13.0 NOISE AND VIBRATION

This chapter describes existing noise and ground-borne vibration and analyzes the potential effects on the environment that may occur with the implementation of the proposed project.

Guidelines and key sources of data used in the preparation of this chapter include the following:

- *City of Pittsburg General Plan* Noise Element (2004)
- City of Pittsburg Municipal Code
- *Construction Noise Handbook* (FHWA, 2006)
- *Transit Noise and Vibration Impact Assessment* (FTA, 2006)
- *WesPac Energy Infrastructure Project, Noise Assessment Report* (TRC, 2011)
- *Willow Pass Generating Station Cumulative Impact Analysis incorporating Tank Farm Project* (URS, 2009)

13.1 ENVIRONMENTAL SETTING

13.1.1 Concepts and Terminology

This noise and vibration analyses rely on the following standard noise- and vibration-related terms and principles.

- **Environmental noise:** Environmental noise is defined as unwanted sound resulting from vibrations in the air. Excessive noise can cause annoyance and adverse health effects. Annoyance can include sleep disturbance and speech interference. It can also distract attention and make activities more difficult to perform (EPA, 1978).

  The range of pressures that create noise is broad. Noise is, therefore, measured on a logarithmic scale, expressed in **decibels (dB)**. Noise is typically measured on the **A-weighted scale (dBA)**, which has been shown to provide a good correlation with human response to sound and is the most widely used descriptor for community noise assessments (Harris, 1998).

  To describe the time-varying character of environmental noise, various statistical noise descriptors are typically used.

  - **Lmax:** Lmax is the maximum noise level generated by a source at a specified distance.

  - **L_{eq}:** L_{eq} is the equivalent noise level over a specified period of time (i.e., one hour). It is a single value of sound that includes all of the varying sound energy in a given duration.

  - **L_{90}, L_{50},** and **L_{10}:** These are the A-weighted sound levels that are exceeded at the specified percentage of time. For example, L_{90} is the sound level exceeded 90 percent of the time and is often considered the background, or residual, noise level. Similarly, L_{10} is the sound level exceeded 10 percent of the time and is commonly used as a measurement of intrusive sounds such as aircraft overflight.

  - **L_{dn}:** L_{dn}, or day-night noise level, is the A-weighted sound level over a 24-hour period with an additional 10 dB penalty imposed on sounds that occur at night between 10 p.m. and 7 a.m.

  - **CNEL:** CNEL, or Community Noise Equivalent Level, is similar to L_{dn} and is the A-weighted sound level over a 24-hour period with an additional 10 dB penalty imposed on sounds that occur between 10 p.m. and 7 a.m., and 5 dB penalty imposed on sounds that occur in the evening between 7 p.m. and 10 p.m. CNEL was developed in California for evaluating noise levels in residential communities. CNEL will always be higher than L_{dn} for the same location; therefore, it is appropriate and conservative to use CNEL when L_{dn} is not available or when comparing calculated noise to an L_{dn} threshold.

- **Vibration:** Vibration is an oscillatory motion that can be described in terms of displacement, velocity, or acceleration. For a vibrating floor, the displacement is simply the distance that a point on the floor moves from its static position. The velocity represents the instantaneous speed of the floor movement, and acceleration is the rate of change of the speed.

  The response of humans, buildings, and equipment to vibration is most accurately described using velocity or acceleration. The **peak particle velocity (PPV)** is defined as the maximum instantaneous positive or negative peak of the vibration signal and is most relative when referring to potential building damage. Since it takes some time to respond to vibration signals, the human body senses an average vibration amplitude, referred to as the **root mean square (RMS)** amplitude when referring to potential for annoyance. The PPV and RMS velocity are normally described in inches per second (in/sec).

Although it is not universally accepted, decibel notation is also common when referring to vibration. Decibel notation acts to compress the range of numbers required to describe vibration. **Vibration velocity level (L_v)** in **decibels (VdB)** is calculated as follows:

$$L_v = 20 \times \log_{10}(V/V_{ref})$$

Where: L_v is the vibration velocity level in decibels,
V is the RMS velocity amplitude, and
V_{ref} is the reference velocity amplitude.

A reference is always specified whenever a quantity is expressed in terms of decibels. The accepted reference quantity for vibration velocity is 0.000001 in/sec (FTA, 2006).

The rumbling sound caused by the vibration of surfaces is called **ground-borne noise**. The annoyance potential of ground-borne noise is usually characterized with the A-weighted sound level. Although the A-weighted sound level is almost the only metric used to characterize community noise, there are potential problems when characterizing low-frequency noise such as most ground-borne noise using A-weighting. This is because of the non-linearity of human hearing, which causes sounds dominated by low-frequency components to seem louder than air-borne sounds that have the same A-weighted level. The result is that ground-borne noise sounds louder than air-borne noise of the same level. For this reason, threshold limits for ground-borne noise are normally lower than would be the case for broadband noise (FTA, 2006).

13.1.2 Overview of Noise and Acoustics

Sound travels through the air as pressure waves caused by some type of vibration. In general, sound waves travel away from a noise source at ground level in a hemispherical pattern. The energy contained in a sound wave is spread over an increasing area as it travels away from the noise source. Typical A-weighted noise levels for various sound sources are summarized in Table 13-1.

The nature of dB scales is such that individual dB ratings for different noise sources cannot be added directly to give the sound level for the combined noise from all sources. Instead, the combined noise level produced by multiple noise sources is calculated using logarithmic summation. For example, if one source produces a noise level of 80 dBA, then two of the identical sources side by side would generate a combined noise level of 83 dBA, or an increase of only 3 dBA.

