Appendix I – Noise

- Noise Assessment Letter (2006)
- Noise Assessment Addendum (2006)

Geomatrix

MEMORANDUM

Project No: 12209.000.0

To: Steve Bingham, Adolfson Associates, Inc.
CC: Ikuno Masterson, Adolfson Associates, Inc.
Karl Hufnagel, R.W. Beck
Date: May 5, 2006
Project: King County's Bow Lake Transfer/Recycling Station Upgrade
Subject: Noise Assessment

This memo describes the noise assessment conducted by Geomatrix Consultants, Inc. (Geomatrix) for King County's Bow Lake Transfer/Recycling Station Upgrade Project. Geomatrix assessed potential noise impacts that might occur due to the upgrade and expansion of the facility. The discussion that follows includes a brief introduction to noise terminology, a review of the regulatory noise limits and performance standards applied to this facility, and a description of the methodology and findings of the noise impact assessment.

1.0 SUMMARY/CONCLUSION

Noise from the upgraded and expanded facility is not anticipated to result in noise impacts to the nearest residences. First, noise from the expanded facility is anticipated to comply with the applicable daytime and nighttime noise limits at the residences nearest the site, on the hillside west of both the facility and I-5. Second and more importantly, noise from vehicles traveling on I-5 dominates the noise environment at the residences on the hillside and traffic noise would be at least 10 dBA louder than noise from the facility. Therefore, noise from the transfer/recycling station would rarely, if ever, be audible at these hillside residences, and no significant adverse noise impacts are anticipated from the project.

2.0 INTRODUCTION TO NOISE TERMINOLOGY

Noise is sometimes defined as unwanted sound. This memo makes no such distinction, and the terms noise and sound are used more or less synonymously. The human ear responds to a very wide range of sound intensities. The decibel (dB) scale used to describe and quantify sound is a logarithmic scale that provides a convenient system for considering the large differences in audible sound intensities.

On the logarithmic dB scale, a doubling of sound-generating activity (i.e., a doubling of the sound energy) causes a 3-dB increase in the sound level produced by that source, not a doubling of the loudness of the sound (which requires a 10-dB increase). For example, if traffic along a road is causing a 60 dB sound level at some nearby location, twice as much traffic on this same road traveling the same speed and comprised of the same types of vehicles would cause the sound level at this same location to increase to 63 dB.

People generally cannot detect sound level differences (increases or decreases) of 1 dB in a given noise source. Although differences of 2 or 3 dB can be detected under ideal laboratory conditions, such changes are difficult to discern in an active outdoor noise environment. A 5-dB change in a given noise source or environment would be likely to be perceived by most people under normal listening conditions. A 10-dB increase represents a perceived doubling of loudness to someone with normal hearing. Therefore, a 70-dB sound level will sound twice as loud as a 60-dB sound level.

When addressing the effects of noise on people, it is useful to consider the frequency response of the human ear. Sound-measuring instruments are, therefore, often programmed to "weight" measured sounds based on the way people hear. The frequency-weighting most often used is A-weighting; it approximates the frequency response of human hearing and is highly correlated to the effects of noise on people. Measurements from instruments using this system are reported in "A-weighted decibels" or dBA. All sound levels in this evaluation are reported in A-weighted decibels.

3.0 PERFORMANCE STANDARDS/NOISE REGULATIONS

The 2006 Facility Master Plan Update for the Bow Lake Transfer/Recycling Station, prepared to provide King County with a blueprint for upgrading the existing facility, includes performance standards for the upgraded facility. The performance standards stipulate that noise levels from the facility must comply with the City of Tukwila and King County noise ordinances.

3.1 KING COUNTY NOISE ORDINANCE

Relevant noise criteria for this evaluation are included in the King County Code Chapters 12.86-12.100. The County code establishes limits on the levels and durations of noise crossing property boundaries. Allowable maximum sound levels depend on the district (land use zone) of the source of the noise and the district (land use zone) of the receiving property when both are

located in King County (see **Table 1**). The maximum permissible levels are the limits a source can generate, not the total of the project and background sound levels.

