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*Sound & Vibration
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7 July 2010

L 08767A
J/N 619

Mr. John Costello
Brookfield Metal Company, Inc.
100 Lamont Street
Elmsford, New York 10523

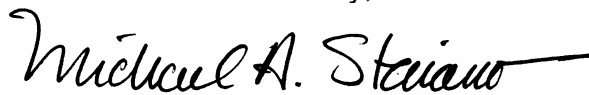
Subject: Site Noise Assessment—Metal Recycling Facility
Wawayanda, New York

Dear Mr. Costello:

Noise from metal recycling operations was predicted based upon peak site activity using facility noise emission levels derived from measured, operating installations and from data reported by the equipment manufacturer. Site sound levels were calculated at eight receptor locations with twelve noise sources in concurrent operation. With a property-line berm topped by a 13-ft wall east of the truck-queueing area and Non-Ferrous Processing Bldg shielding, the predicted sound levels for maximum combined equipment activity during daytime and from queueing trucks during nighttime (that is, early morning) are expected to meet the New York State suburban noise limits for solid-waste management installations. Operational noise controls should be implemented before 7 AM to minimize the risk of unacceptable early morning sound levels from on-site mobile equipment. Verification of these site noise predictions is recommended at sample receptor locations upon completion of the facility construction.

The details of this study are documented in the attached report. If you have any questions or if I can be of further help, please let me know.

Sincerely,

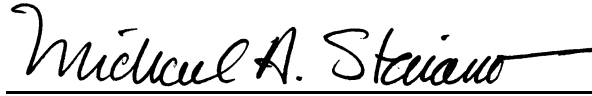

Michael A. Staiano

Attachment: Staiano Engineering Report No. L 08767A

xc: T.J. Malone—Brookfield Metal Company
J. Ullrich—Alpine Environmental Consultants

**SITE NOISE ASSESSMENT
METAL RECYCLING FACILITY
WAWAYANDA, NEW YORK**

By



Michael A. Staiano

Report No. **L 08767A**

7 July 2010

For

Brookfield Metal Company, Inc.
Elmsford, New York
J/N 619

The Brookfield Metal Company is proposing a metal recycling facility in the Town of Wawayanda, N.Y. Regular facility operations are expected 6 AM–5 PM, Monday through Friday. Inbound recyclables will be received beginning at 6 AM. Full-scale unloading will not begin until 7 AM although limited off-loading may start at 6 AM. Materials processing will occur 8 AM–5 PM. (Second-shift maintenance will be performed 3–11 PM, Monday–Friday—as equipment and machines are taken off line.) Outgoing product shipments generally will be made 6:30 AM–5:00 PM. (24-hr/da repairs or operations may arise when required by contractual obligations, emergency conditions, or a key component failure.)

In March 2008, an ambient noise survey was performed at four locations surrounding the proposed site of the metal recycling facility.¹ The measurements found that the ambient noise at three survey locations near Dolsontown Rd. was dominated by the nearby road traffic with 52–58-dBA mean equivalent (average) sound levels. At the Country View Manor Apartments at a location isolated from local street traffic, the mean average sound level was 48 dBA due to birds, aircraft, distant traffic, railroad activity, and industrial noises. Long-term monitoring at the survey position closest to the proposed facility found the day-night average sound level to be 61 dBA and the peak-hour average sound level to be 62 dBA at 5 PM as a result of Dolsontown Rd. traffic.

Noise concerns are expected to be an issue in gaining approval for the proposal. Assessment of the proposed operation is required to assure that no nearby noise-sensitive receptor is subjected to unacceptable exposures from the activity and, if necessary, to determine appropriate noise mitigation for the site. A metal recycling facility produces noise both from the relatively continuous operation of the fixed shredding and

processing machinery and supporting mobile equipment, and from the incidental impulsive noise from very brief detonation of propane canisters occasionally hidden in the vehicles being shredded. This report evaluates the noise from the relatively continuous on-site operations as produced by the proposed future facility and identifies mitigation features desirable to meet appropriate design goals.

SUMMARY

Noise from metal recycling operations was predicted based upon peak site activity using facility noise emission levels derived from measured, operating installations and from data reported by the equipment manufacturer. Site sound levels were calculated at eight receptor locations with twelve noise sources in concurrent operation. With a property-line berm topped by a 13-ft wall east of the truck-queueing area and Non-Ferrous Processing Bldg shielding, the predicted sound levels for maximum combined equipment activity are 47–61 dBA during daytime and 37–52 dBA from only queueing trucks during nighttime (that is, early morning). Consequently, the facility sound levels are expected to meet the New York State suburban noise limits for solid-waste management installations. Operational noise controls should be implemented before 7 AM to minimize the risk of unacceptable early morning sound levels from on-site mobile equipment. Verification of these site noise predictions is recommended at sample receptor locations upon completion of the facility construction.

TERMINOLOGY

Sound level fluctuates due to the varying magnitude of its sources. At any given location, ambient sound may be due to a number of simultaneous causes—for example, the summation of an aircraft flyby, the drone of highway traffic, the chirping of birds, and the rustle of leaves in the wind. Since these sources combine in a random way, the total sound level may vary over a substantial range. Thus, the sound experienced at any given instant may not be representative of long-term patterns. For this reason, noise is often evaluated over an extended period (usually at least 15 min) and described in terms of the statistics of the sound fluctuation during that period.