Table 13-1: Typical A-weighted Sound Levels

Sound Source	Sound Level (dBA)	Typical Human Response
Carrier deck jet operation	140	Painfully loud
Limit of amplified speech	130	
Jet takeoff (200 feet) Auto horn (3 feet)	120	Threshold of feeling and pain
Jet takeoff (2,000 feet) Riveting machine	110	Very annoying
Shout (0.5 feet) New York subway station	100	
Heavy truck (50 feet) Pneumatic drill (50 feet)	90	Hearing damage (8-hour exposure)
Passenger train (100 feet) Helicopter (in flight, 500 feet) Freight train (50 feet)	80	Annoying
Freeway traffic (50 feet)	70	Intrusive
Air conditioning unit (20 feet) Light auto traffic (50 feet)	60	
Normal speech (15 feet)	50	Quiet
Living room Bedroom Library	40	
Soft whisper	30	Very quiet
Broadcasting studio	20	
	10	Just audible
	0	Threshold of hearing

Source: Compiled by TRC

People generally perceive a 10 dBA increase in a noise source as a doubling of loudness. Also, most people cannot detect differences of less than 2 dBA between noise levels of a similar nature, while most could probably perceive a change of approximately 5 dBA. When a new intruding sound is of a different nature than the background sound such as a horn sounding in heavy vehicle traffic, most people can detect changes as low as 1 dBA. When distance is the only factor considered, sound levels from isolated point sources of noise are reduced by approximately 6 dBA for every doubling of distance. The following formula can also be used to determine noise reduction at any distance from an isolated point source:

$$L_2 = L_1 - (20 \text{ x } \log_{10}(r_2/r_1))$$

Where: L_1 is the noise level at reference distance (r_1)
L_2 is the noise level at receptor distance (r_2)

When the noise source is on a continuous line such as vehicle traffic on a highway, sound levels decrease by approximately 3 dBA for every doubling of distance.

Noise levels can also be affected by several factors other than distance. Topographic features and structural barriers absorb, reflect, and scatter sound waves and affect the reduction of noise levels. Atmospheric conditions (wind speed and direction, humidity, and temperature) and the presence of dense vegetation can also affect the degree to which sound waves are attenuated over distance.

13.1.3 Overview of Vibration

Vibration consists of waves transmitted through solid material (Beranek and Ver, 1992). Unlike in air, there are several types of wave motion in solids, including compressional, shear, torsional, and bending. The solid medium can be excited by forces, moments, or pressure fields. This leads to the terminology “air-borne” (pressure fields) or “structure-borne/ground-borne” (forces and moments) vibration.

Ground-borne vibration propagates from the source through the ground to adjacent buildings by surface waves. Vibration may be comprised of a single pulse, a series of pulses, or a continuous oscillatory motion. The frequency of the vibrations describes how rapidly the object is oscillating, and is measured in Hertz (Hz). Most environmental vibrations consist of a composite, or spectrum, of many frequencies and are generally classified as broadband or random vibrations. The normal frequency range of most ground-borne vibration that can be felt generally starts from a low frequency of less than 1 Hz to a high of approximately 200 Hz. Vibration energy spreads out as it travels through the ground, causing the vibration amplitude to decrease with distance from the source. High-frequency vibrations dissipate much more rapidly than low frequencies, so that in the far-field from a source the low frequencies tend to dominate. Soil properties also affect the propagation of vibration. When ground-borne vibration interacts with a building there is usually a ground-to-foundation coupling loss, but the vibration can also be amplified by the structural resonances of the walls and floors. Vibration in buildings is typically perceived as rattling of windows or items on shelves, or the motion of building surfaces. The vibration of building surfaces can also be radiated as sound and heard as a low-frequency rumbling noise, known as ground-borne noise.

Perceptible ground-borne vibration is generally limited to areas within a few hundred feet of railway systems, certain types of industrial operations, and construction activities. Road vehicles rarely create enough ground-borne vibration to be perceptible to humans unless the road surface is poorly maintained and there are potholes or bumps. If traffic, typically heavy trucks, does induce perceptible vibration in buildings such as window rattling or shaking of small loose items, then it is most likely an effect of low-frequency, air-borne noise or ground characteristics.

Building structural components can also vibrate due to high levels of low-frequency noise (typically less than 100 Hz). The many structural components of a building, excited by low-frequency noise, can be coupled together to create complex vibrating systems. The low-frequency vibration of the structural components can cause smaller items such as ornaments, pictures, and shelves to rattle, resulting in potential annoyance to building occupants. Human sensitivity to vibration varies by frequency and by person, but generally people are more sensitive to low-frequency vibration. Human annoyance is also related to the number and duration of events. The more events or the greater the duration, the more annoying it will be to humans.

Construction activities can produce varying degrees of ground vibration, depending on the equipment and methods employed. Ground vibrations from construction activities very rarely reach levels high enough to cause damage to structures, although special consideration must be made in cases where fragile historical buildings are near the construction site. Blasting and impact pile driving, the construction activities that typically generate the highest levels of vibration, are not proposed for the onshore portions of the project.

Table 13-2 presents typical vibration levels that could result in damage to different types of buildings. Table 13-3 presents typical vibration levels that could result in annoyance, including daytime sleep disturbance, to occupants of residential buildings representative of nearby receptor locations.

Table 13-2: Vibration Levels for Building Damage

Building Category	PPV (in/sec)[1]	L_v (VdB)[2]
I. Reinforced concrete, steel, or timber (no plaster)	0.5	102
II. Engineered concrete and masonry (no plaster)	0.3	98
III. Non-engineered timber and masonry	0.2	94
IV. Buildings extremely susceptible to vibration damage (no plaster)	0.12	90

[1]PPV = peak particle velocity; in/sec = inches per second
[2]L_v = vibration velocity level; VdB = decibels
Source: FTA, 2006

Table 13-3: Vibration Levels for Human Annoyance

Event Frequency	L_v (VdB)[1]
Frequent (>70 events per day)	72
Occasional	75
Infrequent (<30 events per day)	80

[1]L_v = vibration velocity level; VdB = decibels
Source: FTA, 2006

13.1.4 Regulatory Context

13.1.4.1 Federal Regulations

There are no federal laws, ordinances, or regulations that directly affect the proposed project with respect to noise or vibration. However, there are some federal standards that can be utilized for consideration of a broad range of noise and vibration issues, as listed below.