Table 1. King County Maximum Permissible Sound Levels

Zoning District of Noise Source	Zoning District of Receiving Property			
	Rural Day / Night	Residential Day / Night	Commercial	Industrial
Rural	49/39	52/42	55	57
Residential	52/42	55/45	57	60
Commercial	55/45	57/47	60	65
Industrial	57/47	60/50	65	70

King County defines daytime hours as 7 a.m. to 10 p.m. weekdays and 9 a.m. to 10 p.m. weekends and holidays. Nighttime hours are 10 p.m. to 7 a.m. weekdays and 10 p.m. to 9 a.m. weekends and holidays.

Source: King County Code Chapter 12.88.020

King County's noise criteria may be exceeded for certain periods of time: 5 dBA for no more than 15 minutes in any hour, or 10 dBA for no more than 5 minutes of any hour or 15 dBA for no more than 1.5 minutes of any hour. Sometimes these exceptions are described in terms of the percentage of time a certain level is exceeded. For example, L_{25} represents a sound level that is exceeded 25 percent of the time, or 15 minutes in an hour. Similarly, $L_{8.33}$ and $L_{2.5}$ are the sound levels that are exceeded 5 and 1.5 minutes in an hour, respectively. At no time can the allowable sound level be exceeded by more than 15 dBA, represented by the L_{max}.

King County's noise code identifies a number of noise sources or activities that are exempt from the maximum permissible sound levels described previously. These exempt sources include:

- Sounds created by motor vehicles on public roads (maximum permissible sound levels for **individual** motor vehicles are regulated by Chapter 12.90.010 of the King County Code)
- Sounds created by warning devices (such as back-up alarms on vehicles) when not operated continuously for more than 30 minutes per incident

Unlike many local jurisdictions, King County applies specific limits on construction noise that vary with the types of sounds being generated. For construction noise, the maximum permissible

sound levels displayed in **Table 1** may be exceeded by no more than 25, 20, or 15 dBA depending on the location, type, and use of the equipment (KCC 12.88.040).

3.2 CITY OF TUKWILA NOISE REGULATIONS

Chapter 8.22 of the Tukwila Municipal Code (TMC 8.22) establishes noise regulations that closely mirror the King County noise regulations discussed above, with the exception that there is no rural designation in the Tukwila code. As with King County, Tukwila specifies the maximum allowable noise levels based on the zoning of the source and receiving properties. Tukwila identifies a Residential District as property zoned as LDR, MDR, or HDR; a Commercial District as zones MUO, O, RCC, NCC, RC, RCM, or TUC; and an Industrial District as zones C/LI, LI, HI, MIC/L, MIC/H, or TVS.

As with the King County rule, TMC 8.22 exempts noise from vehicles traveling on public roadways from the noise limits. Tukwila exempts sounds created by warning devices not operated continuously for more than five minutes per incident.

Unlike King County, TMC 8.22 exempts noise from temporary construction sites affecting Residential Districts from its noise limits between 7 a.m. and 10 p.m. Mondays through Fridays and between 8:00 a.m. and 10:00 p.m. Saturdays, Sundays, and state-recognized holidays. Construction noise affecting Residential Districts outside of these hours is subject to the noise limits. Therefore, a noise variance may be required if nighttime construction is deemed necessary near residential properties. Construction noise is exempt during all hours of the day in Commercial and Industrial Districts.

4.0 EXISTING LAND USE AND ZONING

The project site is in the City of Tukwila on land zoned TVS (Tukwila Valley South), and the facility would be considered a noise source in an Industrial District. The nearest and most-potentially affected receivers to the upgraded facility are residences in the City of Seatac on the west side of Interstate 5 (I-5). These receivers are on land zone for residential use and are in Residential Districts. The noise limit for an Industrial noise source affecting Residential receivers is 60 dBA during the day (7 a.m. to 10 p.m.) and 50 dBA at night (10 p.m. to 7 a.m.).

5.0 EXISTING CONDITIONS

Geomatrix measured the existing sound levels in the project vicinity at 18430 Military Road South, one of the nearest and most exposed residences to the upgraded facility, on the hillside overlooking the facility and I-5. For the measurement, a microphone was placed on a tripod approximately 5 feet above ground elevation. The sound level meter was a Type I Larson Davis 820 that was calibrated immediately prior to the measurements. Although the meter was unattended for the majority of the measurement, area noise sources were noted during the setup and retrieval of the meter. The existing sound levels in the project vicinity were dominated by noise from traffic traveling on I-5 and were also affected by traffic on Military Road South.

