

Fjardaal sf

Fjardaal Smelter Project

Free field noise model

November 2004

Fjardaal sf

Fjardaal Smelter Project

Free field noise model
Initial run

November 2004

Report no. 60024-A-2
Issue no. 1.0
Date of issue December 22, 2004

Prepared Rasmus Krogh
Checked Lars Find Larsen
Approved

Table of Contents

1	Preface	2
2	Mathematical Model of the Site and Surroundings	3
2.1	Software and method	3
2.2	Model	3
3	Noise Sources	5
4	Calculation	8

Table of Appendices

Appendix A, Detailed calculation results
Appendix B, Grid map

1 Preface

A free field noise model of the new Fjardaal Smelter in Iceland has been established. The purpose with the noise model is to determine the noise contribution from relevant noise sources and to rank the sources.

2 Mathematical Model of the Site and Surroundings

2.1 Software and method

A mathematical model of the overall project area has been designed as a 3-dimensional model, using the commercial noise prediction software SoundPLAN version 6.1. SoundPLAN is an expert system capable of predicting noise impact from different kinds of noise sources and using various national standards.

This model is based on the General Predicting Method on environmental noise from industrial plants, 1982. This General Predicting Method is the common Nordic standard and specified in the Icelandic guideline No. 933/1999.

2.2 Model

The mathematical model is based on the CAD drawings; *24956-000-P1-000-00001.dxf*, rev. 28-05-04 (plant layout) and *ffjardaal.dgn*, rev. 23-07-04 (building heights).

As a basis the digital ground model (DGM) has been developed for flat terrain. The DGM is used to vertically position all objects in the model.

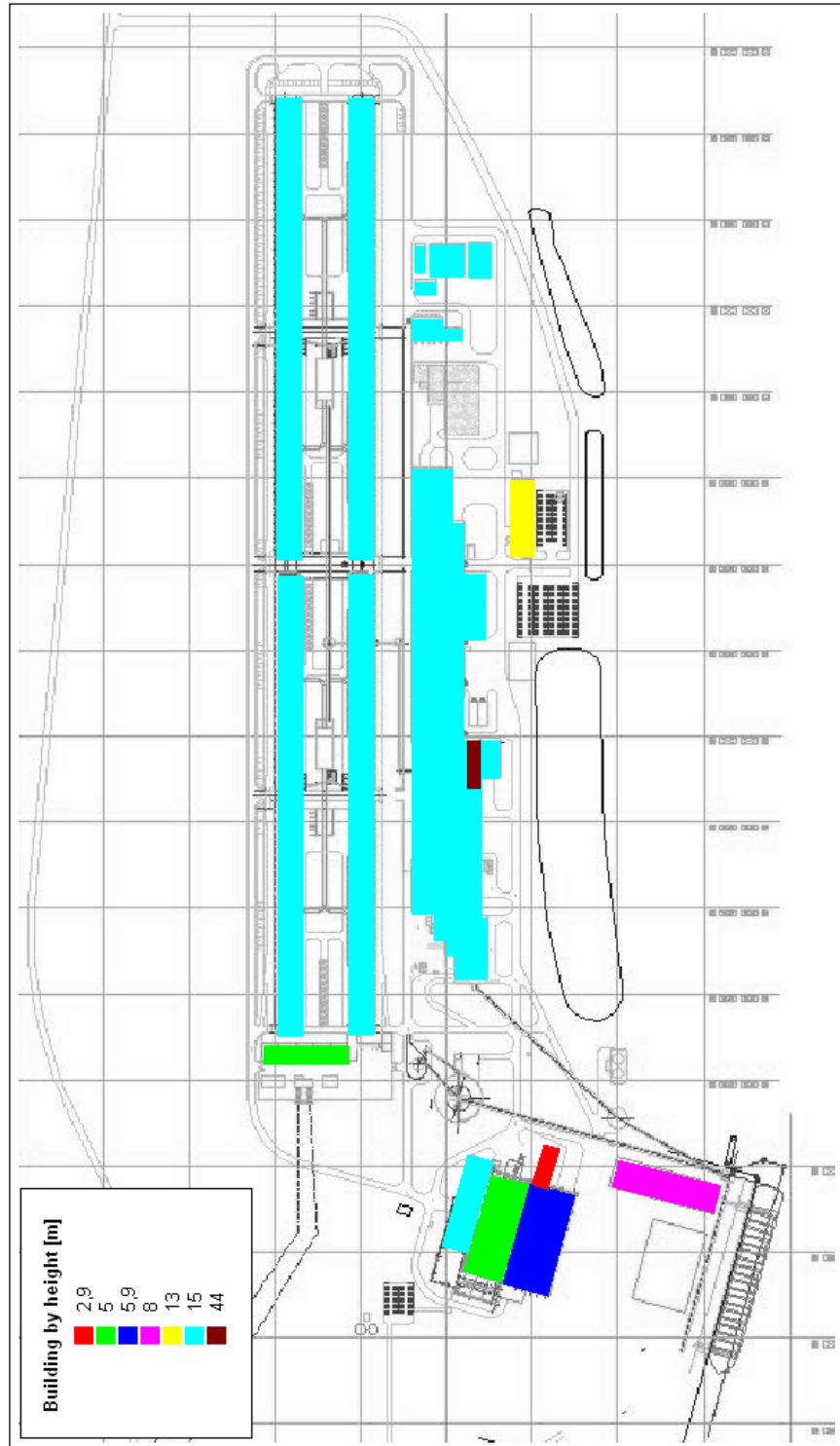
The mathematical model includes object types as listed:

- Building polygons to describe screening, reflections, etc.
- Noise sources
- Ground absorption/reflection describing the acoustical characteristics (impedance) of the surface
- Receiver points
- Calculation area

The model area is approximately 2 x 4 km.

2.2.1 Buildings

The model includes building polygons, which describe the location and height of buildings. The building locations and heights are shown in the drawing below.



3 Noise Sources

All noise sources are defined as one of the following types:

- Point sources
- Line sources
- Area sources

Each source definition includes a time histogram showing operational time during the three dayperiods and an A-weighted sound power spectrum in 1/1 octave bands from 63 - 8.000 Hz.