The U.S. Department of Housing and Urban Development Noise Regulations (Title 24, Code of Federal Regulations, Part 51, Subpart B) identify sound levels that are compatible with residential land use. Sound not exceeding 65 dBA L_{dn} is considered acceptable. Sound levels between 65 dBA L_{dn} and 75 dBA L_{dn} are normally unacceptable unless noise-reduction measures are included to limit noise levels within residences to 45 dBA L_{dn} or below. Sound levels exceeding 75 dBA L_{dn} are unacceptable.

The U.S. Environmental Protection Agency (EPA) has not promulgated standards or regulations for environmental noise. However, it has published a guideline that specifically addresses issues of community noise. This guideline, commonly referred to as the "EPA Levels Document" (EPA, 1974), contains goals for noise levels affecting residential land use of $L_{dn} \leq 55$ dBA for outdoors and $L_{dn} \leq 45$ dBA for indoors. The agency is careful to stress that the recommendations contain a factor of safety and do not consider technical or economic feasibility issues and, therefore, should not be construed as standards or regulations.

The Federal Transit Administration (FTA) has not promulgated standards or regulations for environmental noise by construction. However, it has published a guideline that specifically addresses issues of community noise. This guideline recommends that hourly sound levels of 90 dBA at residential uses from construction noise, including pile driving, would be considered a significant impact (FTA, 2006). The FTA guidelines also address vibration impacts.

13.1.4.2 State Regulations

The following potentially relevant State noise regulations have been identified:

- California Department of Industrial Relations, California Occupational Safety and Health Administration (Title 8, California Code of Regulations, Sections 5095-5098) require that all facility noise levels be limited to 85 dBA to protect worker safety. If workers frequent areas of the facility that exceed 85 dBA then all aspects of a hearing conservation program must be implemented by the employer.

- California Government Code (Section 65302(f)) requires local jurisdictions to prepare general plans that include land use and noise elements.

13.1.4.3 Local Regulations

City of Pittsburg General Plan

The Noise Element of the *City of Pittsburg General Plan* (2004) generally describes a range of changes in ambient (existing) noise levels and how these changes would be perceived by the community such as a residential receptor in terms of significance of impact:

- A 1 dB change cannot be perceived.
- A 3 dB change is considered "just noticeable."
- A 5 dB change is noticeable and would be expected to provoke a response from the community, and would often be considered a significant impact.

Policy 12-P-1 establishes the acceptability of proposed new land uses within existing noise-impacted areas, as shown in Table 13-4. These standards are identical to those in the Contra Costa County General Plan. This table can also be used to determine if receptors within a current land use area would be significantly impacted by a proposed new land use in the vicinity. The maximum exterior noise level considered to be "normally acceptable" for single-family residential uses (as exist adjacent to the proposed project) is 60 dBA L_{dn}. Exterior noise levels of up to 70 dBA L_{dn} are considered to be "conditionally acceptable." This policy does not apply to temporary noise levels such as from construction.

Policy 12-P-7 requires control of noise at the source through site design and other techniques for new development.

Policy 12-P-9 requires that generation of loud noises on construction sites is limited to normal business hours between 8 a.m. and 5 p.m.

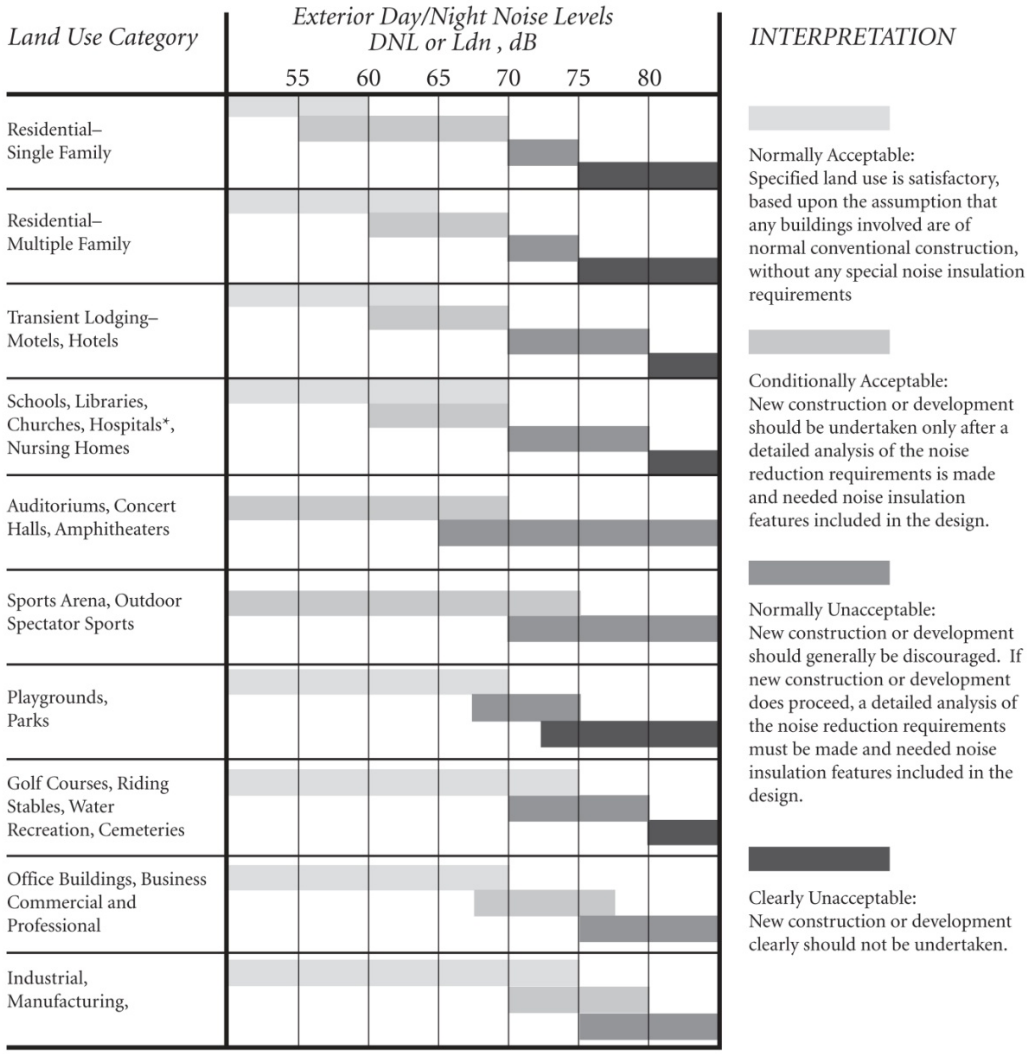
Policy 12-P-10 requires that truck traffic is limited to appropriate truck routes and requires consideration of restricting truck traffic travel times in sensitive areas.