Sound is quantified in terms of "levels" having units of decibels (dB). The human ear responds to sound over a broad frequency range, but it does not sense all frequencies equally well. Sound levels that are weighted to account for the non-uniform frequency sensitivity of human hearing are known as A-weighted sound levels and are given in units of "A-weighted decibels" (dBA). For various purposes, a number of different noise metrics or descriptors have been defined to evaluate sound. The sound level descriptors used in this report are:

- *A-Weighted Sound Level* (L_A) is the overall magnitude of the A-weighted sound throughout the frequency range of human hearing.
- *Equivalent Sound Level* (L_{AeqT}), also known as average sound level, is the level of steady A-weighted sound equivalent to the sound energy of the time-varying sound during the measurement period. Typical evaluation periods are: 15 min, $L_{Aeq\frac{1}{4}hr}$; 1 hr, L_{Aeq1hr} ; daytime (7 AM–10 PM), L_d ; nighttime (10 PM–7 AM), L_n ; and 24 hr, $L_{Aeq24hr}$.

- *Nth-Percentile Sound Level* (L_N) is the A-weighted sound level exceeded during N percent of the measurement period. For example, L_{90} is the sound level exceeded during 90% of the measurement (typical of the relatively steady, low-level noise) and L_{10} is the sound level exceeded during 10% of the measurement (typical of brief, high-level noise events such as loud vehicle pass by).
- *Minimum Sound Level* (L_{Amin}) is the lowest A-weighted sound level measured during a time period or event.
- *Maximum Sound Level* (L_{Amax}) is the highest A-weighted sound level measured during a time period or event.

CRITERIA

The general provisions for the registration of solid-waste management facilities appear in the New York State Code Part 360, which includes paragraph 1.14 (p), "Noise Levels."² This regulation defines the maximum noise a facility may radiate beyond its property line in terms of *equivalent sound levels*. Daytime and nighttime limits are specified "at locations zoned or otherwise authorized for residential purposes" as a function of the "character of community"—rural, suburban or urban, as given in Table 1. For communities of "suburban" character (the most appropriate description of the environment around the proposed facility), the equivalent sound levels should not exceed 62 dBA between 7 AM–10 PM and 52 dBA between 10 PM–7 AM. Any measurements to verify conformance to these limits must be of sufficient duration to allow extrapolation to a one-hour time interval, that is, permit estimation of L_{Aeq1hr} . The regulation also specifies that, when background residual sound levels (i.e., excluding any contributions from the solid-waste management facility) exceed the limits of Table 1, the facility must not produce equivalent sound levels exceeding the background noise. Finally, all internal-combustion engined equipment are required to use mufflers and not emit sound levels exceeding 80 dBA at 50-ft distance.

PREDICTED SOUND LEVELS

Noise exposures from on-site metal shredding operations are due to both fixed plant machinery and mobile equipment activity. Typical operations and sources are:

- Delivery of unprocessed metal scrap via medium and heavy trucks, and unloading via material handlers, wheel loaders, and/or forklifts;
- Initial breakdown of scrap objects, stockpile maintenance, and processing plant conveyor loading using material handlers;
- Processing of scrap materials (shredding and sorting) with permanent fixed plant, and
- Shipment of finished product with wheel loaders loading highway haul trucks.

The noise produced by these sources fluctuates continually and randomly over a considerable range of magnitude. For example, the variation of material handling sound levels was 31 dBA for 98% of the time in 7½ min of measurements (i.e., L_1 – L_{99}), as given in Figure 1.³

Prediction Procedures

Sound levels in the site vicinity due to the relatively continuous noise emissions from the proposed metal shredding activities were predicted by means of a mathematical procedure. This prediction procedure forecasts sound levels at potentially sensitive locations from the sound emissions measured near the noise-generating equipment and the calculated acoustical propagation attenuation due to natural and man-made factors.

Sound-Propagation Effects. The propagation path influences the receptor sound level by the attenuation of sound from various causes. To estimate the site sound levels, noise attenuation was considered due to four mechanisms—spreading, atmospheric absorption, ground reflections ("ground interaction"), and barriers. Sound propagation in a still, uniform atmosphere, e.g., a calm, overcast day, was assumed.

Spreading Attenuation (A_d). Sound traveling from a noise source diminishes in magnitude, as do ripples on the surface of a pond when they propagate away from a disturbance. This effect is known as geometric divergence. Sound emanating from a point source of noise spreads spherically and decreases in intensity with distance, such that a reduction of 6 dB per doubling of distance from the source occurs. For example, a source which emits 85 dBA at 100 ft will cause 79 dBA at 200 ft, 73 dBA at 400 ft, ... 65 dBA at 1000 ft, etc.

Atmospheric Absorption (A_a). As sound propagates through the atmosphere, the vibration of the air molecules gradually dissipates the sound energy in proportion to the propagation distance (in addition to spreading losses). This attenuation depends strongly upon frequency and relative humidity and, to a lesser extent, air temperature. Atmospheric absorption can range from a few tenths of a decibel per thousand feet of propagation distance to over 30 dB per thousand feet of distance.⁴ In the site noise estimates, atmospheric absorption attenuation was considered for conditions corresponding to a minimal rate of atmospheric absorption, 15° C (59° F) air temperature and 50% relative humidity. For the computation of A-weighted sound levels, the absorption rates at a reference frequency, F_{REF} , were assumed as representative of the overall A-weighted frequency content of the equipment noise sources.

Ground Attenuation (A_g). When a sound source or receiver is relatively close to the ground, significant interference can occur between the sound traveling directly from the source to the receiver and that which is reflected from the ground. This interference depends upon: the frequency content of the sound, the reflection angle of the sound with the ground, and the penetrability of the sound into the ground (i.e., whether the ground surface is hard or soft).⁵ Hard surfaces, such as concrete or asphalt or bodies of water, result in interference effects that are relatively insignificant. However, soft surfaces (such as grass-covered ground or forest floor) can cause significantly reduced sound levels at receiver locations. For site sound level predictions, A-weighted ground attenuation was estimated as ≥ 0 dBA for *soft ground*, otherwise 0 dBA for *hard surfaces* or *elevated propagation* paths. "Ground-interaction" attenuation increases as the average height of the sound path above ground decreases. For fixed source and receiver heights, the estimated attenuation increases at 1.5 dBA per doubling of distance from the source.

