APPENDIX F

Noise and Vibration Predictions

Appendix F

Noise and Vibration Predictions

F.1 Construction Equipment Noise and Vibration Prediction

F.1.1 Pile Driving Noise

The estimate of equipment noise to be generated during construction phase operations was based on fundamental acoustic principle with the following equations:

$$L_{eq}(I) = L(I) - 20\log\left(\frac{D(I)}{D0}\right)$$
$$L_{eq} = 10\log \Sigma\, 10^{L_{eq}(I)/10}$$

Where:

L(I) is the typical peak noise emission level of I equipment to be obtained from manufacturer or published levels such as those in Table F-1.
$L_{eq}(I)$ is the sound level resulting from operation of equipment I.
D(I) is the distance from receptor to equipment I.
D0 is the reference distance at which L(I) is measured. D0 = 15.2 meter.
L_{eq} is the cumulative sound level from all equipment during specific construction phasing.

Various pieces of construction equipment operating at the same time would contribute to the actual noise levels at a specific receptor location. However, according to the above logarithmic relationship, the resulting noise levels would be dominated by the noisier source (e.g., 101 dB + 85 dB = 101 dB). Therefore, it is anticipated that the impact pile driver would be the dominant noise source during the one-year construction phase operations.

According to the pile driving schedule and the number of rigs to be utilized simultaneously for different building foundation construction, a total of six pile driving scenarios (Table F-2 and Figure F-1) were established for cumulative noise impact analysis. Figure F-1 shows noise generating piles under six combination scenarios and analyzed receptor locations. The calculated L_{eq} levels at potential worst case receptors locations are summarized in Table F-3 sorted both by scenario and by receptor. Since it is anticipated that the worst-case pile driving noise impact would occur at those sensitive receptors located immediately adjacent to the VAMC site, a total of 11 receptor locations around the VAMC property were analyzed.

F.1.2 Pile Driving Vibration

The ground borne vibration level in terms of peak particle velocity (PPV) at a building from the impact driving event can be estimated using the following equation:

$$PPV_{equip} = PPV_{ref} \times \left(\frac{25}{D}\right)^{1.5}$$

Where:

PPV_{equip} is the peak particle velocity of the equipment adjusted for distance.
PPV_{ref} is the reference peak particle velocity level at 25 feet from Table F-4.
D is the distance from the equipment to the receiver.

Table F-3 summarizes the impact driving event generated worst-case PPV level at each analyzed receptor location.

Table F-1. Typical Construction Equipment Noise Levels (dBA at 15 meters)

Equipment Type	Typical Noise Levels
Earthmoving:	
Loaders	85
Backhoes	80
Dozers	85
Scrapers	89
Graders	85
Truck	88
Pavers	89
Roller	74
Material Handling:	
Concrete Mixers	85
Concrete Pumps	82
Cranes	83
Derricks	88
Stationary:	
Pumps	76
Generators	81
Air Compressors	81
Impact:	
Pile Drivers (impact)	101
Pile Drivers (Sonic)	96
Jack Hammers	88
Pneumatic Tools	85
Other:	
Saws	76
Rock Drill	98
Source: Federal Transit Administration, May 2006.	

Table F-2. Pile Driving Scenarios

Scenario	Building	# of Piles	# of Sensitive Receptors	Closest Sensitive Receptor Distance (ft)
1	Central Energy Plant	2	11	255
	D&T Area A	4		270
	D&T Area C	4		380
	Patient Garage	2		370
2	Central Energy Plant	2		255
	D&T Area A	4		270
	D&T Area C	4		380
	Staff Garage	2		240
3	D&T Area B	4		400
	D&T Area D	4		375
	Staff Garage	2		240
4	D&T Area B	4		400
	D&T Area D	4		375
	Dixie Brewery	2		185
5	Dixie Brewery	2		185
	Inpatient	2		275
	Outpatient	2		620
6	Inpatient	2		275
	Outpatient	2		620
	Transitional Living	2		205