City of Pittsburg Ordinances

The City of Pittsburg's (City) Noise Ordinance (Title 9 - Public Peace, Safety and Morals, Chapter 9.44 - Noise, Section 9.44.010) prohibits the use of pile drivers, pneumatic hammers, and similar equipment between the hours of 10 p.m. and 7 a.m., but does not establish noise-level limits related to fixed noise sources or construction noise.

The City's Building and Construction Ordinance (Title 15 – Buildings and Construction, Chapter 15.88 – Grading, Erosion and Sediment Control, Section 15.88.060.A.5) prohibits grading noise, including warming of equipment motors, within 1,000 feet of a residence between the hours of 5:30 p.m. and 7 a.m. weekdays, unless other hours are approved by the City Engineer.

Table 13-4: City of Pittsburg Noise Level/Land Use Compatibility



Source: Office of Planning and Research, State of California General Plan Guidelines,
Appendix A: Guidelines for the Preparation and Content of the Noise Element of the General Plan, 1998.

*Because hospitals are often designed and constructed with high noise insulation properties, it is possible for them to be satisfactorily located in noisier areas.

Vibration

Most local agencies, including the City of Pittsburg, do not have established specific significance criteria for vibration. General guidelines for building damage and human annoyance due to vibration are provided in Tables 13-2 and 13-3.

13.1.5 Existing Conditions

Nearby sensitive noise receptor locations are shown on Figure 13-1: Noise Receptor Locations. Single-family residences exist to the east of the East Tank Farm (Receptor [R]-1 and R-2), south and east of the South Tank Farm (R-3, R-4, and R-5), and north of the Rail Transload Operations Facility (Rail Transload Facility; R-7). The noise analysis for the Rail Transload Facility accounts for attenuation of noise with distance; therefore, it was only necessary to consider the closest receptor—the residences to the north. Noise levels at the nearby St. Peter Martyr School, located east of both tank farms, are approximated by nearby receptor location R-3.

Ambient noise measurements at the receptor locations near the storage terminal were made during environmental permitting of the adjacent Willow Pass Generating Station Project (URS, 2009). The Willow Pass Generating Station Project has not been constructed, and there have been no changes in either operations or background conditions that would affect the existing noise levels in the project vicinity. For the receptor location adjacent to the Rail Transload Facility (R-7), the ambient noise level is taken from the “Existing Noise Contours” presented on Figure 12-1 in the Noise Element of the *City of Pittsburg General Plan* (2004). The existing ambient noise levels are summarized in Table 13-5.

A conservative comparison of the CNEL noise levels in Table 13-5 to the L_{dn} noise levels in Table 13-4 indicates that the existing ambient noise levels for the nearby residential and school land uses are within the middle to upper portion of the of the “conditionally acceptable” range.

Table 13-5: Existing Ambient Noise Levels

Receptor (R)	L_{eq} (dBA)	CNEL (dBA)[1]	L_{90} (dBA)
R-1	63.1	69.5	50.3
R-2	63.1	69.5	50.3
R-3	61.8	64.7	48.1
R-4	61.8	64.7	48.1
R-5	61.8	64.7	48.1
R-6[2]	63.1	69.5	50.3
R-7	60.0[3]	60.0[4]	N/A

[1] CNEL data is comparable to L_{dn} presented in Table 13-4 and Figure 12-3 of the Noise Element of the *City of Pittsburg General Plan* (City of Pittsburg, 2004).
[2] Receptor location R-6 represents anticipated ambient conditions for the proposed Mariner Walk Residential Development, Phase 2 on adjacent parcels to the southeast of the proposed project. Ambient noise levels were conservatively assumed to be similar to those currently existing at residential receptor locations east of the proposed East Tank Farm (R-1 and R-2).
[3] L_{eq} is assumed to be equal to L_{dn} for Receptor R-7.
[4] Ambient reading is L_{dn} as presented in Figure 12-1 of the Noise Element of the *City of Pittsburg General Plan* (City of Pittsburg, 2004).

Sources: City of Pittsburg, 2004; URS, 2009

X:\WesPac\DEIR Reissue\13 Noise\mxd\Figure 13-1 Noise Receptor Locations.mxd

Figure 13-1
Noise Receptor Locations
City of Pittsburg
WesPac Pittsburg Energy Infrastructure Project

TRC

6/20/2013

Noise Receptor
Terminal Boundary
Rail Transload Facility

N

1:12,000

1 inch = 1,000 feet

0 400 800 ft

BACK PAGE OF FIGURE 13-1

13.2 IMPACT ANALYSIS

13.2.1 Methodology for Impact Analysis

13.2.1.1 Construction Noise

Two separate noise sources would result from project construction: (1) transport of workers, equipment, and material; and (2) use of heavy equipment.

