sims Mesa, Pine River, San Juan River Recreation Area, and Arboles.

Outdoor activity interference/annoyance	Leq(24) < 55	Outdoor areas where people spend limited amounts of time, such as school yards, playgrounds, etc.	General project lands; PJA.
Indoor activity interference/annoyance	Ldn < 45	Indoor residential areas.	Employee Housing at Arboles, Sims Mesa, Pine River, and old Government Camp
Indoor activity interference/annoyance	Leq(24) < 45	Other indoor areas with human activities, such as schools, etc.	Visitor centers and concession buildings at developed recreation areas; offices, etc. at Arboles, Sims Mesa, Pine River, PJA, and old Government Camp

Humans

The effects of noise on humans are varied and are dependent on the noise’s intensity, its frequency, and its duration; the sensitivity and expectations of the person affected; and the environment in which the noise is perceived. The same noise that would be highly intrusive to someone in a quiet park might be barely perceptible in the middle of the freeway at rush hour. Therefore, planning for an acceptable noise exposure must take into account the types of activities and corresponding noise sensitivity in a specified location for each particular set of land uses. See Table E-1 for some general human effects at various noise levels.

Excessive noise exists in our homes, our workplaces, and in our recreational pursuits and can affect the human condition in many ways. Sudden, short-term and infrequent high-pitched and/or high-intensity sounds can be startling and stressful, even fearful, particularly when not expected. While short-term and infrequent periods of high pitch and/or high intensity noise can cause both temporary and permanent hearing loss, the most common human response to such un-wanted noise is annoyance with a short-term mitigation by increasing the volume of conversation or audio equipment, pausing in conversation or other activity, turning off audio equipment, and/or leaving the area. On the other hand, adverse effects to long-term excessive noise can include both direct and indirect effects, such as:

- Permanent loss of hearing
- Permanent ringing or buzzing in the ears
- Stress and stress related illness/disease
- Increase blood pressure, hypertension
- Rest disturbance, sleep deprivation, fatigue
- Absenteeism
- Communication difficulties
- Learning/education difficulties

Wildlife

Like humans, the effect of noise on wildlife is highly varied and is dependent on the noise’s intensity, its frequency, and its duration; the sensitivity of the species or individual affected; and the environment in which the noise is perceived. Unusual, loud, and/or intermittent will generally startle and stress most species of wildlife. Their heart rate increases and they may leave the area for varying lengths of time; once the noise ceases they may return. Increased stress and/or movement during a critical period such as nesting or birthing, or winter, will generally cause greater adverse effects to wildlife than the same stress outside of such critical times. If nesting birds leave the nest for even a short period of time, their nesting success may be reduced; if they abandon the nest, that nesting attempt will fail. Long-term excessive noise may also result in hearing loss which may put wildlife at greater risk of death because of a reduced ability to detect and avoid danger. If a noise is somewhat regular in its intensity and pitch, even though it has a

long duration, some species and/or individuals may become accustomed to it, stay in the area, and not show signs of adverse effect.

Noise Regulation

There are several Federal, State, and local laws or regulations that regulate and/or abate noise. OSHA requirements for noise levels and hearing protection within the workplace are examples of such regulation, but will not be discussed further here. Table E-3 shows some of the laws and regulation that apply to noise in the vicinity of Navajo Reservoir.

Table E-3: Noise Abatement Requirements affecting the Navajo Reservoir Area (as of 10/14/04)

ENTITY	REQUIREMENT(S)	CITATION	COMMENTS
Federal Agencies (USBR, BLM, BIA, etc.)	<ul style="list-style-type: none"> ▪ Promote an environment for all Americans free from noise that jeopardizes their health or welfare. ▪ Compliance with Federal, State, interstate, and local environmental noise control and abatement requirements to the same extent that any person is subject to them. 	<ul style="list-style-type: none"> ▪ Federal Noise Control Act of 1972 (PL 92-57) 	<ul style="list-style-type: none"> ▪ Applicable to all federal lands, programs, and activities.
BLM (FFO)- Oil/Gas Development	<ul style="list-style-type: none"> ▪ Long-term, continuous noise sources require noise control ▪ Noise control will be receptor-focused or boundary-focused: <ul style="list-style-type: none"> ▪ Receptor-focus control requires a ≤ 48.6 dBA 24-hour Leq sound level at designated receptor points in: <ul style="list-style-type: none"> ▪ Simon Canyon SMA* ▪ Simon Ruin SMA ▪ Reese Canyon RNA* ▪ Negro Canyon SMA ▪ Navajo Lake Horse Trail SMA* ▪ Bald Eagle ACEC* ▪ Recreation areas ▪ Boundary-focus control requires a ≤ 48.6 dBA 24-hour Leq sound level at 400 feet in all directions and includes: <ul style="list-style-type: none"> ▪ Carracas Mesa SMA ▪ All USBR land around Navajo Reservoir ▪ For noise sources near occupied buildings the ≤ 48.6 dBA 24-hour Leq shall be met 100 feet from the building. ▪ Stricter standards may be applied to those areas marked with an asterisk. ▪ Transient oil/gas operations will be handled on a case-by case basis. ▪ New NSAs may be added over time. ▪ Allows for phased implementation over 5 years. ▪ Sets noise survey measurements protocol. 	<ul style="list-style-type: none"> ▪ FFO-RMP/ROD ▪ NTL 04-2 FFO 	<ul style="list-style-type: none"> ▪ Applicable to federal and Indian oil/gas leases under the jurisdiction of BLM's FFO, NM, including the NM portion of the Navajo Reservoir Area.
State of Colorado- General Statutes	<ul style="list-style-type: none"> ▪ Statewide limits for noise level s. Noise exceeding the established limits is a public nuisance. ▪ Activities shall be conducted so produced noise is not objectionable 	<ul style="list-style-type: none"> ▪ CRS § 25-12-101, et. seq. 	<ul style="list-style-type: none"> ▪ Applicable within Colorado-state wide ▪ Political subdivisions of the state having jurisdiction may further regulate noise.