Results of the sound level measurement (SLM) are summarized in **Table 2.** A detailed table and a chart of the measurement results are provided at the end of this memorandum.

Table 2. Range of Measured Existing Environmental Sound Levels (dBA)

SLM Location	Time	L_{eq}[a]	L_{max}	L_{25}	L_{90}[b]
18430 Military Road S	Daytime[c]	70-74	76-101[d]	71-74	68-71
	Nighttime[c]	66-74	75-82	67-74	61-72
KC/Tukwila Noise Limits	Daytime[c]	NA	75	60	NA
	Nighttime[c]	NA	65	50	NA

[a] The L_{eq} is the "energy-averaged" sound level.
[b] The L_{90} is the sound level exceeded 90% of the time, often considered the "background" sound level.
[c] "Daytime" refers to the hours between 7 a.m. and 10 p.m. "Nighttime" refers to the hours between 10 p.m. and 7 a.m.
[d] The highest measured L_{max} sound level of 101dBA was an anomalous occurrence, most likely due to an event directly adjacent to the measurement equipment. The next highest measured L_{max} was 92 dBA.
Source: Sound level measurement by Geomatrix Consultants, Inc., 2006

As can be seen in **Table 2**, during every hour of the day the measured existing sound levels at the hillside residence currently exceed the daytime and nighttime noise limits. The existing noise is dominated by traffic on I-5, an exempt source. Existing sound levels exceed the daytime noise limit for the L_{25} by at least 11 dBA and the nighttime noise limit by at least 17 dBA. The background sound level (represented by the L_{90}) dips only as low as 61 dBA during the quietest hour of the day.

6.0 IMPACTS

6.1 POTENTIAL NOISE IMPACTS DURING CONSTRUCTION

During construction of the proposed facility there would be temporary increases in sound levels near active construction areas of the site due to the use of heavy equipment and along roadways used for hauling construction materials. The increases in noise levels would depend on the type of equipment being used, and the amount of time it is in use.

However, much of the construction activity will occur further than 600 feet from the nearest residences to the site and I-5 lies between these residences and the construction site. The restriction of construction activities to daytime hours, when noise from traffic traveling on I-5 is greatest, and the distance between most of the construction and the nearest residential locations would minimize or eliminate noise impacts due to construction.

6.2 POTENTIAL NOISE IMPACTS DURING OPERATION

The upgraded transfer station proposes to operate 24-hours a day, seven days a week. It currently operates 24-hours per day on weekdays and between 8:30 a.m. and 5:30 p.m. on Saturdays and Sundays.

Noise sources associated with the upgraded transfer station would be similar to the sources at the existing facility. Primary noise sources would include heavy-duty equipment, trucks, and trailers. In the future, the majority of activities and equipment would occur inside of the facility, and the building structure would provide a substantial noise reduction for interior activities. Presently, there are no walls on the transfer station to act as noise barriers for much of the equipment and activities. The primary noise-producing equipment or activities are listed below:

- A top-pick or reach stacker for containers
- Forklifts in outdoor recycling areas
- Two compactors, with hydraulic power units installed in the building
- Two rubber-tired front end loaders working in the building
- Two yard tractors (i.e., yard goats) moving trailers in and out of the loading bays on the lower level
- Approximately 1,000 vehicles on an average day in 2030 and 2,100 vehicles on a peak day. Approximately 26% commercial vehicles (trucks), 71% self-haul vehicles (pickups and cars) and 3% business self-haulers (smaller trucks). By 2030, there are expected to be an average of 46 transfer trailer vehicles per day, with peak days of approximately 82 vehicles.

Geomatrix evaluated noise anticipated to be generated by the transfer/recycling station at the nearest residential receivers to the facility using the Cadna/A noise model. Cadna/A is a computer program that calculates sound levels after considering the noise reductions or enhancements caused by distance, topography, ground surfaces, atmospheric absorption, and meteorological conditions. Results of this modeling are discussed below.