Transportation of workers, equipment, and materials to and from the construction site would incrementally increase noise levels along public roads leading to the project location. Although there could be a relatively high single-event noise exposure potential with passing trucks, the increase in overall noise would be minimal when averaged over a 24-hour period.

With respect to heavy equipment operation, noise would be produced during pipeline, storage terminal, and Rail Transload Facility construction activities. As with most construction projects, construction would require the use of a number of pieces of typical heavy equipment, including bulldozers, backhoes, loaders, and cranes. No impact-type equipment such as pile drivers or jackhammers is proposed for construction of the pipeline, storage terminal, and Rail Transload Facility.

Composite construction noise has been best characterized by Bolt, Beranek, and Newman (EPA, 1971). Although published years ago, this document remains the industry standard for the estimated base noise emissions from construction equipment and associated noise impact analyses, as it is included in the latest construction noise guidance from the Federal Highway Administration (FHWA, 2006). Further, use of the data is considered to be conservative since the evolution of construction equipment has been toward quieter designs to protect both operators from exposure to high noise levels and the community from undue noise intrusion. Table 13-6 presents noise levels from some common construction equipment as proposed for the project.

The noise levels during construction would vary during the different activity periods, depending upon the activity location(s) and the number and types of equipment being used. Aggregate noise levels during typical phases of construction are summarized in Table 13-7.

Since there is no applicable quantitative regulatory requirement to limit temporary increases in noise levels due to project construction activities, the following analysis is meant to provide a general estimate of the construction noise level that would occur at the receptor locations near the storage terminal (R-1 through R-6) and is presented for informational purposes only.

Table 13-6: Noise Levels from Common Construction Equipment

Equipment	Typical Sound Pressure Level at 50 Feet (dBA)
Air compressor	80
Compactor	80
Loader	80
Generator	82
Dump truck	84
Flatbed truck	84
Backhoe	85
Crane	85
Dozer	85
Forklift	85

Source: EPA, 1971

Table 13-7: Standard Construction Equipment Aggregate Noise Emission Values

Typical Construction Phase	Aggregate Equipment Sound Pressure Level at 50 Feet (dBA)
Site clearing	84
Excavation	89
Foundation	77
Building	84
Finishing	89

Source: EPA, 1971

As indicated in Table 13-7, the highest aggregate sound levels (89 dBA at 50 feet) are associated with the excavation and finishing phases of construction. It is important to consider that these noise estimates are adjusted for time-usage factors and varying power settings, and would not be continuous noise emissions. Construction noise would vary considerably throughout project construction.

The aggregate operation of heavy equipment would result in both steady and episodic noise, which would add to the ambient levels at the nearby receptor locations. If an average distance of 500 feet from construction activities to receptor locations is assumed, receptors would potentially perceive construction noise of approximately 69 dBA (using the equation presented in Section 13.1.2). This is a conservative estimate since the only attenuating mechanism considered was divergence of the sound waves in open air based on distance from the source. Additional noise attenuation would be expected from air absorption, ground effects, and shielding from intervening topography or structures.

13.2.1.2 Operational Noise

Computer modeling was performed to calculate the estimated noise levels during project operations at each of the receptor locations adjacent to the storage terminal. The commercially available CadnaA model developed by Datakustik GmBH was used for the analysis. This software program takes into account spreading losses, ground and atmospheric effects, shielding from terrain and structures (including engineering controls), and reflections from structural surfaces. By default, the model assumes that all receptors are downwind of the noise sources to produce a conservative result. Standard atmospheric conditions were assumed. The barrier and reflection effects of both existing and proposed berms, tanks, walls, and buildings were incorporated into the model. All ground cover was assumed to be partially acoustically reflective. Appendix L: WesPac Energy Infrastructure Project, Noise Assessment Report presents the methodology of the noise analyses and describes the various operational equipment scenarios and noise levels associated with each piece of equipment.

For the Rail Transload Facility, the estimated noise level during project operations was calculated using the distance-attenuation formula. This is a conservative estimate since the only attenuating mechanism considered was divergence of the sound waves in open air based on distance from the source. Additional noise attenuation would be expected from air absorption and ground effects, and would be provided by parked railcars themselves (located within the existing BNSF Railway Company [BNSF] rail yard) and the existing walls along the rail yard perimeter to the north.

The railroad operations and movements at the Rail Transload Facility are preempted from local and State environmental regulations by federal law (Interstate Commerce Commission Termination Act). Therefore, the City of Pittsburg, as lead agency, and other State and local responsible agencies are preempted from imposing any mitigation measures, conditions, or regulations to reduce or mitigate any potential impacts of BNSF train movements. By contrast, all of the activities performed to unload the rail cars and transfer the oil out of the Rail Transload Facility to the storage terminal are not preempted by federal law. Therefore, only noise generated from the unloading processes at the Rail Transload Facility was considered to determine if there would be resulting impacts.

13.2.1.3 Vibration

To analyze vibration impacts from construction equipment, a quantitative assessment of vibration with respect to human annoyance was performed in accordance with the FTA-recommended methodology (FTA, 2006). To be conservative, the analysis considered only the equipment with the most potential to create ground-borne vibration.

During construction of the storage terminal, the compactor, or vibratory roller, would generate a ground-borne vibration of 94 VdB at a distance of 25 feet (FTA, 2006). The nearest receptor locations that would potentially perceive ground-borne vibration from construction of the storage terminal are generally at least 500 feet from the construction areas where the compactor would be operating (around and between pump locations). The vibration velocity level, $L_v(D)$, at any distance (D) from the vibration source is determined by the following equation:

$$L_v(D) = L_v(25 \text{ feet}) - (30 \text{ x } \log_{10}(D/25 \text{ feet}))$$

At a distance of 500 feet, ground-borne vibration levels from storage terminal construction equipment would be approximately 55 VdB.