ENTITY	REQUIREMENT(S)	CITATION	COMMENTS
	<p>due to intermittence, beat, frequency or shrillness.</p> <ul style="list-style-type: none"> ▪ Maximum permissible noise levels 25 feet past the property line where the noise source is located: <ul style="list-style-type: none"> ▪ Residential zone: day- 55 dBA; night- 50 dBA. ▪ Commercial zone: day- 60 dBA; night- 55 dBA. ▪ Light industrial zone: day- 70 dBA; night- 65 dBA. ▪ Industrial zone: day- 80 dBA; night- 75 dBA. ▪ During the day, the above noise levels may be increased by 10 dbA for a period not to exceed 15 minutes in any one-hour period. ▪ Periodic, impulsive, or shrill noises 5 dBA less than the maximum allowable are a public nuisance. ▪ Counties, municipalities, etc. may establish noise abatement ▪ Provides for exceptions and guidance for measurement of sound levels. 		
State of Colorado- COGCC Rules	<ul style="list-style-type: none"> ▪ Similar to the general Colorado statute, plus elements specific to oil and gas development. ▪ Operations involving pipeline or gas facility installation or maintenance, the use of a drilling rig, workover rig, or stimulation are subject to the maximum allowable noise levels for industrial zones. ▪ Exhaust from mechanized equipment shall be vented away from occupied buildings to the extent practicable. All facilities with non-electric motors within 400 feet of occupied buildings shall be equipped with properly installed and maintained quiet design mufflers. 	COGCC Rules and Regulations 802- Noise Abatement	<ul style="list-style-type: none"> ▪ Applies to oil/gas operations in Colorado.
State of Colorado- CDPOR Regulations	<ul style="list-style-type: none"> ▪ Quiet hours from 10:00 pm to 6:00 am; loud radios, generators and other loud noises that disturb the peace are prohibited then. 	CDPOR Regulations Chapter 1, Article I, #100 e.	
La Plata County (CO) (Oil/Gas Development)	<ul style="list-style-type: none"> ▪ At minimum, requires compliance with COGCC standards, as may be adopted and amended. ▪ Exhaust to be vented away from closest residences or platted subdivision lots. ▪ Facilities with non-electric motors shall be equipped with properly installed and maintained quiet design mufflers or equivalent. ▪ Facility equipment to be anchored to minimize ground transmission of vibration. ▪ Additional mitigation measures may be required on a case-by-case basis. 	La Plata County Code Section 90-122 (d)	<ul style="list-style-type: none"> ▪ Applies to unincorporated lands within La Plata County, except where county jurisdiction is preempted by federal or state law or by SUIT jurisdiction.
Archuleta County (CO) (Oil/Gas Development)	<ul style="list-style-type: none"> ▪ Details of requirements are unknown at this time; WCAO has not yet received a copy of Appendix F 	Archuleta County Land Use Code- Appendix F	<ul style="list-style-type: none"> ▪ Applies to oil/gas activities within Archuleta County
State of New Mexico	<ul style="list-style-type: none"> ▪ No apparent general state-wide environmental noise control or abatement requirements that may 		<ul style="list-style-type: none"> ▪ Statement based on internet search; subject to change.

ENTITY	REQUIREMENT(S)	CITATION	COMMENTS
	affect current or anticipated activities within or adjacent to the reservoir area other than muffler requirements for motorized vehicles, including snowmobiles.		
State of New Mexico-NMSPD	<ul style="list-style-type: none"> ▪ Quiet hours from 10:00 pm to 7:00 am; loud radios, generators and other loud activities that disturb others are prohibited then. 	NMAC 19.5.2.22 Noise Limitations	<ul style="list-style-type: none"> ▪
San Juan County (NM)	<ul style="list-style-type: none"> ▪ No apparent statutes or regulations for noise limits that would affect current or anticipated activities within or adjacent to the reservoir area. 		<ul style="list-style-type: none"> ▪ Statement based on internet search; subject to change.
Rio Arriba County (NM)	<ul style="list-style-type: none"> ▪ No apparent statutes or regulations for noise limits that would affect current or anticipated activities within or adjacent to the reservoir area. 		<ul style="list-style-type: none"> ▪ Statement based on internet search; subject to change.
Southern Ute Indian Tribe (SUIT)	<ul style="list-style-type: none"> ▪ No identified statutes or regulations for noise limits that would affect current or anticipated activities within or adjacent to the reservoir area. 		<ul style="list-style-type: none"> ▪ Statement based on internet search; subject to change.

Noise Mitigation/Reduction

Noise may be reduced by a variety of means including reduction, muffling, absorption, and deflection. The best mitigation is to reduce noise at its source and includes such things as using quieter equipment (i.e., electrical vs internal combustion motors), maintaining equipment in good working order; reducing the volume of the stereo or television; and muffling the equipment. Additional mitigation of unwanted or excessive noise may take place at the receptor and includes muffling, such as hands over the ears or the use of ear plugs and earmuffs; audio competition, such as the use of “white noise” or music; and increasing the distance between the source and the receptor. Other means of noise mitigation may take place between the source and the receptor, and include acoustical insulation of structures and vehicles; closing of doors and windows; the use of topographic, structural, and vegetative screening; and increasing the distance between the source and the receptor.