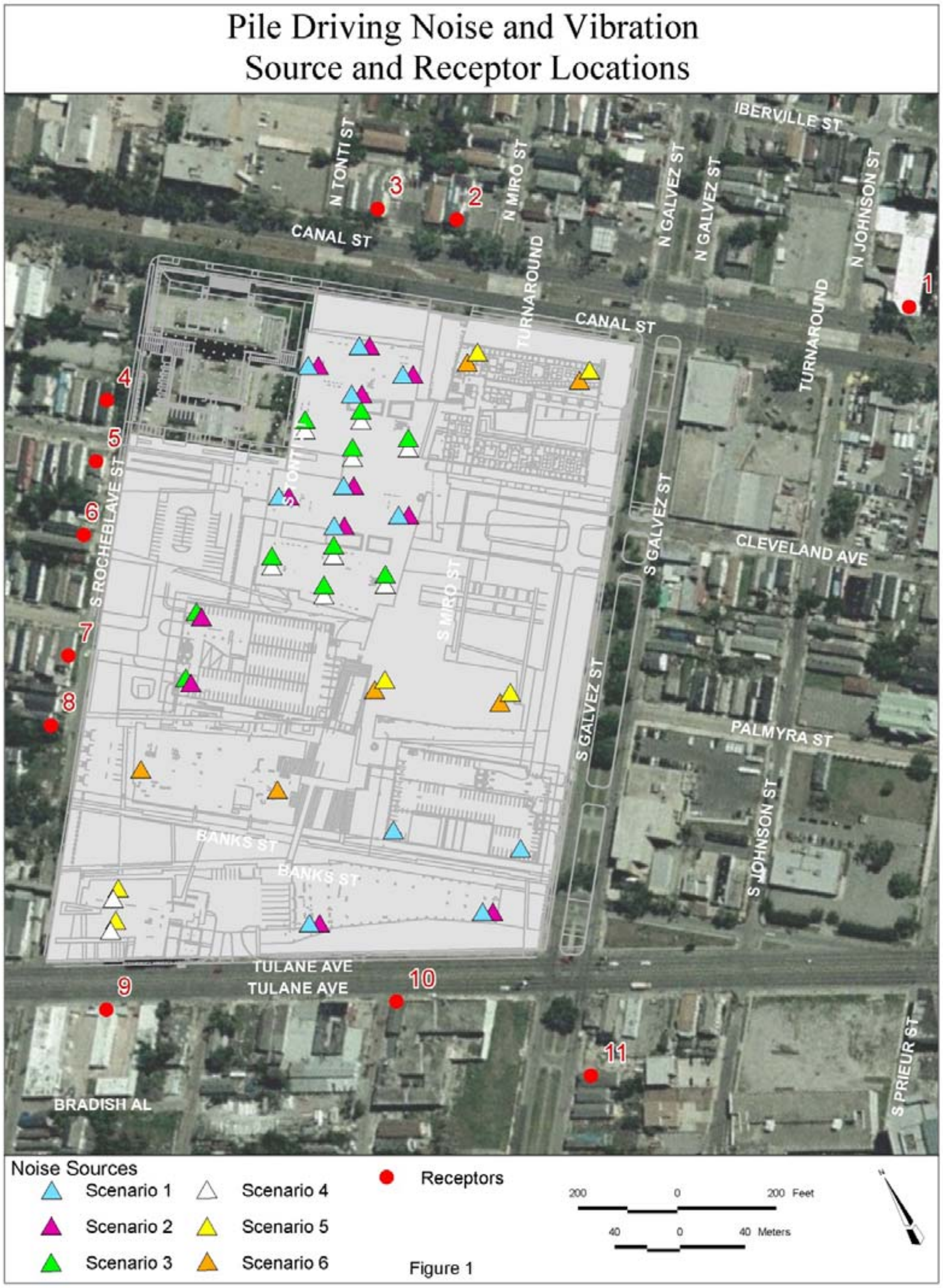

Figure F-1. Pile Drive Noise and Vibration Source and Receptor Locations

Table F-3a. Pile Driving Cumulative L_{eq} Noise Levels – Sorted by Scenario

Pile Driving Scenario	Receptor	Leq Noise Level (dBA)	Vibration Level (inch/sec)
1	1	76.8	0.0052
	2	84.6	0.0348
	3	85.2	0.0428
	4	83.5	0.0237
	5	83.3	0.0256
	6	82.8	0.0233
	7	81.5	0.0153
	8	80.7	0.0115
	9	79.9	0.0202
	10	84.9	0.0466
	11	80.8	0.0229
	Range	76.8-85.2	0.0052-0.0466
2	1	76.7	0.0052
	2	84.6	0.0348
	3	85.3	0.0428
	4	84.2	0.0237
	5	84.4	0.0267
	6	84.9	0.0416
	7	85.1	0.0510
	8	83.5	0.0405
	9	79.9	0.0202
	10	83.9	0.0466
	11	79.5	0.0229
	Range	76.7-85.3	0.0052-0.051
3	1	76.0	0.0056
	2	82.4	0.0213
	3	82.7	0.0229
	4	83.8	0.0237
	5	84.4	0.0267
	6	85.1	0.0416
	7	85.3	0.0510
	8	83.6	0.0405
	9	78.1	0.0106
	10	78.3	0.0085
	11	76.1	0.0053
	Range	76.0-85.3	0.0053-0.051

Table F-3a. Pile Driving Cumulative L_{eq} Noise Levels by Scenario (Cont.)

Pile Driving Scenario	Receptor	Leq Noise Level (dBA)	Vibration Level (inch/sec)
4	1	75.8	0.0056
	2	82.2	0.0213
	3	82.5	0.0229
	4	83.1	0.0237
	5	83.4	0.0237
	6	83.3	0.0261
	7	82.7	0.0202
	8	82.7	0.0284
	9	85.1	0.0754
	10	79.2	0.0126
	11	76.4	0.0058
	Range	75.8-85.1	0.0056-0.0754
5	1	75.2	0.0108