6.2.1 Daytime Sound Levels

Geomatrix estimated daytime sound levels of the upgraded facility assuming the following equipment would operate continuously over a one-hour period: two loaders in the transfer building, two yard tractors/goats near the compactors at the south end of the transfer building and in the trailer maneuvering area, a reach stacker in the trailer maneuvering area, and a forklift in the paid recycling area. In addition, during a peak daytime hour, Geomatrix assumed there would be 150 customer vehicles/trucks, 50 commercial vehicles, and 10 transfer trailers traveling on the on-site roads. Although compactors often can be noisy due to hydraulics, this equipment will be installed inside the transfer building and is not expected to contribute to the exterior noise. Therefore, the compactor was not considered in this analysis.

Model-calculated sound levels (L_{25s}[1]) of the peak daytime operations range from 48 to 52 dBA at the nearest residences on the hillside to the west. Such levels would comply with both King County's and the City of Tukwila's daytime noise limit of 60 dBA. The existing background sound levels (L_{90s}) during the day range from 68 to 71 dBA and are at least 16 dBA higher than the predicted facility sound levels. Consequently, noise from the freeway would obscure noise from the facility. Therefore, it is unlikely that noise from the transfer/recycling station would be audible, except during rare lulls in I-5 traffic. No significant adverse noise impacts are anticipated.

6.2.2 Nighttime Sound Levels

Geomatrix estimated nighttime sound levels of the upgraded facility assuming the following equipment would operate continuously during any nighttime hour (i.e., between 10 p.m. and 7 a.m.): two loaders in the transfer building, a yard tractor/goat near the compactors at the south end of the transfer building, a reach stacker in the trailer maneuvering area, and a forklift in the paid recycling area. We also assumed there would be 20 customer vehicles/trucks, 5 commercial

[1] Each model-calculated level is the result of a combination of L_{25} and L_{eq} data but provides a reasonable prediction of an L_{25}.

vehicles, and 5 transfer trailers traveling on the on-site roads. Again, the compactor was not considered in this analysis.

Model-calculated sound levels (L_{25s}[2]) of nighttime operations (expected to occur between 10 p.m. and 7 a.m.) range from 46 to 50 dBA at the nearest residences on the hillside to the west. These levels would comply with both King County's and the City of Tukwila's nighttime noise limit of 50 dBA. The existing background sound levels (L_{90s}) during the night range from 61 to 72 dBA, at least 11 dBA higher than the modeled transfer/recycling facility sound levels. Therefore, freeway noise would effectively obscure noise from the transfer/recycling station. Consequently, it is unlikely that activities at the proposed future facility would be audible, except during rare lulls in traffic on I-5. No significant adverse noise impacts are anticipated.

7.0 MITIGATION

7.1 CONSTRUCTION MITIGATION

Construction activities will be restricted to daytime hours when traffic noise from I-5 is greatest.