During construction of the marine terminal, the impact pile driver would generate a ground-borne vibration of 112 VdB at a distance of 25 feet (FTA, 2006). The nearest receptor locations that would potentially perceive ground-borne vibration from marine construction are at least 1,200 feet from the areas where the impact pile driver would be operating. At a distance of 1,200 feet, ground-borne vibration levels from marine terminal construction equipment would be approximately 62 VdB.

During construction of the Rail Transload Facility, the compactor would generate a ground-borne vibration of 94 VdB at a distance of 25 feet (FTA, 2006). The nearest receptor location that would potentially perceive ground-borne vibration from Rail Transload Facility construction is approximately 150 feet from the areas where the compactor would be operating. At a distance of 150 feet, ground-borne vibration levels from rail transload facility construction equipment would be approximately 71 VdB.

13.2.2 Significance Criteria

13.2.2.1 Noise

For the purposes of this analysis, based on the regulatory guidance described in Section 13.1.4, an impact was considered to be significant and to require mitigation if it would result in any of the following:

- Cause a permanent increase in ambient noise level of more than 3 dBA L_{eq} above existing ambient conditions at any receptor location
- Cause a permanent increase in noise level above existing levels, which are all currently within the "conditionally acceptable" range, indicated on Table 13-4, at any receptor location
- Violate any applicable policy of the *City of Pittsburg General Plan* Noise Element or City Ordinance

13.2.2.2 Vibration

For the purposes of this analysis, an impact was considered to be significant and to require mitigation if it would exceed the residential annoyance guideline level of 72 VdB for frequent events indicated in Table 13-3. Residential annoyance would occur at a lower vibration level than would potentially cause damage to even the most susceptible buildings, as indicated in Table 13-2.

13.2.3 Impacts and Mitigation Measures

13.2.3.1 Proposed Project

<u>Construction-related Impacts</u>

Impact Noise and Vibration (NV)-1: Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. (Less than significant.) No numerical thresholds for acceptable project construction noise levels have been set by the City of Pittsburg; rather, limiting construction work hours and days in accordance with applicable policies of the *City of Pittsburg General Plan* Noise Element and City Ordinances (refer to Section 13.1.4.3) is considered to qualitatively reduce project construction noise impacts at nearby residential receptor locations to less than significant levels, and Environmental Commitment NV-1 would commit the project to complying with these standards. Environmental Commitment NV-2 also would commit truck traffic associated with project construction to use appropriate routes during these times (see Chapter 15.0: Land Transportation for a description of the truck routes). Transportation of workers, equipment, and materials to and from the construction site would incrementally increase noise levels along public roads.

Mitigation Measure: No mitigation required.

Impact NV-2: Expose persons to, or generate, excessive ground-borne vibration or ground-borne noise. (Less than significant.) The compactor would generate the most ground-borne vibration during construction of the storage terminal and Rail Transload Facility. The nearest receptor locations that would potentially perceive ground-borne vibration from construction are generally at least 500 feet from the storage terminal and 150 feet from the Rail Transload Facility construction areas where the compactor would be operating. At a distance of 500 feet, ground-borne vibration levels from the storage terminal construction equipment would be approximately 55 VdB. At a distance of 150 feet, ground-borne vibration levels from the Rail Transload Facility construction equipment would be approximately 71 VdB. These vibration levels are lower than the guideline levels for human annoyance and, consequently, the guideline level for building damage (refer to Tables 13-2 and 13-3).

During construction of the marine terminal, pile driving would occur on the pier very close to shore. The impact pile driver would generate a ground-borne vibration of 112 VdB at a distance of 25 feet (FTA, 2006). The nearest receptor locations that would potentially perceive ground-borne vibration from marine construction are at least 1,200 feet from the closest area where the impact pile driver would be operating. At a distance of 1,200 feet, ground-borne vibration levels from marine terminal construction equipment would be approximately 62 VdB, which is lower than the guideline level for human annoyance and, consequently, the guideline level for building damage (refer to Tables 13-2 and 13-3).

Mitigation Measure: No mitigation required.

<u>Operational Impacts</u>

Impact NV-3: Expose persons to, or generate, new permanent noise levels in excess of established standards. (Less than significant.) The project would not violate any of the requirements of the *City of Pittsburg General Plan* Noise Element or Noise Ordinance.

All reasonable equipment scenarios associated with the proposed storage terminal were evaluated to determine the total noise at each nearby receptor location (R-1 through R-6) during operations (see Appendix L). These scenarios account for ambient and cumulative noise during simultaneous tanker loading and pipeline shipping, from concurrently running pumps, transformers, and the thermal oxidizer unit. The barrier and reflection effects of both existing and proposed berms, tanks, walls, and buildings were also incorporated into the model. The operational noise level at each receptor location was considered to be the maximum noise level resulting from any of the scenarios, so the same equipment scenario does not necessarily result in the maximum operational noise level at each receptor location.

A typical tanker docking and undocking scenario was also evaluated to determine the operational noise at each nearby receptor location (R-1 through R-6) during these activities at the proposed marine terminal. Only noise associated with docking and undocking the tankers was considered for the proposed marine terminal. Noise generated from ship loading was considered within the various operational equipment scenarios for the proposed storage terminal described above. Noise generated from ship unloading was not evaluated since the tanker would only be operating on a generator engine and all pumps and motors are contained within the ship's hull below water level; also, the distance from the marine terminal to the nearest receptor location is approximately 2,000 feet and localized pump and motor noise would be less than that resulting from the various operational equipment scenarios at the proposed storage terminal, which is much closer to the receptor locations.