Barrier Attenuation (A_b). A noise barrier is any obstacle which blocks the path of sound such that the sound traveling through the barrier is significantly less than that which is forced to travel above or around the obstacle. Natural topography, specially constructed barriers, or buildings can cause this sound shielding. The attenuation provided by a barrier is determined by the increase in the source-to-receiver sound travel distance around the barrier versus the direct sound path from the source to the receiver in the absence of the barrier. The greater the distance increase, the greater the attenuation provided by the barrier for a given frequency. Overall A-weighted barrier attenuation was estimated from the attenuation expected at a reference frequency, F_{REF} . A semi-empirical procedure was used in the computations.⁶ The calculation incorporated an asymptotic maximum barrier attenuation limit of 23 dBA for

berms and 20 dBA for walls. The barrier attenuation was computed separately for each source and receptor combination.

Equipment Sound Levels. Noise emissions for the metal shredding equipment were quantified with Staiano Engineering measurements at an existing, operating installation³ and with data reported by the equipment manufacturer, Metso Minerals Industries.⁷ When the measured and reported sound levels were compared for two existing facilities, the manufacturer data for the shredder component noise source appeared about 4-dBA too high. Consequently, adjusted emissions levels were assumed for the Wawayanda analyses which gave better agreement with available measured data.

Nine different types of noise sources were included in the predictions. Sound emission levels for the equipment, L_{AS} , were derived from: Reference 7 above, Staiano Engineering file data or information supplied by equipment manufacturers, and standardized backup alarm output magnitudes.⁸ Sound emission levels for the equipment were defined for a reference distance of 100 ft. The predictions considered no machinery noise mitigation other than the stock exhaust mufflers normally fitted to the mobile equipment. The source input data used in the computations are summarized in Table 2 for all equipment.

If more than one unit of a source type operates at essentially the same location, their combined effect can be calculated by adjusting the source emission level for the number of operating units, N . This adjustment will be 3 dB, 5 dB, 6 dB ... 10 dB for $N=2, 3, 4 \dots 10$ units, respectively.

Receiver Sound Levels. The site sound levels for each receptor location were calculated as

$$L_{Ar} = L_{As} + 10 \log (N) - A_d - A_a - \max (A_g , A_b)$$

where L_{Ar} is the receptor-location A-weighted sound level. At each receptor location, six stationary and two mobile noise source *types* are assumed operating at one of three positions on the site. The mobile sources included two heavy trucks at high-idle engine speed and four heavy trucks at low-idle engine speed. Thus, a total of twelve noise sources in simultaneous operation were considered to contribute to the receptor group-equipment-operation total noise exposure. The total receiver sound level was found by the logarithmic, "decibel addition" summation of the receiver sound levels of the individual sources, $\text{sum}(L_{Ar}) \approx L_{Aeq}$, excluding back-up alarm sound levels that were computed separately.

Computation Accuracy. The above-described prediction procedure has been applied to numerous other Staiano Engineering client sites. Prediction accuracy has been verified where adequate receiver noise exposure measurements are available.⁹ Eight sites with 19 total locations/conditions

* Since barrier attenuation increases with increasing barrier height while ground attenuation decreases with increasing source height, ground attenuation tends to decrease as barrier attenuation increases. Therefore, for engineering estimates, the ground and barrier attenuation values were not summed and only the single mechanism producing the greatest attenuation was considered, i.e., $\max (A_g , A_b)$.

(spanning distances 200–2100 ft) were suitable for verifications. The results were found to be—mean prediction error, +3.3 dBA, and error standard deviation, 6.1 dBA, for the expected maxima of individual or group-combined noise sources. I.e., the predictions tend to overestimate actual noise by about 3 dBA.

Computation Inputs and Assumptions

Peak-site-activity noise exposures were predicted at eight receptor locations around the site, denoted by the round targets in Figure 2. The source positions are denoted by square targets in Figure 2. The source numbers and elevations are given in Table 2 and Table 3; respectively. The receptor elevations are given in Table 4. The ground surfaces between the sources and receivers were characterized as "soft;" noise barriers were characterized as "berms" with the exception of shielding afforded by a processing plant structure and a freestanding noise control barrier—which were characterized as "walls." Receptor heights were taken at 5 ft. The source-receptor distances and the distances of any intervening noise barrier are tabulated in Table 5. These data were derived from Alpine Environmental Consultants electronic CAD file received 7 April 2010, "BROOK-040710 R2000.dwg."

Assumptions. Total receptor noise exposures were predicted for twelve noise sources in concurrent operation. Note that *the site sound level predictions, L_{Ar} , are such that all equipment is simultaneously operating at maximum noise emission conditions.* Mobile noise sources were assumed at specific locations representative of their realistic typical operating position—essentially a "snapshot" of the site in its noisiest configuration. The orientation and directional sound radiation characteristics of the noise sources were ignored, i.e., the sources were assumed omnidirectional.

Expected Sound Levels

Site sound levels were calculated for the expected operation of the proposed metal shredding facility. Since the truck queuing activity may intrude into the period prior to 7 AM, exposures with respect to the nighttime limits were examined. To meet the site design goal, a barrier wall was evaluated atop the property-line berm east of the truck-queueing area. The barrier configuration was optimized to identify the least height and length yielding sound levels within the goal noise limits—resulting in a 13-ft-high, berm-top wall. The computations are given in Table 6 with intermediate results and are summarized in Table 7. With the noise barrier wall, the predicted sound levels for combined equipment activity are expected to be reduced to:

- *Daytime—all operations—47–61 dBA and*
- *Nighttime (early morning)—queueing trucks only—37–52 dBA.*

Consequently, the sound levels are expected to meet the New York State suburban noise limits for solid-waste management facilities. Backup alarms are expected to produce sound levels of 33–46 dBA.