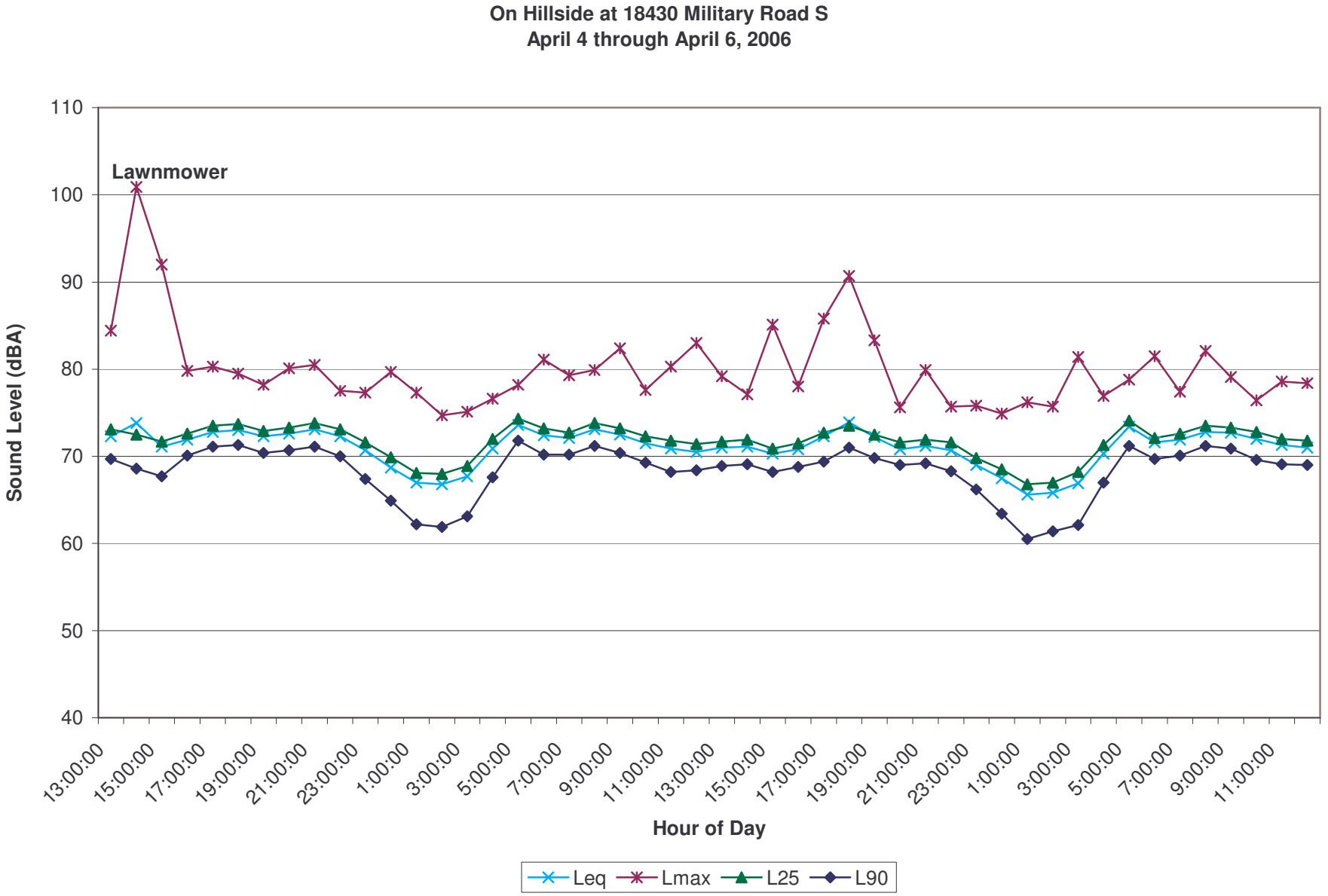
7.2 OPERATION MITIGATION

No operational adverse noise impacts were identified; therefore no operational noise mitigation is proposed.

[2] Each model-calculated level is the result of a combination of L25 and Leq data but provides a reasonable prediction of an L25.