Noise generated during tanker docking and undocking would primarily come from the tugboats that escort the tankers in the shipping channel and move them into place at, or away from, the dock. Two tugboats would work in tandem during docking and undocking. To be conservative, the noise evaluation assumed that the process could take up to 30 minutes each for docking and undocking and that the tugboats would be operating continuously at full power; it is likely the process would be completed more quickly and the tugboats would operate at full power for less than five minutes. Also, because the docking/undocking and loading/unloading processes would happen at any time, day or night, the scenario in which these activities occur at night was evaluated.

All large pumps associated with the Rail Transload Facility would be located belowground and, as such, pump noise would be attenuated to an insignificant level. Noise from unloading operations at the Rail Transload Facility would be generated primarily by man-lifts operating alongside the railcars that are used when opening and closing vents on top of the railcars. A total of four man-lifts would operate at any given time. The man-lifts would operate in various locations along the rail lines. A man-lift generates a sound level of 75 dBA at 50 feet when operated at full-throttle (FHWA, 2006). A full-throttle condition would occur infrequently while the man-lifts are in use. A total of four man-lifts would be used for approximately three hours per day and would only be stationary for short periods of time as they move from one railcar to another.

Estimated sound levels due to man-lift operation were calculated considering the sound emission level, the percentage of time that the man-lifts would operate at any one location, and the potential that nighttime operation could occur. Because the four man-lifts would be spread across the site when operating, the calculation was performed for a single man-lift operating at the closest possible approach (approximately 150 feet) to a residential location (R-7), and conservatively assuming it would be stationary for a one-hour period. During actual operations at the Rail Transload Facility, the remaining man-lifts would be much farther from R-7, and the cumulative effect would be minimal. Noise from the remaining man-lifts would be further attenuated, to a significant extent, by the presence of the railcar to which they would be attending. Also, the man-lifts would not operate at full-throttle simultaneously. L_{eq} and an L_{dn} (to account for potential nighttime operation) sound levels were calculated to compare directly to the ambient condition of 60 dBA L_{dn}, as provided in the Noise Element of the *City of Pittsburg General Plan* (City of Pittsburg, 2004).

The analysis revealed that Rail Transload Facility operation sound levels would be 51.2 dBA as an L_{eq}, and 57.6 dBA as an L_{dn}. When combined with existing ambient noise conditions, the sound levels during operation of the Rail Transload Facility would increase ambient levels at R-7 to 60.5 dBA L_{eq} and 62.0 dBA L_{dn}. These are considered conservative sound levels since the existing masonry walls located between the Rail Transload Facility and R-7 would act to further attenuate operational noise. The man-lifts would also be fitted with backing warning alarms that automatically adjust to generate a noise level of only 5 dBA above the ambient level. This would result in lower backup beeper sound levels during times of lower ambient noise conditions.

As shown in Table 13-8, the analyses indicate that estimated noise levels at each of the receptor locations during project operations would increase slightly (no more than 0.5 dBA at all receptor locations) but remain within the “conditionally acceptable” range shown on Table 13-4. Existing residences would not be exposed to operational noise levels above 69.2 dBA L_{dn} under any scenario. Typically, estimated noise levels falling within the “conditionally acceptable” range would require noise mitigation in order to reduce the associated impacts down to a less than significant level (bringing the noise levels as close to the “normally acceptable” range as possible); however, in this instance there are already effective noise-reducing features in place, including the masonry wall located immediately north of R-7 at the Rail Transload Facility, and an existing perimeter berm planted with mature landscaping along the eastern edge of the East Tank Farm near R-1 and R-2. In addition, the proposed project design incorporates noise attenuating features for new equipment, such as noise barriers at pump locations (see Chapter 2 for more details). According to the Pittsburg General Plan (page 12-3), changes in noise levels of 1 dB or less are generally not perceived by nearby receptors; therefore, the minimal expected noise increase associated with the project, paired with the presence of existing noise mitigating features in the area and noise attenuating features associated with new equipment, would not constitute a need for new noise mitigation and the resulting impact would be considered less than significant.

In addition, Table 13-8 demonstrates that operational noise levels at potential receptor location R-6, which is currently characterized as vacant land but is representative of the proposed Mariner Walk Residential Development, Phase 2 on adjacent parcels to the southeast of the proposed project, would be less than significant, assuming that the Mariner Walk project includes an 8-foot-high sound wall at the common property line (City of Pittsburg, 2005). It should be noted that

Table 13-8: Estimated Noise Levels during Project Operations

Receptor	L_{eq} (dBA)	Increase in L_{eq} (dBA)	L_{dn}[1] (dBA)
Storage Terminal Scenarios			
R-1	63.1	0	69.2
R-2	63.1	0	69.2
R-3	61.9	0.1	64.6
R-4	62.0	0.2	64.9
R-5	62.0	0.2	64.8
R-6[2]	63.2	0.1	69.3
Marine Terminal Scenarios			
R-1	63.6	0.5	69.2
R-2	63.5	0.4	69.2
R-3	62.0	0.2	64.4
R-4	61.9	0.1	64.4
R-5	61.9	0.1	64.4
R-6[2]	63.3	0.2	69.2
Rail Transload Facility Scenario			
R-7	60.5	0.5	62.0

[1] L_{dn} noise levels for Receptors R-1 though R-6 are extrapolated from calculated operational noise levels and reported ambient CNEL noise levels (URS, 2009)

[2] Operational noise levels at receptor location R-6 represent projected conditions for the proposed Mariner Walk Residential Development, Phase 2 on adjacent parcels to the southeast of the proposed project. Noise analyses assumed that noise mitigation measures proposed for the residential project, including an 8-foot-high sound wall at the common property line, would be instituted (City of Pittsburg, 2005). This analysis is presented for informational purposes only, as the proposed development is not part of the existing conditions that constitute the California Environmental Quality Act baseline.

the "baseline" for California Environmental Quality Act (CEQA) analysis consists of existing physical conditions and does not include planned future development such as that planned at R-6. Accordingly, the projection of noise exposure at receptor location R-6, in the event that the Mariner Walk project is developed as currently planned, is presented for informational purposes only and does not address a "potentially significant impact" in the context of this CEQA analysis. In any case, the projected noise at the future development location (R-6) would be less than the threshold of significance.