The noise sources have been divided into following groups:

1. GTC Stack (point source)
2. GTC Fans (point source)
3. Rectifiers (point source)
4. Casthouse fluid cooling (point source)
5. Ship unloader (point source)
7. Casthouse HVAC (point source)
9. Hot metal vehicles (line source)
10. Port vehicles (area source)
11. Electrode Plant (point source)

(Noise source 6. - Crucible cleaning and 8. - Compressor house was discussed, but was not found relevant)

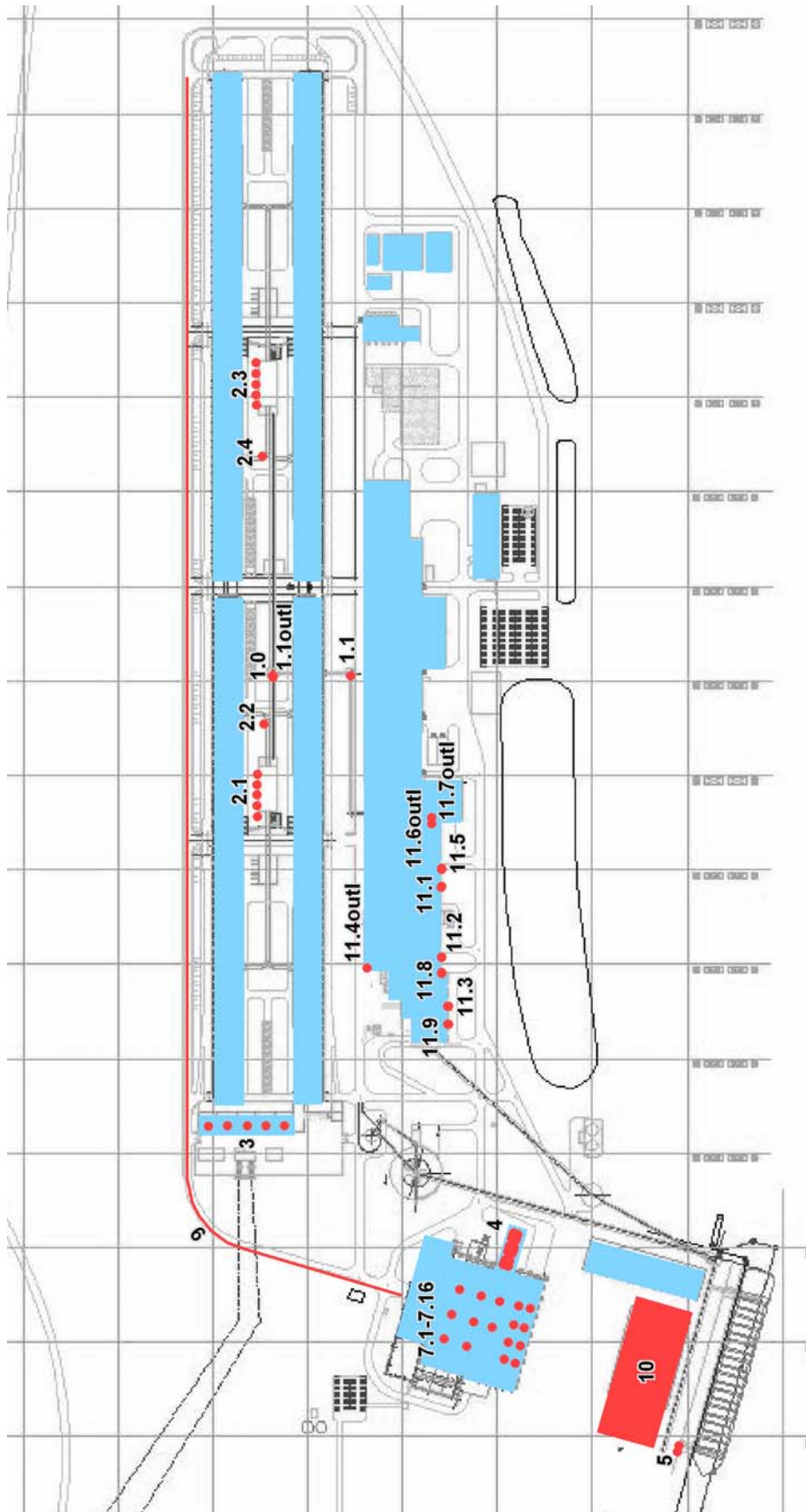
Source data have been collected by Bechtel from all the different suppliers and converted into sound power levels.

The source data is shown below:

Noise source	Elevation in meters (relative to ground level)	Number of sources	Operation time (%)			LwA per 1/1 octave band (center frequency)											LwA additional sources
			day	evening	night	63	125	250	500	1K	2K	4K	8K	LwA			
1.DOUTL	GTC stack, outlet	1	100	100	100	99	102	97	91	84	89	88	81	105			
1.1	Other fan into the stack	1	100	100	100	82	93	89	90	91	86	81	78	98			
1.10OUTL	Other fan, stack outlet	1	100	100	100	72	71	55	40	38	50	50	52	75			
2.1	West GTC Fans	5	100	100	100	63	72	77	77	62	52	44	30	81	Motor level 77 dB(A) and outlet silencer (line 6)		
2.2	West GTC Booster Fans	2	100	100	100	69	73	76	81	77	74	67	64	84			
2.3	East GTC Fans	5	100	100	100	63	72	77	77	62	52	44	30	81	Motor level 77 dB(A) and outlet silencer (line 6)		
2.4	East GTC Booster Fans	2	100	100	100	69	73	76	81	77	74	67	64	84			
3	Rectifiers	5	100	100	100	89	99	104	104	104	89	79	112	112	5 rectifier bays (data for each bay)		
4	Casthouse fluid cooling	18	100	100	100	79	88	92	93	94	89	83	75	99	3 units, each unit 6 fans		
5	Ship unloader, fan outlet	2	100	100	100	57	75	79	86	87	87	87	81	93	2 units		
7.1	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.2	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.3	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.4	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.5	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.6	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.7	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.8	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.9	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.10	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.11	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.12	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.13	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.14	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.15	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.16	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.17	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
7.18	Casthouse HVAC fans	1	100	100	100	68	76	79	80	80	76	70	64	88			
9	Hot metal vehicles	1	27	27	27	95	103	108	109	111	109	108	103	118			
10	Port vehicles	4	100	100	100	95	103	108	109	111	109	108	103	118			
11.1	Electrode Plant, Rodding Shop	2.0	100	100	100	81	91	95	94	93	90	84	73	100	441-MKB-0001		
11.10OUTL	Electrode Plant, Rodding Shop	16.0	100	100	100	81	94	100	99	98	96	90	79	100	441-MKB-0001 outlet		
11.2	Electrode Plant, Rodding Shop	2.0	100	100	100	54	67	78	80	83	81	76	70	92	441-MKB-0002		
11.20OUTL	Electrode Plant, Rodding Shop	16.0	100	100	100	54	67	78	80	83	81	76	70	92	441-MKB-0002 outlet		
11.3	Electrode Plant, Rodding Shop	2.0	100	100	100	54	67	78	80	83	81	76	70	92	441-MKB-0003		
11.30OUTL	Electrode Plant, Rodding Shop	16.0	100	100	100	54	67	78	80	83	81	76	70	92	441-MKB-0003 outlet		
11.4	Electrode Plant, Rodding Shop	2.0	100	100	100	58	73	86	98	91	90	85	79	100	441-MKB-0004		
11.40OUTL	Electrode Plant, Rodding Shop	16.0	100	100	100	58	73	86	98	91	90	85	79	100	441-MKB-0004 outlet		
11.5	Electrode Plant, Bath Process	2.0	100	100	100	81	91	95	94	93	90	84	73	100	442-MKB-0001		
11.50OUTL	Electrode Plant, Bath Process	20.0	100	100	100	81	93	99	98	97	95	89	78	100	442-MKB-0001 outlet		
11.6	Electrode Plant, Bath Process	45.0	100	100	100	80	80	84	94	91	91	88	81	100	442-MKB-0002		
11.60OUTL	Electrode Plant, Bath Process	45.0	100	100	100	80	80	84	94	91	91	88	81	100	442-MKB-0002 outlet		
11.7	Electrode Plant, Anode Butt re.	2.0	100	100	100	81	94	100	100	99	97	91	80	100	480-MKB-0001		
11.70OUTL	Electrode Plant, Anode Butt re.	16.0	100	100	100	81	94	100	100	99	97	91	80	100	480-MKB-0001 outlet		
11.8	Electrode Plant, Anode Butt re.	2.0	100	100	100	73	80	94	83	93	91	86	79	100	480-MKB-0001 outlet		
11.80OUTL	Electrode Plant, Anode Butt re.	16.0	100	100	100	73	80	94	83	93	91	86	79	100	480-MKB-0001 outlet		
11.9	Electrode Plant, Anode Butt re.	2.0	100	100	100	54	67	78	80	83	81	76	70	92	480-MKB-0002		
11.90OUTL	Electrode Plant, Anode Butt re.	19.0	100	100	100	54	67	78	80	83	81	76	70	92	480-MKB-0002 outlet		