Sound Level Measurement Data - 18430 Military Road South								
Date	**Time**	**Leq**	**Lmax**	**Lmin**	**L2**	**L8**	**L25**	**L90**
4-Apr	13:00:00	72.3	84.4	66.8	75.7	74.6	73.1	69.7
4-Apr	14:00:00	73.8	100.9	64.6	75.2	73.9	72.5	68.6
4-Apr	15:00:00	71.1	92	63.3	73.9	72.8	71.7	67.7
4-Apr	16:00:00	71.9	79.8	66.5	74.4	73.5	72.6	70.1
4-Apr	17:00:00	72.8	80.3	68.7	75.2	74.4	73.5	71.1
4-Apr	18:00:00	73	79.5	68.4	75.4	74.6	73.7	71.3
4-Apr	19:00:00	72.3	78.2	67.9	74.8	73.9	72.9	70.4
4-Apr	20:00:00	72.6	80.1	67.3	75	74.3	73.3	70.7
4-Apr	21:00:00	73.1	80.5	67.7	75.7	74.8	73.8	71.1
4-Apr	22:00:00	72.3	77.5	65	74.9	74.1	73.1	70
4-Apr	23:00:00	70.7	77.3	62.5	73.8	72.8	71.6	67.4
5-Apr	0:00:00	68.7	79.7	57.6	72.4	71.2	69.9	64.9
5-Apr	1:00:00	67	77.3	54.9	71.7	70	68.1	62.2
5-Apr	2:00:00	66.8	74.7	50	71.3	69.8	68	61.9
5-Apr	3:00:00	67.7	75.1	55.1	71.8	70.5	68.9	63.1
5-Apr	4:00:00	70.9	76.6	58.1	74.1	73.2	72	67.6
5-Apr	5:00:00	73.6	78.2	67.9	75.7	74.9	74.3	71.8
5-Apr	6:00:00	72.4	81.1	65.7	75	74.4	73.2	70.2
5-Apr	7:00:00	72.1	79.3	67.3	74.3	73.6	72.7	70.2
5-Apr	8:00:00	73.1	79.9	68.5	75.4	74.7	73.8	71.2
5-Apr	9:00:00	72.5	82.4	67.5	75	74.2	73.2	70.4
5-Apr	10:00:00	71.5	77.6	66.7	74	73.2	72.3	69.3
5-Apr	11:00:00	70.9	80.3	64.9	73.9	73	71.8	68.2
5-Apr	12:00:00	70.5	83	63.4	73	72.4	71.4	68.4
5-Apr	13:00:00	71	79.2	64.7	73.7	72.8	71.7	68.9
5-Apr	14:00:00	71.1	77.1	66	73.8	72.8	71.9	69.1
5-Apr	15:00:00	70.3	85.1	64	72.9	71.9	70.9	68.2
5-Apr	16:00:00	70.8	78	65.3	73.4	72.5	71.5	68.8
5-Apr	17:00:00	72.3	85.8	66.1	76	74	72.7	69.4
5-Apr	18:00:00	73.9	90.7	68.2	80.5	75.3	73.5	71
5-Apr	19:00:00	72.2	83.3	67	77.5	74	72.5	69.8
5-Apr	20:00:00	70.8	75.6	65.8	73.3	72.5	71.6	69
5-Apr	21:00:00	71.2	79.9	65.5	73.8	72.9	71.9	69.2
5-Apr	22:00:00	70.7	75.7	63.5	73.6	72.7	71.6	68.3
5-Apr	23:00:00	69	75.8	60.2	72.3	71.2	69.8	66.2
6-Apr	0:00:00	67.5	74.9	55.7	71.6	70.2	68.5	63.4
6-Apr	1:00:00	65.6	76.2	53.3	70.4	68.7	66.8	60.5

Sound Level Measurement Data - 18430 Military Road South								
Date	**Time**	**Leq**	**Lmax**	**Lmin**	**L2**	**L8**	**L25**	**L90**
6-Apr	2:00:00	65.8	75.7	54.2	70.5	68.8	67	61.4
6-Apr	3:00:00	66.9	81.4	54.4	71.3	70	68.2	62.1
6-Apr	4:00:00	70.3	76.9	60.1	73.6	72.6	71.3	67
6-Apr	5:00:00	73.4	78.8	67.2	75.6	74.9	74.1	71.2
6-Apr	6:00:00	71.6	81.5	67.3	74.4	73.2	72.1	69.7
6-Apr	7:00:00	71.9	77.4	66.9	74.7	73.7	72.6	70.1
6-Apr	8:00:00	72.8	82.1	69	75	74.4	73.5	71.2
6-Apr	9:00:00	72.7	79.1	68	74.9	74.2	73.3	70.9
6-Apr	10:00:00	72	76.4	66.3	74.9	73.9	72.8	69.6
6-Apr	11:00:00	71.3	78.6	66.2	74.1	73.1	72	69.1
6-Apr	12:00:00	71	78.4	65.4	73.6	72.7	71.8	69


On Hillside at 18430 Military Road S
April 4 through April 6, 2006
Lawnmower
Sound Level (dBA)
110
100
90
80
70
60
50
40
13:00:00
15:00:00
17:00:00
19:00:00
21:00:00
23:00:00
1:00:00
3:00:00
5:00:00
7:00:00
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3:00:00
5:00:00
7:00:00
9:00:00
11:00:00
Hour of Day
Leq
Lmax
L25
L90

Geomatrix

Memorandum

TO:	Steve Bingham, ESA Adolfson	**DATE:**	October 16, 2006
FROM:	Kristen Wallace	**PROJ. NO.:**	12209.000.0
CC:	Karl Hufnagel, R.W. Beck	**PROJ. NAME:**	Bow Lake Transfer/Recycling Station Upgrade

SUBJECT: **Response to La Pianta Appeal Comment Regarding Noise**

Geomatrix Consultants, Inc. (Geomatrix) was asked to respond to a comment made as part of the SEPA appeal by representatives of the La Pianta LLC group (La Pianta) regarding the noise section of the SEPA checklist for the King County's Bow Lake Transfer/Recycling Station Upgrade Project. Specifically, La Pianta expressed concern that the SEPA checklist did not adequately address potential noise impacts to their neighboring, undeveloped property to the north of the Bow Lake site, particularly during nighttime operations. This memorandum provides our response to La Pianta's comment.