Mitigation Measure: No mitigation required.

Impact NV-4: Expose persons to, or generate, excessive ground-borne vibration or ground-borne noise levels. (Less than significant.) Equipment used during operation of the proposed project (e.g., pumps, heaters) typically does not produce significant vibration. Vibration of the equipment generally indicates the equipment is not operating properly, and vibration analyzers are often used to detect wear on pumps and other rotating equipment. The pumps proposed for the project are compliant with the stringent vibration standards of American Petroleum Institute 610 (Teague, 2012). There are no vibration regulations or standards for the other types of equipment proposed for the project (e.g., heaters).

Mitigation Measure: No mitigation required.

Impact NV-5: Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project. (Less than significant.) As indicated in Table 13-8, ambient noise would be increased by a maximum of 0.5 dBA at any receptor location, which is not perceptible and is well below the significance threshold (3 dBA L_{eq}) described in Section 13.2.2.1. Therefore, impacts would be less than significant.

Mitigation Measure: No mitigation required.

13.2.3.2 Alternative 1: Reduced Onshore Storage Capacity

<u>Construction-related Impacts</u>

Impact NV-6: Result in a substantial temporary or periodic increase in ambient noise levels in the project vicinity above levels existing without the project. (Less than significant.) Construction noise levels would be the same as or lower than those resulting from the proposed project (refer to Impact NV-1) at all receptor locations. Receptor locations R-1 and R-2 (east of the East Tank Farm, refer to Figure 13-1) would experience the most noise reduction.

Mitigation Measure: No mitigation required.

Impact NV-7: Expose persons to, or generate, excessive ground-borne vibration or ground-borne noise. (Less than significant.) Construction vibration levels would be the same as or lower than those resulting from the proposed project (refer to Impact NV-2) at all receptor locations. Receptor locations R-1 and R-2 (east of the East Tank Farm, refer to Figure 13-1) would experience the most vibration reduction.

Mitigation Measure: No mitigation required.

Operational Impacts

Impact NV-8: Expose persons to, or generate, noise levels in excess of established standards. (Less than significant.) Operational noise levels would be the same as or lower than those resulting from the proposed project (refer to Impact NV-3) and remain below the established standards at all receptor locations. Receptor locations R-1 and R-2 (east of the East Tank Farm, refer to Figure 13-1) would experience the most noise reduction.

Mitigation Measure: No mitigation required.

Impact NV-9: Expose persons to, or generate, excessive ground-borne vibration or ground-borne noise levels. (Less than significant.) Proposed project equipment (pumps, heaters, etc.) would not produce significant vibration when operating, so operational vibration levels would be the same as or lower than those resulting from the proposed project (refer to Impact NV-4) at all receptor locations. Receptor locations R-1 and R-2 (east of the East Tank Farm, refer to Figure 13-1) would experience the most vibration reduction.

Mitigation Measure: No mitigation required.

Impact NV-10: Result in a substantial permanent increase in ambient noise levels in the project vicinity above levels existing without the project. (Less than significant.) Operational noise levels would be the same as or lower than the proposed project (refer to Impact NV-5). Receptor locations R-1 and R-2 (east of the East Tank Farm, refer to Figure 13-1) would experience the most ambient noise reduction.

Mitigation Measure: No mitigation required.

13.2.3.3 Alternative 2: No Project

Impact NV-11: Exceed significance criteria for noise or vibration. (No impact.) Under Alternative 2, existing facilities would remain at the project site and proposed construction associated with the modernization and reactivation of the current facilities and subsequent operation would not occur. Because the site would essentially remain as it is now, no impacts would occur. Noise and vibration would remain at existing ambient levels at all receptor locations.

Mitigation Measure: No mitigation required.

13.3 REFERENCES

13.3.1 Printed References and Websites

Beranek, L.L. and I.L. Ver. 1992. *Noise and Vibration Control Engineering, Principles and Applications.*

City of Pittsburg. 2011. Municipal Code.

____. 2005. CEQA Initial Study Checklist, Mariner Walk.

____. 2004. General Plan.

Federal Highway Administration (FHWA). 2006. *Construction Noise Handbook*, FHWA-HEP-06-015, DOT-VNTSC-FHWA-06-02, NTIS No. PB2006-109102.

Federal Transit Administration (FTA), U.S. Department of Transportation, Office of Planning and Environment. 2006. *Transit Noise and Vibration Impact Assessment*, FTA-VA-90-1003-06.

Harris, C. M. 1998. *Handbook of Acoustical Measurements and Noise Control*, 3rd Edition, Acoustical Society of America.

TRC. 2011. *WesPac Pittsburg Energy Infrastructure Project, Noise Assessment Report.*

URS. 2009. *Willow Pass Generating Station Cumulative Impact Analysis incorporating Tank Farm Project.*

United States Environmental Protection Agency (EPA). 1978. Office of Noise Abatement and Control, "Protective Noise Levels" Report No. EPA 550/9-79-100.

____. 1974. *Levels of Environmental Noise Requisite to Protect Public Health and Welfare with an Adequate Margin of Safety*, EPA/ONAC 550/9-74-004.

____. 1971. *Noise from Construction Equipment and Operations, Building Equipment, and Home Appliances*, by Bolt, Beranek, and Newman, Inc.

13.3.2 Personal Communication

Teague, R. Scott, Sulzer Pumps (US) Inc. Sales Engineer. Telephone communication with S. Huvane, TRC. April 3, 2012. 714-345-8453.