Verification Testing. As discussed in Reference 7, some uncertainty exists in the magnitude of the shredder noise emissions—the single most significant component

noise source on the site. Although the emission levels assumed in this analysis were substantiated by two references, verification the site noise prediction results reported herein at sample receptor locations is recommended upon completion of the shredding facility construction.

Typical Sound Levels. A worst-case scenario of equipment use was assumed in performing this assessment. Everyday operations often will involve quieter conditions. For example, noise exposures will be less with fewer concurrent operations. Consequently, the sound levels at the receptors may be quieter than those reported herein—often much quieter.

NOISE MITIGATION

Operational Noise Controls. Predicted on-site mobile equipment sound levels were evaluated with respect to daytime limits, although limited off-loading of raw scrap and outgoing product shipment may occur before 7 AM. To minimize the risk of unacceptable early morning sound levels, additional operational noise controls should be implemented before 7 AM:

- Only unloading via material handlers with scrap metal drop heights minimized,
- Wheel loaders not used, and
- Dump trucks not unloaded.

Barrier Design. The analyzed noise barrier extends approximately 300 ft along the site boundary with the Gardianos Property, as shown in Figure 3. To obtain significant sound level reductions with a noise barrier, the barrier must be of sufficient height and length, and adequately impervious to sound. For a freestanding wall, wall panels capable of reducing sound transmission by at least 24 dBA (i.e., have sound transmission loss, $TL \geq 24$ dBA) are adequate for this application. Acceptable configurations include concrete, masonry, or wood constructions that do not permit sound radiation to penetrate between or beneath panels. Wall panel materials that provide sufficient transmission loss performance can be selected from those highlighted in Table 8.¹⁰ Wood construction should be at least $\frac{3}{4}$ -in. thick for durability and should have lapped joints or battens to prevent leakage between panels. Noise barriers also may be created from stacked stone cribs or gabions (large rectangular wire-mesh baskets containing crushed stone), or stacked planting bins (of concrete, plastic or wood) that are filled with soil and seeded with suitable vegetation. Sample providers of various noise barrier systems—some of which may be offered on a turnkey basis—are given in Table 9.

Electronic Backup Alarms. Electric backup alarms are probably the noise sources most often found objectionable in mobile equipment operations—even when well within environmental noise limits. Therefore, the minimization of backup alarm noise is strongly encouraged. However, backup alarms are required by Federal safety regulations that mandate *audible* warning devices for industrial or mining equipment moving in reverse. BACKUP ALARMS SHOULD NOT BE DISABLED since accident risks will be increased and potential liability may be incurred in the event of an accident.

Several options exist for further abatement of noise exposures from site-based equipment. The performance of electric backup alarms is governed by SAE J994 which provides for five backup alarm types with emission levels over a 35-dBA range, as shown in Table 10.⁸ If a machine's backup alarm is a noisy design type, it may be replaced with one significantly quieter and still provide adequate warnings. A high-output, Type-B backup alarm was evaluated in the Table 6 computations. The lowest amplitude backup alarm sufficient for "audibility" to meet safety requirements should be used—a Type-C or -D backup alarm may be adequate. Alternatively, alarms that automatically adjust their volume based on ambient sound level are commercially available. In addition, discriminating backup alarm controllers that sound the alarm only when an obstacle is detected also are available and are recommended.

REFERENCES

- 1 Staiano, M.A., "Metal Shredding Facility Ambient Noise Survey—Wawayanda, New York," Staiano Engineering Report No. L 08753, 16 April 2008.
- 2 State of New York, "Part 360-Conditions for Registration of Solid Waste Management Facilities," New York Code of Rules and Regulations, 6 NYCRR 360-1.14(p), 31 March 1994.
- 3 Staiano, M.A., "Metal Shredding Facility Noise Emission Measurements—Conservit, Inc., Hagerstown, Md." Staiano Engineering Report No. L 08751, 20 February 2008.
- 4 American National Standards Institute, Standard Method for the Calculation of the Absorption of Sound in the Atmosphere, ANSI S1.26–1978.
- 5 Piercy, J.E., T.F.W. Embleton and L.C. Southerland, "Review of Noise Propagation in the Atmosphere," Journal of the Acoustical Society of America, Vol. 61, No. 6, June 1977.
- 6 Maekawa, Z., "Noise Reduction by Screens," Applied Acoustics, Volume 1, Pages 157–173, 1968.
- 7 Staiano, M.A., "Noise Emission Levels for Metal Shredding Facility, Wawayanda, N.Y.," Staiano Engineering Report No. L 10791, 2 July 2010.
- 8 Society of Automotive Engineers (SAE), "SAE Recommended Practice—Alarm—Backup—Electric—Performance, Test, and Application," SAE J994 MAR85, 1993 SAE Handbook—Volume 3, 1993.
- 9 Staiano, M.A., "Experience Predicting Construction-Site Noise," Paper No. 00-0329, Transportation Research Record—Journal of the Transportation Research Board—No. 1702, National Academy Press, Washington, DC, 2000.
- 10 Cohn, L.F., Highway Noise Barriers, NCHRP Synthesis 87, Transportation Research Board, December 1981.