As seen the operation time of each noise source are 100 % in each of the three periods (day, evening and night) except for source 9 where hot metal vehicles only have 71 journeys (equal to 27 % operation time per period).

The location of each noise source is shown below:



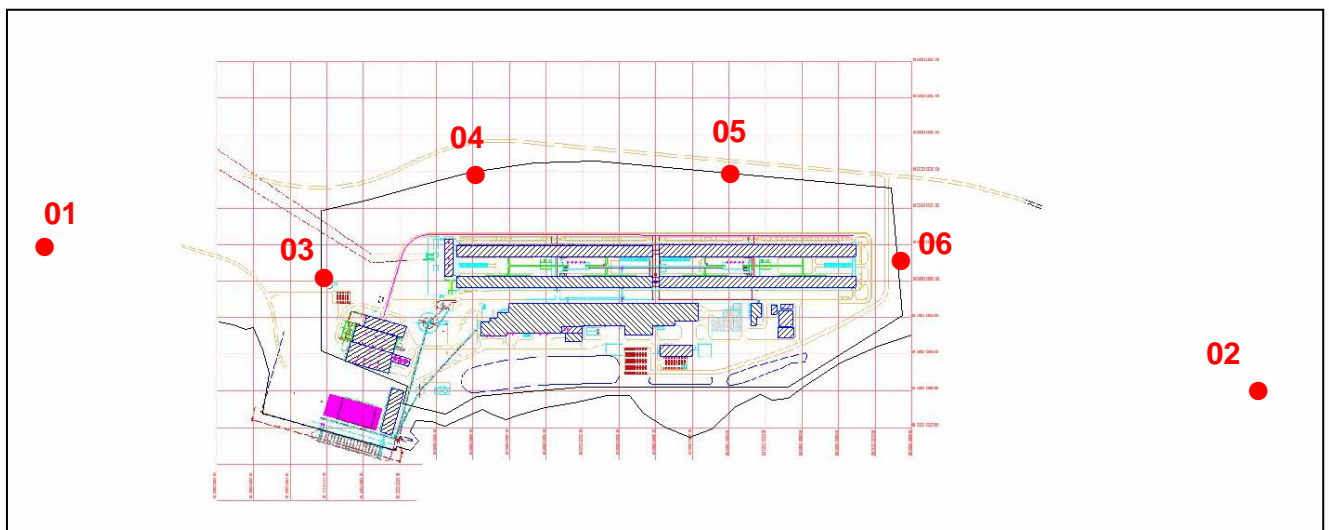
4 Calculation

The acoustical property of the ground surface is as default value set to acoustically hard within the plant area and soft (absorbing) outside. Areas with hard surface reflecting the sound is specified by definite polygons and related absorption coefficients.

Calculations are made 1.5 meters above terrain according to the Common Nordic Standard. The results are given as energy mean and A-weighted values.

The calculations are for a worst case situation, with all sources 100 % active in the three day periods, except for source 9 as described in section 3.

The receiver points are shown on the map below.



The results of the calculations (L_{Aeq}) in each receiver point are:

Receiver	Day [dB(A)]	Evening [dB(A)]	Night [dB(A)]
01 The Framnes Farm	50	50	50
02 The Holmar's Farm	37	37	37
03 Western site boundary	64	64	64
04 North-western site boundary	63	63	63
05 North-eastern site boundary	56	56	56
06 Eastern site boundary	50	50	50

Detailed calculation results showing contribution from each source can be seen in appendix A.

Calculation result shown as a grid map 1.5 meters above terrain can be seen in appendix B

Appendix A, Detailed calculation results

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
Receiver 01 Framnes Farm				
10 Port vehicle 1	Area	42,7	42,7	42,7
10 Port vehicle 2	Area	42,7	42,7	42,7
10 Port vehicle 3	Area	42,7	42,7	42,7
10 Port vehicle 4	Area	42,7	42,7	42,7
3 Rectifier	Point	36,5	36,5	36,5
3 Rectifier	Point	34,1	34,1	34,1
3 Rectifier	Point	34,1	34,1	34,1
3 Rectifier	Point	34,1	34,1	34,1
3 Rectifier	Point	34,1	34,1	34,1
9 Hot Metal Vehicle 1	Line	32,2	32,2	32,2
1.0OUTL GTC stack	Point	28,6	28,6	28,6
11.5OUTL 442-MKB-0001 outlet	Point	26,6	26,6	26,6
11.7OUTL 442-MKB-0003 outlet	Point	23,4	23,4	23,4
11.1OUTL 441-MKB-0001 outlet	Point	22,7	22,7	22,7
1.1 Other fan into the stack	Point	21,6	21,6	21,6
11.4OUTLET 441-MKB-0004	Point	21,5	21,5	21,5
11.2OUTL 441-MKB-0002	Point	21,4	21,4	21,4
11.9OUTL 460-MKB-0002 outlet	Point	20,7	20,7	20,7
11.3OUTL 441-MKB-0003	Point	20,6	20,6	20,6
11.8OUTL 460-MKB-0001	Point	20,0	20,0	20,0
4 Casthouse fluid cooling	Point	18,4	18,4	18,4
4 Casthouse fluid cooling	Point	18,2	18,2	18,2
4 Casthouse fluid cooling	Point	18,1	18,1	18,1
11.6OUTL 442-MKB-0002 outlet	Point	18,0	18,0	18,0
4 Casthouse fluid cooling	Point	17,9	17,9	17,9
4 Casthouse fluid cooling	Point	17,7	17,7	17,7
4 Casthouse fluid cooling	Point	17,5	17,5	17,5
4 Casthouse fluid cooling	Point	17,4	17,4	17,4
4 Casthouse fluid cooling	Point	17,3	17,3	17,3
4 Casthouse fluid cooling	Point	17,1	17,1	17,1
4 Casthouse fluid cooling	Point	17,1	17,1	17,1
4 Casthouse fluid cooling	Point	17,0	17,0	17,0
4 Casthouse fluid cooling	Point	16,9	16,9	16,9
4 Casthouse fluid cooling	Point	16,8	16,8	16,8
4 Casthouse fluid cooling	Point	16,7	16,7	16,7
5 Ship unloader, fan outlet	Point	16,6	16,6	16,6
4 Casthouse fluid cooling	Point	16,5	16,5	16,5
5 Ship unloader, fan outlet	Point	16,5	16,5	16,5
4 Casthouse fluid cooling	Point	16,4	16,4	16,4
4 Casthouse fluid cooling	Point	15,5	15,5	15,5
4 Casthouse fluid cooling	Point	15,0	15,0	15,0
7.10 Casthouse HVAC Fan	Point	11,8	11,8	11,8
7.14 Casthouse HVAC Fan	Point	11,7	11,7	11,7
7.11 Casthouse HVAC Fan	Point	11,7	11,7	11,7
7.15 Casthouse HVAC Fan	Point	11,7	11,7	11,7
7.13 Casthouse HVAC Fan	Point	11,7	11,7	11,7
7.8 Casthouse HVAC Fan	Point	11,6	11,6	11,6
7.12 Casthouse HVAC Fan	Point	11,6	11,6	11,6