	2	81.5	0.0416
	3	79.7	0.0290
	4	76.8	0.0096
	5	77.2	0.0099
	6	77.7	0.0112
	7	79.3	0.0180
	8	80.7	0.0284
	9	84.8	0.0754
	10	78.4	0.0126
	11	75.5	0.0085
	Range	75.2-84.8	0.0085-0.0754
6	1	75.4	0.0108
	2	81.6	0.0416
	3	79.9	0.0290
	4	77.5	0.0097
	5	78.1	0.0126
	6	79.1	0.0186
	7	81.8	0.0440
	8	83.2	0.0646
	9	78.0	0.0162
	10	78.5	0.0160
	11	75.7	0.0085
	Range	75.4-83.2	0.0085-0.0646

Table F-3b. Pile Driving Cumulative L_{eq} Noise Levels – Sorted by Receptor

Receptor	Pile Driving Scenario	Leq Noise Level (dBA)	Vibration Level (inch/sec)
1	1	76.8	0.0052
	2	76.7	0.0052
	3	76	0.0056
	4	75.8	0.0056
	5	75.2	0.0108
	6	75.4	0.0108
	Range	75.2-76.8	0.0052-0.0108
2	1	84.6	0.0348
	2	84.6	0.0348
	3	82.4	0.0213
	4	82.2	0.0213
	5	81.5	0.0416
	6	81.6	0.0416
	Range	81.5-84.6	0.0213-0.0416
3	1	85.2	0.0428
	2	85.3	0.0428
	3	82.7	0.0229
	4	82.5	0.0229
	5	79.7	0.029
	6	79.9	0.029
	Range	79.7-85.3	0.0229-0.0428
4	1	83.5	0.0237
	2	84.2	0.0237
	3	83.8	0.0237
	4	83.1	0.0237
	5	76.8	0.0096
	6	77.5	0.0097
	Range	76.8-84.2	0.0096-0.0237
5	1	83.3	0.0256
	2	84.4	0.0267
	3	84.4	0.0267
	4	83.4	0.0237
	5	77.2	0.0099
	6	78.1	0.0126
	Range	77.2-84.4	0.0099-0.0267

Table F-3b. Pile Driving Cumulative L_{eq} Noise Levels – Sorted by Receptor (Cont.)