Table 1. NEW YORK STATE MAXIMUM ALLOWABLE NOISE LEVELS
for solid-waste management facilities per 6 NYCRR360

TIME PERIOD	EQUIVALENT SOUND LEVEL, L_{Aeq1hr} (dBA) for COMMUNITY CHARACTER*		
	Rural	Suburban	Urban
Daytime (7 AM-10 PM)	57	62	67
Nighttime (10 PM-7 AM)	47	52	57

*when background residual sound levels exceed these limits, the facility must not produce sound levels exceeding the background sound levels

Table 2. SUMMARY of EVALUATED NOISE SOURCES
sound emission levels, L_{As} , specified at a 100-ft reference distance

SYM	L_{As}	F_{REF}	N	Hgt.	Description
Stationary Equipment/Operations					
M11	81.3	1000	1	13.3	In-feed Conveyor / Feeding Chute
M12A	86.3	1000	1	32.0	Shredder
M13	83.3	1000	1	16.0	Separating Station
M14	72.3	1000	1	50.0	Dedusting Plant
M15	73.3	1000	1	8.0	Fan
M16	77.3	1000	1	12.5	Trans-loading and pre-sort point for in-feed material
Mobile Equipment					
HT	73.0	500	2	10.0	Highway Haul Truck—high idle
HTi	63.0	500	4	10.0	Highway Haul Truck—low idle
BAb	79.0	1000	1	3.0	SAE Type B electronic backup alarm

Table 3. EVALUATED NOISE SOURCE LOCATIONS
elevations in feet

LOC	EI.	Description
Feed	474	Feedstock handling & conveyor loading
Proc	472	Processing plant--shredding & sorting
Que	472	Truck scale queue at entrance

Table 4. EVALUATED NOISE RECEPTORS
approximate first-floor elevations

REC	EI.	Description
A	460	Gardianos Property--1128 Dolsontown Rd.
B	460	Dwelling to SE--Dolsontown Rd.
C	480	Rotundo Property--1235 Dolsontown Rd.
D	500	Dwelling to NNE--Genung St.
E	480	Country View Manor Apts.--Bldg. 10
F	540	Moore Property--Dolsontown Rd.
G	528	Klingman Property--1065 Dolsontown Rd.
H	467	Southernmost dwelling--Caskey Ln.

Table 5. SOURCE-BARRIER-RECEPTOR GEOMETRY

MITIGATED: east property-line berm with 13-ft berm-top wall and Non-Ferrous Processing Bldg shielding; dimensions in feet

REC	SRC LOC	REC Dist	BARRIER				
			Elev.	Hgt.	Dist	Typ.	Object
A	Que	324	480	13	146	Wall	1a--perimeter berm, east + wall
	Feed	971	472	45	718	Wall	6--Non-Ferrous Processing Bldg
	Proc	850	472	45	541	Wall	6--Non-Ferrous Processing Bldg
B	Que	1433	480	13	153	Wall	1a--perimeter berm, east + wall
	Feed	1660	470	0	615	Berm	5--perimeter fill, north & east
	Proc	1471	470	0	427	Berm	5--perimeter fill, north & east
C	Que	2489	480	0	216	Berm	1--perimeter berm, east
	Feed	2334	470	0	507	Berm	5--perimeter fill, north & east
	Proc	2181	470	0	301	Berm	5--perimeter fill, north & east
D	Que	3133	470	0	1099	Berm	5--perimeter fill, north & east
	Feed	2533	470	0	487	Berm	3--cut, north
	Proc	2517	470	0	562	Berm	5--perimeter fill, north & east
E	Que	2291	481	0	1037	Berm	3--cut, north
	Feed	1576	488	0	302	Berm	3--cut, north
	Proc	1668	481	0	444	Berm	3--cut, north
F	Que	1220	520	0	695	Berm	2--cut, west
	Feed	1248	506	0	316	Berm	2--cut, west
	Proc	1378	508	0	527	Berm	2--cut, west
G	Que	1718	520	0	790	Berm	2--cut, west
	Feed	1823	540	0	1299	Berm	7--Moore Prop. Hill
	Proc	1949	540	0	1417	Berm	7--Moore Prop. Hill
H	Que	1808	498	0	390	Berm	4--perimeter grading, south (w/o ROW berm)
	Feed	2234	517	0	1187	Berm	4--perimeter grading, south (w/o ROW berm)
	Proc	2291	511	0	1176	Berm	4--perimeter grading, south (w/o ROW berm)

Table 6. PREDICTED SOUND LEVELS

Predicted sound levels, L_{Ar} , are for source noise emissions per Table 2, geometry per Figure 2 and Table 3–Table 5, and noise barrier per Figure 3.

The results are rounded to the nearest whole decibel and highlighted for 6 NYCRR360 exceedence—**nighttime** or **daytime**.

REC LOC	SOURCE		ATTENUATION (dBA)				RECEPTOR L_{Aeq} (dBA)		
	SYM	LOC	A_d	A_a	A_g	A_b	Src	Tot	O/A TOT
A	M16	Feed	20	1	5	18	38	44	55
	M11	Feed	20	1	5	18	42		
	M12A	Proc	19	1	3	18	49	51	
	M13	Proc	19	1	4	18	46		
	M14	Proc	19	1	2	17	36		
	M15	Proc	19	1	5	18	36		
	HT	Que	10	0	3	14	51		
	HTi	Que	10	0	3	14	44		
	BAb	Feed	20	1	6	18	40	40	
B	M16	Feed	24	2	6	0	45	51	60
	M11	Feed	24	2	6	0	49		
	M12A	Proc	23	2	4	0	57	59	
	M13	Proc	23	2	5	0	53		
	M14	Proc	23	2	3	0	44		
	M15	Proc	23	2	6	0	42		
	HT	Que	23	1	6	10	42		
	HTi	Que	23	1	6	10	35		
	BAb	Feed	24	2	8	0	45	45	
C	M16	Feed	27	3	7	0	40	46	54
	M11	Feed	27	3	7	0	45		
	M12A	Proc	27	3	5	0	52	54	
	M13	Proc	27	3	6	0	48		
	M14	Proc	27	3	4	0	39		
	M15	Proc	27	3	7	0	37		
	HT	Que	28	2	7	0	39		
	HTi	Que	28	2	7	0	32		
	BAb	Feed	27	3	8	0	40	40	
D	M16	Feed	28	3	7	0	39	45	53
	M11	Feed	28	3	7	0	43		
	M12A	Proc	28	3	5	0	50	52	
	M13	Proc	28	3	6	0	46		
	M14	Proc	28	3	4	0	37		
	M15	Proc	28	3	7	0	35		
	HT	Que	30	2	8	0	36		
	HTi	Que	30	2	8	0	29		
	BAb	Feed	28	3	9	0	39	39	

continued

Table 6. PREDICTED SOUND LEVELS (Continued)

Predicted sound levels, L_{Ar} , are for source noise emissions per Table 2, geometry per Figure 2 and Table 3–Table 5, and noise barrier per Figure 3.
The results are rounded to the nearest whole decibel and highlighted for 6 NYCRR360 exceedence—**nighttime** or **daytime**.