The La Pianta property is in the City of Seatac and is zoned U-L 9,600 (Urban Low Density Residential). Although the property is currently undeveloped, La Pianta indicates that it is likely that the property will be developed into single-family residences in the future. These residential parcels would be considered Residential receivers for purposed of applicable noise rules. The noise limit for an Industrial noise source affecting Residential receivers is 60 dBA during the day (7 a.m. to 10 p.m.) and 50 dBA at night (10 p.m. to 7 a.m.).

In general terms, the La Pianta property is approximately the same distance (~ 550 feet) from the developed portion of the transfer station site as the nearest residences on the hillside west of I-5. The proposed future La Pianta residences (unlike the hillside residences west of I-5) would not be overlooking the site and would receive some benefit from intervening terrain and/or on-site buildings. In addition, when constructed the residences nearest to the transfer station would be a similar distance to I-5 as the hillside residences considered in the SEPA checklist and would be subject to similar existing levels of freeway traffic noise. Therefore, it is expected that any future residences on the La Pianta property would be less affected by noise from the proposed Bow Lake Transfer/Recycling Station upgrades than the most-affected hillside residences considered in the SEPA checklist. No impacts would be anticipated.

To confirm this general conclusion, Geomatrix modeled the sound levels of the facility at the nearest La Pianta property boundary north of the facility. As with the assessment conducted for the SEPA checklist, Geomatrix used the Cadna/A noise model to predict future sound levels from the expanded operation and equipment at the facility.

19203 36th Avenue West, Suite 101
Lynnwood, Washington 98036-5772
Tel 425.921.4000
Fax 425.921.4040
www.geomatrix.com

Daytime Operation

Using the same assumptions as detailed in the noise report attached to the SEPA checklist, the model-calculated sound level (L_{25}[1]) at the nearest portion of the La Pianta property is 49 dBA during daytime operations. Such a level would comply with the applicable daytime noise limit of 60 dBA. For comparison, the model-calculated sound levels of the peak daytime operations presented in the SEPA checklist ranged from 48 to 52 dBA at the nearest residences on the hillside to the west. The existing background sound levels (L_{90}s) during the day range from 68 to 71 dBA and are at least 19 dBA higher than the predicted facility sound levels at the La Pianta property. Consequently, noise from the freeway would obscure noise from the facility, and it is unlikely that noise from the facility would be audible, except during rare lulls in I-5 traffic. No adverse noise impacts are anticipated.

Nighttime Operation

The model-calculated sound level (L_{25}) at the nearest portion of the La Pianta property during nighttime operations (between 10 p.m. and 7 a.m.) is 48 dBA. Such a level would comply with the applicable nighttime noise limit of 50 dBA. The model-calculated sound levels of the peak nighttime operations presented in the SEPA checklist ranged from 46 to 50 dBA at the nearest residences on the hillside to the west. The existing background sound levels (L_{90}s) during the night range from 61 to 72 dBA, or at least 13 dBA higher than the predicted transfer/recycling facility sound levels. As with daytime operations, freeway noise would effectively obscure noise from the transfer/recycling station, and it is unlikely that activities at the proposed future facility would be audible, except during rare lulls in traffic on I-5. No adverse noise impacts are anticipated.

Conclusion

The SEPA checklist considered the potential noise impacts at the most-affected existing residences in the project vicinity and found virtually no potential for adverse noise impacts due to the project. Further analysis conducted in response to the appeal by La Pianta indicates that sound levels from the upgraded Bow Lake Transfer/Recycling Station would be lower than the highest predicted levels presented in the SEPA checklist, would comply with the applicable daytime and nighttime noise limits at the La Pianta property north of the facility, and would have even less potential to cause adverse noise impacts due to high existing levels of freeway noise.

[1] Each model-calculated level is the result of a combination of L_{25} and L_{eq} data but provides a reasonable prediction of an L_{25}.