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
7.2 Casthouse HVAC Fan	Point	11,2	11,2	11,2
7.5 Casthouse HVAC Fan	Point	11,2	11,2	11,2
7.7 Casthouse HVAC Fan	Point	11,2	11,2	11,2
7.1 Casthouse HVAC Fan	Point	11,1	11,1	11,1
7.3 Casthouse HVAC Fan	Point	11,1	11,1	11,1
7.6 Casthouse HVAC Fan	Point	11,1	11,1	11,1
7.4 Casthouse HVAC Fan	Point	11,1	11,1	11,1
7.9 Casthouse HVAC Fan	Point	11,1	11,1	11,1
7.16 Casthouse HVAC Fan	Point	11,1	11,1	11,1
11.1 441-MBK-0001	Point	6,4	6,4	6,4
2.2 West GTC Booster Fan	Point	6,0	6,0	6,0
2.4 East GTC Booster Fan	Point	4,2	4,2	4,2
2.1 West GTC Fans	Point	2,6	2,6	2,6
2.1 West GTC Fans	Point	2,6	2,6	2,6
2.1 West GTC Fans	Point	2,5	2,5	2,5
2.1 West GTC Fans	Point	2,4	2,4	2,4
2.1 West GTC Fans	Point	2,4	2,4	2,4
1.1 OUTL Other fan, stack outlet	Point	0,6	0,6	0,6
2.3 East GTC Fans	Point	0,2	0,2	0,2
2.3 East GTC Fans	Point	0,1	0,1	0,1
2.3 East GTC Fans	Point	0,1	0,1	0,1
2.3 East GTC Fans	Point	0,0	0,0	0,0
2.3 East GTC Fans	Point	0,0	0,0	0,0
11.8 460-MBK-0001	Point	-2,8	-2,8	-2,8
11.4 442-MBK-0001	Point	-3,7	-3,7	-3,7
11.2 441-MBK-0002	Point	-4,6	-4,6	-4,6
11.3 441-MBK-0003	Point	-5,0	-5,0	-5,0
11.9 460-MBK-0002	Point	-5,5	-5,5	-5,5
Receiver 02 Holmar's Farm				
1.0OUTL GTC stack	Point	27,6	27,6	27,6
10 Port vehicle 1	Area	26,4	26,4	26,4
10 Port vehicle 2	Area	26,4	26,4	26,4
10 Port vehicle 3	Area	26,4	26,4	26,4
10 Port vehicle 4	Area	26,4	26,4	26,4
3 Rectifier	Point	25,6	25,6	25,6
3 Rectifier	Point	25,6	25,6	25,6
11.7OUTL 442-MKB-0003 outlet	Point	23,3	23,3	23,3
9 Hot Metal Vehicle 1	Line	21,5	21,5	21,5
11.5OUTL 442-MKB-0001 outlet	Point	20,8	20,8	20,8
1.1 Other fan into the stack	Point	17,8	17,8	17,8
11.4OUTLET 441-MKB-0004	Point	17,3	17,3	17,3
11.1OUTL 441-MKB-0001 outlet	Point	17,1	17,1	17,1
11.2OUTL 441-MKB-0002	Point	16,4	16,4	16,4
3 Rectifier	Point	15,2	15,2	15,2
11.3OUTL 441-MKB-003	Point	15,0	15,0	15,0
11.6OUTL 442-MKB-0002 outlet	Point	15,0	15,0	15,0
11.9OUTL 460-MKB-0002 outlet	Point	14,9	14,9	14,9
11.8OUTL 460-MKB-0001	Point	14,9	14,9	14,9
4 Casthouse fluid cooling	Point	14,6	14,6	14,6

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
4 Casthouse fluid cooling	Point	14,5	14,5	14,5
4 Casthouse fluid cooling	Point	14,4	14,4	14,4
4 Casthouse fluid cooling	Point	14,2	14,2	14,2
4 Casthouse fluid cooling	Point	14,2	14,2	14,2
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	14,1	14,1	14,1
4 Casthouse fluid cooling	Point	13,4	13,4	13,4
4 Casthouse fluid cooling	Point	13,4	13,4	13,4
4 Casthouse fluid cooling	Point	13,2	13,2	13,2
4 Casthouse fluid cooling	Point	13,1	13,1	13,1
4 Casthouse fluid cooling	Point	12,3	12,3	12,3
4 Casthouse fluid cooling	Point	12,3	12,3	12,3
3 Rectifier	Point	12,3	12,3	12,3
3 Rectifier	Point	10,9	10,9	10,9
11.3 441-MBK-0003	Point	8,3	8,3	8,3
11.9 460-MBK-0002	Point	8,2	8,2	8,2
11.1 441-MBK-0001	Point	6,0	6,0	6,0
2.4 East GTC Booster Fan	Point	4,0	4,0	4,0
5 Ship unloader, fan outlet	Point	3,6	3,6	3,6
5 Ship unloader, fan outlet	Point	3,5	3,5	3,5
7.6 Casthouse HVAC Fan	Point	3,4	3,4	3,4
11.8 460-MBK-0001	Point	2,0	2,0	2,0
7.9 Casthouse HVAC Fan	Point	1,8	1,8	1,8
7.13 Casthouse HVAC Fan	Point	1,8	1,8	1,8
7.4 Casthouse HVAC Fan	Point	1,7	1,7	1,7
7.10 Casthouse HVAC Fan	Point	1,5	1,5	1,5
7.14 Casthouse HVAC Fan	Point	1,5	1,5	1,5
7.7 Casthouse HVAC Fan	Point	1,4	1,4	1,4
7.5 Casthouse HVAC Fan	Point	1,4	1,4	1,4
7.2 Casthouse HVAC Fan	Point	1,3	1,3	1,3
7.11 Casthouse HVAC Fan	Point	1,3	1,3	1,3
7.15 Casthouse HVAC Fan	Point	1,3	1,3	1,3
7.8 Casthouse HVAC Fan	Point	0,9	0,9	0,9
7.12 Casthouse HVAC Fan	Point	0,9	0,9	0,9
7.16 Casthouse HVAC Fan	Point	0,9	0,9	0,9
7.3 Casthouse HVAC Fan	Point	0,8	0,8	0,8
2.3 East GTC Fans	Point	0,3	0,3	0,3
1.1 OUTL Other fan, stack outlet	Point	-0,4	-0,4	-0,4
2.3 East GTC Fans	Point	-0,5	-0,5	-0,5
2.1 West GTC Fans	Point	-0,5	-0,5	-0,5
2.1 West GTC Fans	Point	-0,8	-0,8	-0,8
2.1 West GTC Fans	Point	-0,8	-0,8	-0,8
2.1 West GTC Fans	Point	-0,8	-0,8	-0,8
2.1 West GTC Fans	Point	-0,8	-0,8	-0,8