REC LOC	SOURCE		ATTENUATION (dBA)				RECEPTOR L_{Aeq} (dBA)		
	SYM	LOC	A_d	A_a	A_g	A_b	Src	Tot	O/A TOT
E	M16	Feed	24	2	6	1	46	51	58
	M11	Feed	24	2	6	0	50		
	M12A	Proc	24	2	4	0	56	57	
	M13	Proc	24	2	6	0	51		
	M14	Proc	24	2	3	0	42		
	M15	Proc	24	2	7	0	40	41	
	HT	Que	27	2	7	0	40		
	HTi	Que	27	2	7	0	33		
BAb	Feed	24	2	7	8	45	45		
F	M16	Feed	22	2	5	3	49	54	61
	M11	Feed	22	2	5	3	53		
	M12A	Proc	23	2	4	0	58	60	
	M13	Proc	23	2	5	0	54		
	M14	Proc	23	2	3	0	45		
	M15	Proc	23	2	6	1	43	49	
	HT	Que	22	1	6	0	48		
	HTi	Que	22	1	6	0	41		
BAb	Feed	22	2	7	10	46	46		
G	M16	Feed	25	2	6	13	37	43	51
	M11	Feed	25	2	6	12	41		
	M12A	Proc	26	2	5	10	48	50	
	M13	Proc	26	2	6	12	43		
	M14	Proc	26	2	4	7	37		
	M15	Proc	26	2	7	13	32	44	
	HT	Que	25	1	6	7	44		
	HTi	Que	25	1	6	7	37		
BAb	Feed	25	2	8	14	38	38		
H	M16	Feed	27	3	7	16	32	37	47
	M11	Feed	27	3	6	16	36		
	M12A	Proc	27	3	5	12	44	46	
	M13	Proc	27	3	6	14	39		
	M14	Proc	27	3	4	8	34		
	M15	Proc	27	3	7	15	28	41	
	HT	Que	25	1	6	10	40		
	HTi	Que	25	1	6	10	33		
BAb	Feed	27	3	8	17	33	33		

Table 7. SUMMARY of PREDICTED SOUND LEVELS

Predicted *peak-activity metal shredding facility* sound levels, $L_{Ar} = L_{Aeq}$, per per Table 2, geometry per Figure 2 and Table 3–Table 5, and noise barrier per Figure 3.

The results are rounded to the nearest whole decibel and highlighted for 6 NYCRR360 exceedence—**nighttime** or **daytime**.

REC	PREDICTED SITE NOISE TOTAL L_{Aeq}			Meas. Amb. L_{Aeq}
LOC	Operations	Ops	Overall	
A	Mobile Equipment	44	55	59
	Plant	51		
	Highway Trucks	52	59	
	Backup Alarm	40		
B	Mobile Equipment	51	60	
	Plant	59		
	Highway Trucks	43	45	
	Backup Alarm	45		
C	Mobile Equipment	46	54	54
	Plant	54		
	Highway Trucks	40	54	
	Backup Alarm	40		
D	Mobile Equipment	45	53	
	Plant	52		
	Highway Trucks	37	39	
	Backup Alarm	39		
E	Mobile Equipment	51	58	48
	Plant	57		
	Highway Trucks	41	48	
	Backup Alarm	45		
F	Mobile Equipment	54	61	
	Plant	60		
	Highway Trucks	49	46	
	Backup Alarm	46		
G	Mobile Equipment	43	51	56
	Plant	50		
	Highway Trucks	44	56	
	Backup Alarm	38		
H	Mobile Equipment	37	47	
	Plant	46		
	Highway Trucks	41	33	
	Backup Alarm	33		

Table 8. POSSIBLE NOISE BARRIER WALL MATERIALS
Materials and thicknesses suitable for the subject site are highlighted.

	MATERIAL	THICKNESS		TL ^a (dBA)
		(in.)	(mm)	
WOOD ^b	Fir	1/2	13	17
		1	25	20
		2	50	24
	Pine	1/2	13	16
		1	25	19
		2	50	23
	Redwood	1/2	13	16
		1	25	19
		2	50	23
	Cedar	1/2	13	15
		1	25	18
		2	50	22
	Plywood	1/2	13	20
		1	25	23
	Particle board ^c	1/2	13	20
METAL ^d	Aluminum	1/16	1.6	23
		1/8	3	25
		1/4	6	27
	Steel	24 ga.	0.6	18
		20 ga.	0.9	22
		16 ga.	1.6	25
		Lead	1/16	1.6
CONCRETE/ MASONRY	Light concrete	4	100	36
		6	150	39
	Dense concrete	4	100	40
	Concrete block	4	100	32
		6	150	36
COMPOSITES	Aluminum-faced plywood ^d	3/4	19	21-23
	Aluminum-faced particle board ^d	3/4	19	21-23
	Plastic lamina on plywood	3/4	19	21-23
	Plastic lamina on particle board	3/4	19	21-23
MISCELLANEOUS	Glass (safety glass)	1/4	6	22
	Plexiglas (shatterproof)	-	-	22-25
	Masonite	1/2	13	20
	Fiberglass/resin	1/4	6	20
	Stucco on metal lath	1	25	32
	Polyester with aggregate surface ^e	3	75	20-30

^a A-weighted overall transmission loss (TL) based on generalized truck spectrum.

Transmission Loss is the reduction in sound amplitude as it travels *through* the wall panel.