Receptor	Pile Driving Scenario	Leq Noise Level (dBA)	Vibration Level (inch/sec)
6	1	82.8	0.0233
	2	84.9	0.0416
	3	85.1	0.0416
	4	83.3	0.0261
	5	77.7	0.0112
	6	79.1	0.0186
	Range	77.7-85.1	0.0112-0.0416
7	1	81.5	0.0153
	2	85.1	0.051
	3	85.3	0.051
	4	82.7	0.0202
	5	79.3	0.018
	6	81.8	0.044
	Range	79.3-85.3	0.0153-0.051
8	1	80.7	0.0115
	2	83.5	0.0405
	3	83.6	0.0405
	4	82.7	0.0284
	5	80.7	0.0284
	6	83.2	0.0646
	Range	80.7-83.6	0.0115-0.0646
9	1	79.9	0.0202
	2	79.9	0.0202
	3	78.1	0.0106
	4	85.1	0.0754
	5	84.8	0.0754
	6	78	0.0162
	Range	78.1-85.1	0.0106-0.0754
10	1	84.9	0.0466
	2	83.9	0.0466
	3	78.3	0.0085
	4	79.2	0.0126
	5	78.4	0.0126
	6	78.5	0.016
	Range	78.3-84.9	0.0085-0.0466

Table F-3b. Pile Driving Cumulative L_{eq} Noise Levels – Sorted by Receptor (Cont.)

Receptor	Pile Driving Scenario	Leq Noise Level (dBA)	Vibration Level (inch/sec)
11	1	80.8	0.0229
	2	79.5	0.0229
	3	76.1	0.0053
	4	76.4	0.0058
	5	75.5	0.0085
	6	75.7	0.0085
	Range	75.5-80.8	0.0053-0.0229

Table F-4. Typical Vibration Emission Levels for Construction Equipment

Type of Equipment	PPV at 25 ft (inch/second)
Pile Driver (Impact) – Upper Range	1.518
Typical	0.644
Pile Driver (sonic) – Upper Range	0.734
Typical	0.170
Clam shovel drop	0.202
Hydromill - in soil	0.008
in rock	0.017
Vibratory Roller	0.210
Hoe Ram	0.089
Large bulldozer	0.089
Caisson drilling	0.089
Loaded trucks	0.076
Jackhammer	0.035
Small bulldozer	0.003

Source: Federal Transit Administration, May 2006.

F.2 Vehicular Traffic Noise Prediction

Future noise increases at a specific receptor location in the midblock of a traffic route (Table F-5) were predicted based on traffic volume changes at those traffic lanes immediate adjacent to the receptor based on the logarithmic relationship between future volume and existing volume.
The traffic volumes at midblock of the roadway segment where the receptors are located used were obtained from *Southeast Louisiana Veterans Medical Center Traffic Impact Analysis* (Urban System, Inc. August 2009).

Table F-5. Build Condition Noise Increase (dBA) Over Existing Conditions

Street	Mid Block Location	Traffic Volume Existing		Traffic Volume Build		Build Noise Increase from Existing	
		AM	PM	AM	PM	AM	PM
South Broad Street	Between Tulane Avenue and Canal Street	2167	2195	2206	2221	0.08	0.05
Canal Street	Between North Broad Street and North Galvez Street	2032	2042	2376	2225	0.68	0.37
North Galvez Street	Between Bienville Avenue and Canal Street	464	396	543	425	0.68	0.31
South Galvez Street	Between Canal Street and Tulane Avenue	515	548	513	645	-0.02	0.71
Tulane Avenue	Between South Galvez Street and South Claiborne Avenue	2095	1659	2198	1726	0.21	0.17
Tulane Avenue	Between South Broad Street and South Galvez Street	1806	1845	2418	2195	1.27	0.75