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
2.3 East GTC Fans	Point	-1,7	-1,7	-1,7
2.3 East GTC Fans	Point	-1,8	-1,8	-1,8
11.2 441-MBK-0002	Point	-3,0	-3,0	-3,0
2.3 East GTC Fans	Point	-3,3	-3,3	-3,3
7.1 Casthouse HVAC Fan	Point	-3,4	-3,4	-3,4
2.2 West GTC Booster Fan	Point	-4,8	-4,8	-4,8
11.4 442-MBK-0001	Point	-7,0	-7,0	-7,0
Receiver 03 Western site boundary				
10 Port vehicle 1	Area	55,8	55,8	55,8
10 Port vehicle 2	Area	55,8	55,8	55,8
10 Port vehicle 3	Area	55,8	55,8	55,8
10 Port vehicle 4	Area	55,8	55,8	55,8
3 Rectifier	Point	53,0	53,0	53,0
3 Rectifier	Point	51,0	51,0	51,0
3 Rectifier	Point	51,0	51,0	51,0
3 Rectifier	Point	51,0	51,0	51,0
3 Rectifier	Point	50,8	50,8	50,8
9 Hot Metal Vehicle 1	Line	49,5	49,5	49,5
11.5OUTL 442-MKB-0001 outlet	Point	39,8	39,8	39,8
11.7OUTL 442-MKB-0003 outlet	Point	39,1	39,1	39,1
11.4OUTLET 441-MKB-0004	Point	38,4	38,4	38,4
1.0OUTL GTC stack	Point	37,7	37,7	37,7
11.1OUTL 441-MKB-0001 outlet	Point	36,3	36,3	36,3
11.9OUTL 460-MKB-0002 outlet	Point	35,9	35,9	35,9
11.2OUTL 441-MKB-0002	Point	35,7	35,7	35,7
11.3OUTL 441-MKB-0003	Point	35,5	35,5	35,5
1.1 Other fan into the stack	Point	34,6	34,6	34,6
11.8OUTL 460-MKB-0001	Point	34,3	34,3	34,3
7.4 Casthouse HVAC Fan	Point	33,6	33,6	33,6
7.5 Casthouse HVAC Fan	Point	33,2	33,2	33,2
7.6 Casthouse HVAC Fan	Point	32,5	32,5	32,5
7.1 Casthouse HVAC Fan	Point	31,7	31,7	31,7
11.6OUTL 442-MKB-0002 outlet	Point	31,1	31,1	31,1
7.9 Casthouse HVAC Fan	Point	29,9	29,9	29,9
7.7 Casthouse HVAC Fan	Point	29,7	29,7	29,7
7.10 Casthouse HVAC Fan	Point	29,6	29,6	29,6
7.13 Casthouse HVAC Fan	Point	29,4	29,4	29,4
7.14 Casthouse HVAC Fan	Point	29,4	29,4	29,4
7.11 Casthouse HVAC Fan	Point	29,3	29,3	29,3
7.15 Casthouse HVAC Fan	Point	29,3	29,3	29,3
7.8 Casthouse HVAC Fan	Point	29,0	29,0	29,0
7.12 Casthouse HVAC Fan	Point	29,0	29,0	29,0
4 Casthouse fluid cooling	Point	29,0	29,0	29,0
4 Casthouse fluid cooling	Point	29,0	29,0	29,0
4 Casthouse fluid cooling	Point	29,0	29,0	29,0
7.16 Casthouse HVAC Fan	Point	28,9	28,9	28,9
4 Casthouse fluid cooling	Point	28,5	28,5	28,5
4 Casthouse fluid cooling	Point	28,5	28,5	28,5
4 Casthouse fluid cooling	Point	28,5	28,5	28,5

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
4 Casthouse fluid cooling	Point	28,5	28,5	28,5
4 Casthouse fluid cooling	Point	28,4	28,4	28,4
4 Casthouse fluid cooling	Point	28,3	28,3	28,3
4 Casthouse fluid cooling	Point	27,9	27,9	27,9
4 Casthouse fluid cooling	Point	27,8	27,8	27,8
5 Ship unloader, fan outlet	Point	26,7	26,7	26,7
5 Ship unloader, fan outlet	Point	26,7	26,7	26,7
4 Casthouse fluid cooling	Point	24,5	24,5	24,5
2.2 West GTC Booster Fan	Point	21,3	21,3	21,3
2.1 West GTC Fans	Point	19,6	19,6	19,6
2.1 West GTC Fans	Point	19,4	19,4	19,4
2.1 West GTC Fans	Point	19,3	19,3	19,3
2.1 West GTC Fans	Point	19,2	19,2	19,2
2.1 West GTC Fans	Point	19,0	19,0	19,0
4 Casthouse fluid cooling	Point	16,3	16,3	16,3
4 Casthouse fluid cooling	Point	16,3	16,3	16,3
11.1 441-MBK-0001	Point	15,8	15,8	15,8
2.4 East GTC Booster Fan	Point	15,6	15,6	15,6
4 Casthouse fluid cooling	Point	15,5	15,5	15,5
4 Casthouse fluid cooling	Point	15,5	15,5	15,5
4 Casthouse fluid cooling	Point	14,5	14,5	14,5
4 Casthouse fluid cooling	Point	14,3	14,3	14,3
7.2 Casthouse HVAC Fan	Point	12,6	12,6	12,6
2.3 East GTC Fans	Point	12,4	12,4	12,4
2.3 East GTC Fans	Point	12,3	12,3	12,3
2.3 East GTC Fans	Point	12,2	12,2	12,2
7.3 Casthouse HVAC Fan	Point	12,1	12,1	12,1
2.3 East GTC Fans	Point	12,1	12,1	12,1
2.3 East GTC Fans	Point	12,0	12,0	12,0
11.8 460-MBK-0001	Point	9,8	9,8	9,8
11.9 460-MBK-0002	Point	8,1	8,1	8,1
11.3 441-MBK-0003	Point	7,9	7,9	7,9
1.1 OUTL Other fan, stack outlet	Point	7,9	7,9	7,9
11.2 441-MBK-0002	Point	7,2	7,2	7,2
11.4 442-MBK-0001	Point	6,2	6,2	6,2
Receiver 04 Northwestern site boundary				
3 Rectifier	Point	55,9	55,9	55,9
3 Rectifier	Point	55,2	55,2	55,2
3 Rectifier	Point	54,6	54,6	54,6
3 Rectifier	Point	54,1	54,1	54,1
3 Rectifier	Point	53,3	53,3	53,3
9 Hot Metal Vehicle 1	Line	52,5	52,5	52,5
10 Port vehicle 1	Area	41,5	41,5	41,5
10 Port vehicle 2	Area	41,5	41,5	41,5
10 Port vehicle 3	Area	41,5	41,5	41,5
10 Port vehicle 4	Area	41,5	41,5	41,5
1.0OUTL GTC stack	Point	40,7	40,7	40,7
11.7OUTL 442-MKB-0003 outlet	Point	40,3	40,3	40,3
11.4OUTLET 441-MKB-0004	Point	38,3	38,3	38,3