^b Tongue-and-groove boards recommended to avoid leaks (for fir, pine, redwood and cedar).

^c Should be treated for water resistance.

^d Aluminum is 0.01-in. (0.25-mm) thick. Special care is necessary to avoid delamination (for all composites).

^e TL depends on surface density of the aggregate.

Table 9. SAMPLE PROVIDERS of VARIOUS NOISE BARRIER SYSTEMS

PRECAST CONCRETE

Concrete Precast Systems—www.cpsprecast.com, Chantilly, Va., 703-222-9700
Concrete Solutions, Inc.—www.soundsorb.com, Austin, Tx., 512-327-8481
Durisol USA Inc.—www.durisol.com, McLean, Va., 866-801-0999
Faddis Concrete Products—www.faddis.com, Downingtown, Pa., 800-777-7973
Smith-Midland Corp.—www.smithmidland.com, Midland, Va., 540-439-3266
Sound Zero—www.soundzero.com, Birdsboro, Pa., 800-321-6275

WOOD

Hoover Treated Wood Products, Inc.—www.plywall.com, Thomson, Ga., 800-531-5558

STEEL

Diamond Manufacturing Company—www.acoustax.com, Wyoming, Pa., 800-233-9601
Industrial Acoustics Co.—www.industrialacoustics.com, Bronx, N.Y., 718-931-8000

PLASTIC/COMPOSITE

Carsonite International*—www.carsonite.com, Newberry, S.C., 800-648-7916
Sound Fighter Systems, L.L.C.—<http://soundfighter.com>, Shreveport, La., 318- 861-6640

PLANTING BIN

Evergreen Wall—www.evergreenwall.com, E. Pembroke, N.Y., 716-434-6174

* with scrap tire fill

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Table 10. ELECTRONIC BACK-UP ALARM SOUND LEVELS
back-up alarm performance requirement per SAE J994 MAR85;
allowed tolerance ± 4 dB with normal electrical system voltage, 14-28 V

ALARM TYPE	BACKUP-ALARM SOUND LEVEL (dBA)	
	Required @ 4 ft	Estimated @ 100 ft
A	112	84
B	107	79
C	97	69
D	87	59
E	77	49

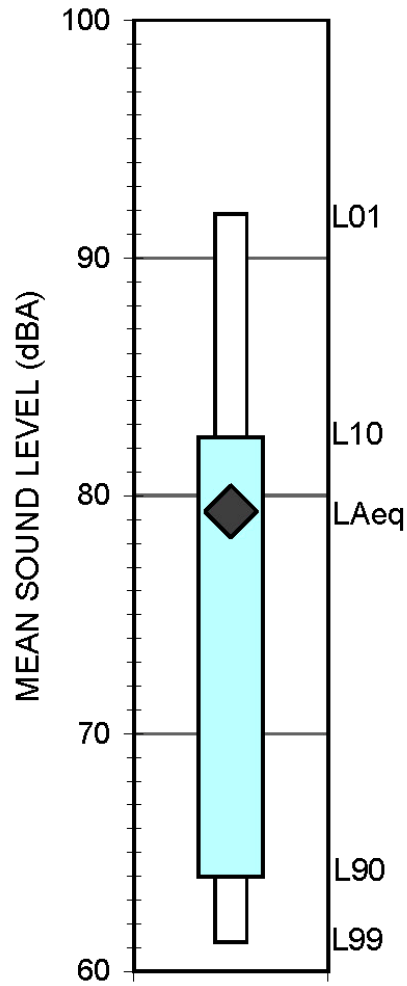
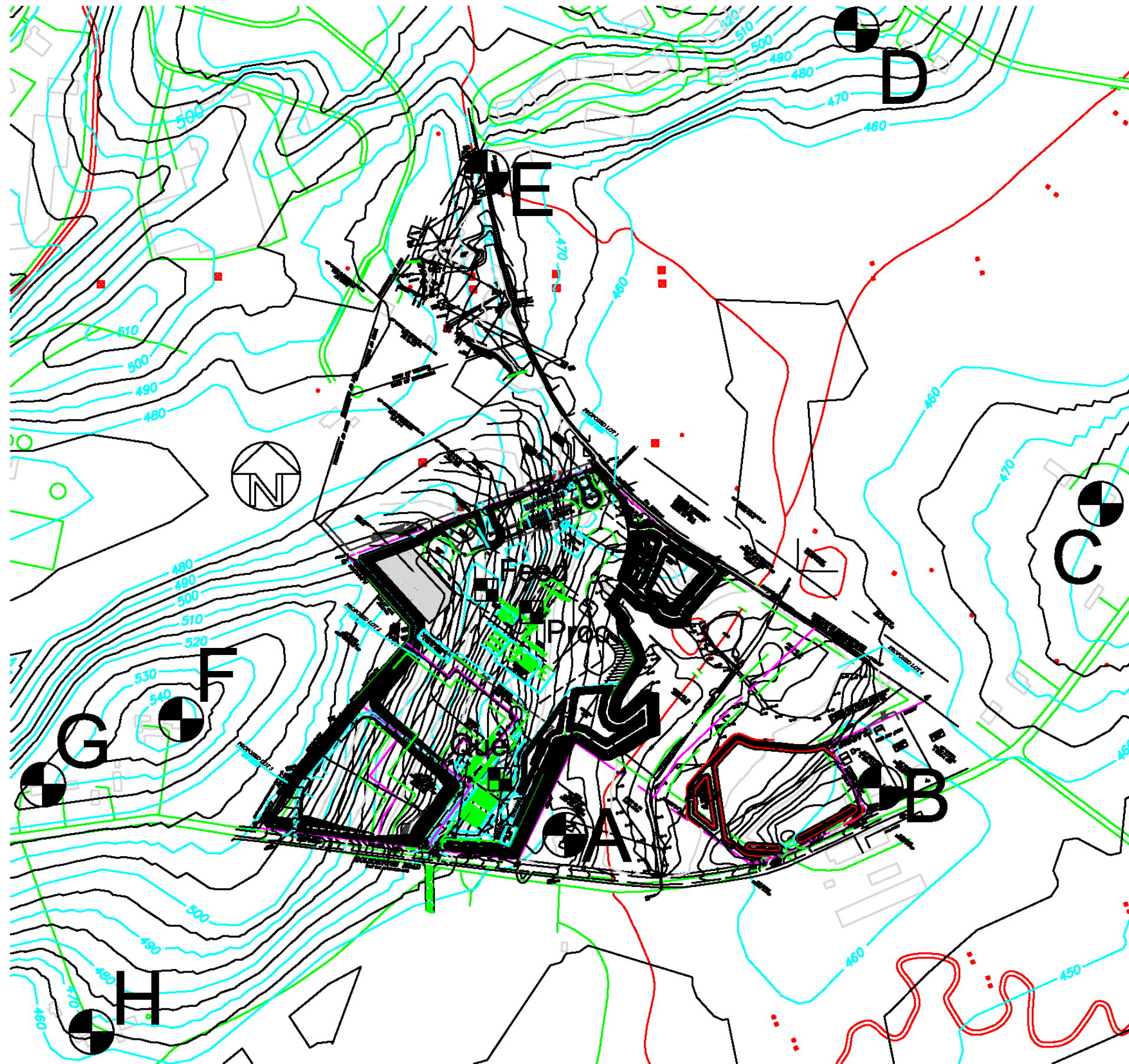