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
11.5OUTL 442-MKB-0001 outlet	Point	38,2	38,2	38,2
11.9OUTL 460-MKB-0002 outlet	Point	34,7	34,7	34,7
4 Casthouse fluid cooling	Point	34,7	34,7	34,7
4 Casthouse fluid cooling	Point	34,7	34,7	34,7
11.3OUTL 441-MKB-003	Point	34,7	34,7	34,7
4 Casthouse fluid cooling	Point	34,7	34,7	34,7
4 Casthouse fluid cooling	Point	34,6	34,6	34,6
4 Casthouse fluid cooling	Point	34,6	34,6	34,6
4 Casthouse fluid cooling	Point	34,6	34,6	34,6
4 Casthouse fluid cooling	Point	33,3	33,3	33,3
4 Casthouse fluid cooling	Point	33,3	33,3	33,3
11.1OUTL 441-MKB-0001 outlet	Point	33,1	33,1	33,1
11.6OUTL 442-MKB-0002 outlet	Point	32,6	32,6	32,6
11.2OUTL 441-MKB-0002	Point	32,4	32,4	32,4
4 Casthouse fluid cooling	Point	32,3	32,3	32,3
4 Casthouse fluid cooling	Point	32,2	32,2	32,2
4 Casthouse fluid cooling	Point	32,2	32,2	32,2
4 Casthouse fluid cooling	Point	32,2	32,2	32,2
4 Casthouse fluid cooling	Point	32,2	32,2	32,2
4 Casthouse fluid cooling	Point	32,1	32,1	32,1
4 Casthouse fluid cooling	Point	32,1	32,1	32,1
4 Casthouse fluid cooling	Point	32,1	32,1	32,1
11.8OUTL 460-MKB-0001	Point	30,5	30,5	30,5
4 Casthouse fluid cooling	Point	28,9	28,9	28,9
4 Casthouse fluid cooling	Point	28,6	28,6	28,6
1.1 Other fan into the stack	Point	22,6	22,6	22,6
5 Ship unloader, fan outlet	Point	21,1	21,1	21,1
5 Ship unloader, fan outlet	Point	21,0	21,0	21,0
1.1 OUTL Other fan, stack outlet	Point	11,5	11,5	11,5
2.2 West GTC Booster Fan	Point	9,5	9,5	9,5
7.16 Casthouse HVAC Fan	Point	8,6	8,6	8,6
7.15 Casthouse HVAC Fan	Point	8,5	8,5	8,5
7.14 Casthouse HVAC Fan	Point	8,4	8,4	8,4
7.13 Casthouse HVAC Fan	Point	8,3	8,3	8,3
7.12 Casthouse HVAC Fan	Point	8,1	8,1	8,1
7.11 Casthouse HVAC Fan	Point	8,1	8,1	8,1
7.10 Casthouse HVAC Fan	Point	7,9	7,9	7,9
7.9 Casthouse HVAC Fan	Point	7,9	7,9	7,9
7.8 Casthouse HVAC Fan	Point	7,7	7,7	7,7
2.1 West GTC Fans	Point	7,4	7,4	7,4
7.7 Casthouse HVAC Fan	Point	7,4	7,4	7,4
2.1 West GTC Fans	Point	7,3	7,3	7,3
2.1 West GTC Fans	Point	7,2	7,2	7,2
2.1 West GTC Fans	Point	7,2	7,2	7,2
2.1 West GTC Fans	Point	7,1	7,1	7,1
2.4 East GTC Booster Fan	Point	6,4	6,4	6,4
2.3 East GTC Fans	Point	5,4	5,4	5,4
7.6 Casthouse HVAC Fan	Point	5,3	5,3	5,3
2.3 East GTC Fans	Point	5,3	5,3	5,3

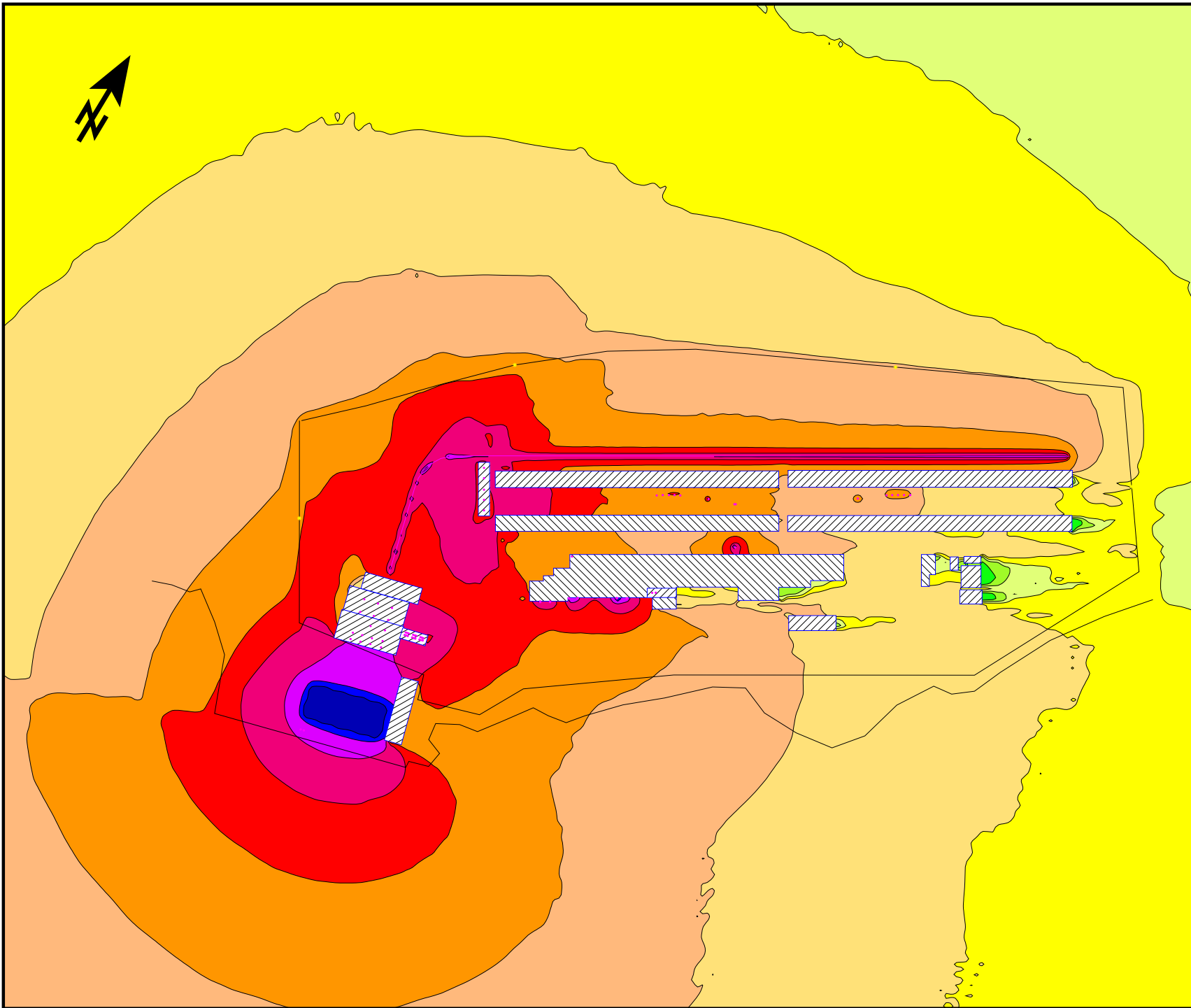
Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
2.3 East GTC Fans	Point	5,2	5,2	5,2
7.5 Casthouse HVAC Fan	Point	5,2	5,2	5,2
2.3 East GTC Fans	Point	5,2	5,2	5,2
2.3 East GTC Fans	Point	5,0	5,0	5,0
7.4 Casthouse HVAC Fan	Point	5,0	5,0	5,0
7.3 Casthouse HVAC Fan	Point	3,6	3,6	3,6
11.1 441-MBK-0001	Point	3,5	3,5	3,5
7.1 Casthouse HVAC Fan	Point	3,5	3,5	3,5
7.2 Casthouse HVAC Fan	Point	3,3	3,3	3,3
11.8 460-MBK-0001	Point	-2,7	-2,7	-2,7
11.9 460-MBK-0002	Point	-6,7	-6,7	-6,7
11.3 441-MBK-0003	Point	-6,8	-6,8	-6,8
11.2 441-MBK-0002	Point	-6,8	-6,8	-6,8
11.4 442-MBK-0001	Point	-7,0	-7,0	-7,0
Receiver 05 Northeastern site boundary				
9 Hot Metal Vehicle 1	Line	53,9	53,9	53,9
1.0OUTL GTC stack	Point	43,6	43,6	43,6
3 Rectifier	Point	41,1	41,1	41,1
10 Port vehicle 1	Area	40,5	40,5	40,5
10 Port vehicle 2	Area	40,5	40,5	40,5
10 Port vehicle 3	Area	40,5	40,5	40,5
10 Port vehicle 4	Area	40,5	40,5	40,5
3 Rectifier	Point	39,8	39,8	39,8
11.7OUTL 442-MKB-0003 outlet	Point	39,2	39,2	39,2
3 Rectifier	Point	36,5	36,5	36,5
3 Rectifier	Point	36,3	36,3	36,3
11.5OUTL 442-MKB-0001 outlet	Point	36,3	36,3	36,3
11.1OUTL 441-MKB-0001 outlet	Point	32,9	32,9	32,9
11.4OUTLET 441-MKB-0004	Point	32,3	32,3	32,3
11.2OUTL 441-MKB-0002	Point	32,3	32,3	32,3
11.6OUTL 442-MKB-0002 outlet	Point	31,3	31,3	31,3
11.8OUTL 460-MKB-0001	Point	30,5	30,5	30,5
11.3OUTL 441-MKB-003	Point	30,5	30,5	30,5
11.9OUTL 460-MKB-0002 outlet	Point	30,3	30,3	30,3
4 Casthouse fluid cooling	Point	29,6	29,6	29,6
4 Casthouse fluid cooling	Point	29,0	29,0	29,0
4 Casthouse fluid cooling	Point	28,9	28,9	28,9
4 Casthouse fluid cooling	Point	28,9	28,9	28,9
3 Rectifier	Point	27,8	27,8	27,8
4 Casthouse fluid cooling	Point	27,3	27,3	27,3
4 Casthouse fluid cooling	Point	27,3	27,3	27,3
4 Casthouse fluid cooling	Point	27,2	27,2	27,2
4 Casthouse fluid cooling	Point	27,2	27,2	27,2
4 Casthouse fluid cooling	Point	27,1	27,1	27,1
4 Casthouse fluid cooling	Point	27,0	27,0	27,0
4 Casthouse fluid cooling	Point	27,0	27,0	27,0
4 Casthouse fluid cooling	Point	26,9	26,9	26,9
4 Casthouse fluid cooling	Point	26,8	26,8	26,8
4 Casthouse fluid cooling	Point	26,7	26,7	26,7