Figure 1. MATERIAL HANDLING NOISE
mean 35–80-ft measured sound levels over several periods totaling approximately 7½ min
of measurement and normalized to 100-ft reference distance

Figure 2.
NOISE PREDICTION
LOCATIONS
Square targets indicate
evaluated noise source positions;
round targets indicate
receptor noise prediction locations.



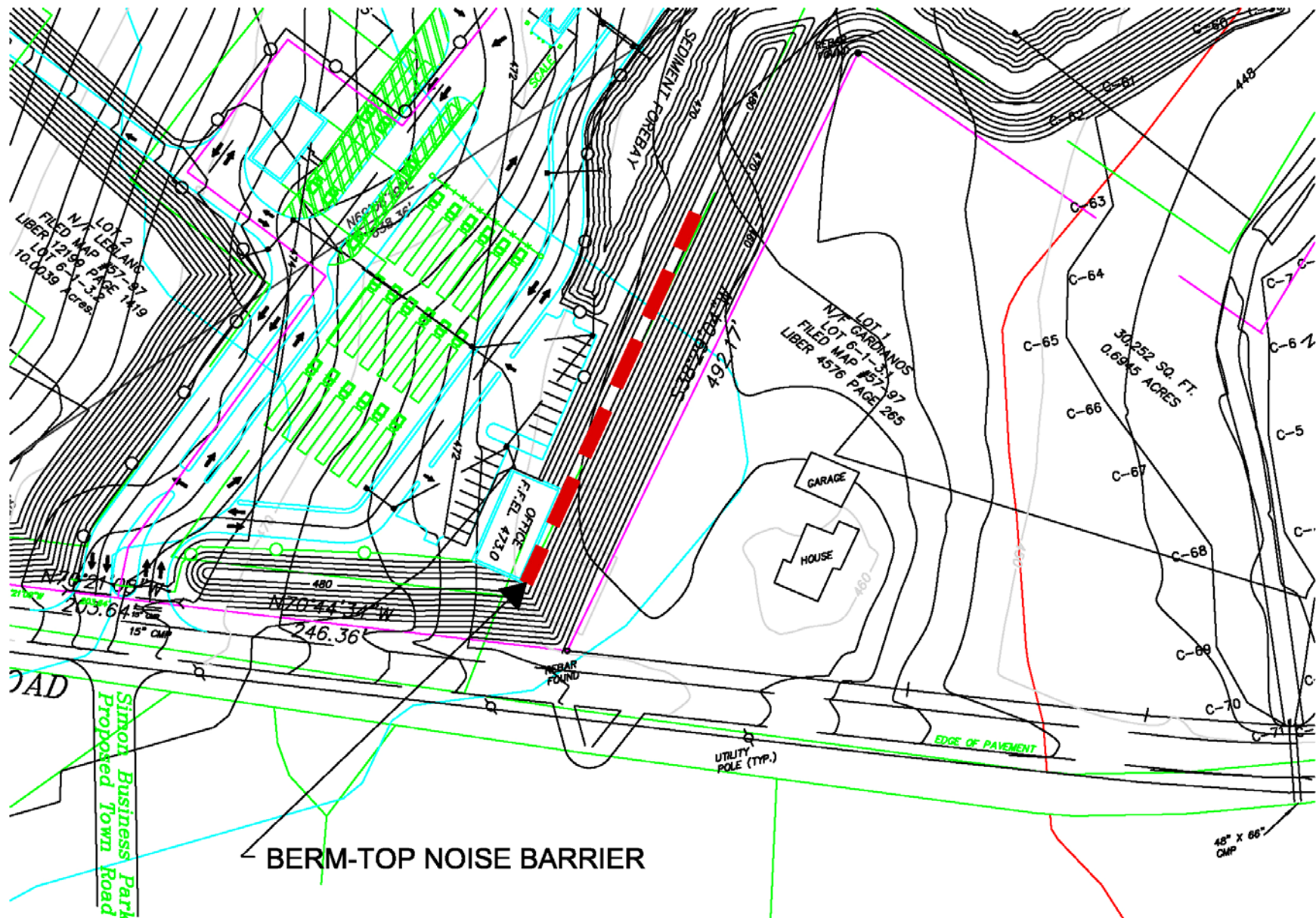


Figure 3. ANALYZED NOISE BARRIER