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
4 Casthouse fluid cooling	Point	26,7	26,7	26,7
4 Casthouse fluid cooling	Point	26,6	26,6	26,6
4 Casthouse fluid cooling	Point	26,3	26,3	26,3
4 Casthouse fluid cooling	Point	26,3	26,3	26,3
1.1 Other fan into the stack	Point	21,6	21,6	21,6
5 Ship unloader, fan outlet	Point	16,3	16,3	16,3
5 Ship unloader, fan outlet	Point	16,2	16,2	16,2
7.6 Casthouse HVAC Fan	Point	14,5	14,5	14,5
7.15 Casthouse HVAC Fan	Point	14,5	14,5	14,5
7.12 Casthouse HVAC Fan	Point	14,5	14,5	14,5
7.11 Casthouse HVAC Fan	Point	14,4	14,4	14,4
7.16 Casthouse HVAC Fan	Point	14,4	14,4	14,4
7.14 Casthouse HVAC Fan	Point	14,3	14,3	14,3
7.10 Casthouse HVAC Fan	Point	14,2	14,2	14,2
7.13 Casthouse HVAC Fan	Point	14,1	14,1	14,1
7.8 Casthouse HVAC Fan	Point	14,0	14,0	14,0
1.1 OUTL Other fan, stack outlet	Point	13,9	13,9	13,9
2.4 East GTC Booster Fan	Point	12,0	12,0	12,0
2.2 West GTC Booster Fan	Point	10,3	10,3	10,3
2.3 East GTC Fans	Point	9,5	9,5	9,5
2.3 East GTC Fans	Point	9,5	9,5	9,5
2.3 East GTC Fans	Point	9,5	9,5	9,5
2.3 East GTC Fans	Point	9,5	9,5	9,5
2.3 East GTC Fans	Point	9,5	9,5	9,5
2.1 West GTC Fans	Point	7,6	7,6	7,6
2.1 West GTC Fans	Point	7,6	7,6	7,6
2.1 West GTC Fans	Point	7,5	7,5	7,5
2.1 West GTC Fans	Point	7,5	7,5	7,5
2.1 West GTC Fans	Point	7,4	7,4	7,4
11.8 460-MBK-0001	Point	6,5	6,5	6,5
7.9 Casthouse HVAC Fan	Point	5,4	5,4	5,4
11.2 441-MBK-0002	Point	4,4	4,4	4,4
7.7 Casthouse HVAC Fan	Point	3,9	3,9	3,9
11.3 441-MBK-0003	Point	3,8	3,8	3,8
11.1 441-MBK-0001	Point	3,7	3,7	3,7
11.9 460-MBK-0002	Point	3,7	3,7	3,7
7.5 Casthouse HVAC Fan	Point	1,5	1,5	1,5
7.4 Casthouse HVAC Fan	Point	1,4	1,4	1,4
7.3 Casthouse HVAC Fan	Point	-1,2	-1,2	-1,2
7.2 Casthouse HVAC Fan	Point	-1,5	-1,5	-1,5
7.1 Casthouse HVAC Fan	Point	-1,7	-1,7	-1,7
11.4 442-MBK-0001	Point	-6,5	-6,5	-6,5
Receiver 06 Eastern site boundary				
9 Hot Metal Vehicle 1	Line	46,8	46,8	46,8
3 Rectifier	Point	39,8	39,8	39,8
3 Rectifier	Point	39,8	39,8	39,8
1.0OUTL GTC stack	Point	39,1	39,1	39,1
11.7OUTL 442-MKB-0003 outlet	Point	37,9	37,9	37,9
3 Rectifier	Point	36,7	36,7	36,7

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
11.4OUTLET 441-MKB-0004	Point	31,9	31,9	31,9
11.2OUTL 441-MKB-0002	Point	30,6	30,6	30,6
10 Port vehicle 1	Area	29,7	29,7	29,7
10 Port vehicle 2	Area	29,7	29,7	29,7
10 Port vehicle 3	Area	29,7	29,7	29,7
10 Port vehicle 4	Area	29,7	29,7	29,7
11.6OUTL 442-MKB-0002 outlet	Point	29,6	29,6	29,6
11.3OUTL 441-MKB-003	Point	29,0	29,0	29,0
11.8OUTL 460-MKB-0001	Point	28,8	28,8	28,8
11.9OUTL 460-MKB-0002 outlet	Point	28,8	28,8	28,8
3 Rectifier	Point	28,3	28,3	28,3
4 Casthouse fluid cooling	Point	27,7	27,7	27,7
2.3 East GTC Fans	Point	26,0	26,0	26,0
2.4 East GTC Booster Fan	Point	25,9	25,9	25,9
2.3 East GTC Fans	Point	25,7	25,7	25,7
2.3 East GTC Fans	Point	25,5	25,5	25,5
4 Casthouse fluid cooling	Point	25,4	25,4	25,4
4 Casthouse fluid cooling	Point	25,4	25,4	25,4
4 Casthouse fluid cooling	Point	25,3	25,3	25,3
4 Casthouse fluid cooling	Point	25,3	25,3	25,3
2.3 East GTC Fans	Point	25,3	25,3	25,3
4 Casthouse fluid cooling	Point	25,2	25,2	25,2
1.1 Other fan into the stack	Point	25,1	25,1	25,1
4 Casthouse fluid cooling	Point	25,1	25,1	25,1
4 Casthouse fluid cooling	Point	24,6	24,6	24,6
4 Casthouse fluid cooling	Point	24,2	24,2	24,2
4 Casthouse fluid cooling	Point	24,0	24,0	24,0
2.3 East GTC Fans	Point	23,8	23,8	23,8
2.2 West GTC Booster Fan	Point	19,2	19,2	19,2
2.1 West GTC Fans	Point	15,8	15,8	15,8
2.1 West GTC Fans	Point	15,7	15,7	15,7
2.1 West GTC Fans	Point	15,6	15,6	15,6
2.1 West GTC Fans	Point	15,5	15,5	15,5
2.1 West GTC Fans	Point	15,3	15,3	15,3
11.5OUTL 442-MKB-0001 outlet	Point	14,3	14,3	14,3
7.5 Casthouse HVAC Fan	Point	13,8	13,8	13,8
7.11 Casthouse HVAC Fan	Point	13,6	13,6	13,6
7.10 Casthouse HVAC Fan	Point	13,5	13,5	13,5
7.9 Casthouse HVAC Fan	Point	13,5	13,5	13,5
7.14 Casthouse HVAC Fan	Point	13,4	13,4	13,4
7.13 Casthouse HVAC Fan	Point	13,3	13,3	13,3
7.8 Casthouse HVAC Fan	Point	13,3	13,3	13,3
7.6 Casthouse HVAC Fan	Point	13,2	13,2	13,2
7.12 Casthouse HVAC Fan	Point	13,1	13,1	13,1
7.7 Casthouse HVAC Fan	Point	13,1	13,1	13,1
3 Rectifier	Point	13,0	13,0	13,0
7.15 Casthouse HVAC Fan	Point	12,9	12,9	12,9
11.1 441-MBK-0001	Point	11,6	11,6	11,6
11.1OUTL 441-MKB-0001 outlet	Point	10,7	10,7	10,7

Source	SrcType	LAeq, 8h dB(A)	LAeq, 1h dB(A)	LAeq, 0,5h dB(A)
1.1 OUTL Other fan, stack outlet	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	9,0	9,0	9,0
4 Casthouse fluid cooling	Point	8,9	8,9	8,9
5 Ship unloader, fan outlet	Point	7,9	7,9	7,9
5 Ship unloader, fan outlet	Point	7,7	7,7	7,7
7.4 Casthouse HVAC Fan	Point	3,2	3,2	3,2
11.4 442-MBK-0001	Point	2,6	2,6	2,6
11.3 441-MBK-0003	Point	1,3	1,3	1,3
7.3 Casthouse HVAC Fan	Point	-0,2	-0,2	-0,2
7.2 Casthouse HVAC Fan	Point	-0,4	-0,4	-0,4
7.1 Casthouse HVAC Fan	Point	-0,6	-0,6	-0,6
11.8 460-MBK-0001	Point	-1,8	-1,8	-1,8
7.16 Casthouse HVAC Fan	Point	-2,8	-2,8	-2,8
11.9 460-MBK-0002	Point	-4,8	-4,8	-4,8
11.2 441-MBK-0002	Point	-5,8	-5,8	-5,8

Appendix B, Grid map



Fjardaal sf
Fjardaal Smelter Project

Free Field model
Initial run

22-12-2004/RSK

Signs and symbols

- Point source
- Line source
- Area source
- Main building

Noise level

L_{Aeq}, 8h
in dB(A)

	<= 25
	25 < <= 30
	30 < <= 35
	35 < <= 40
	40 < <= 45
	45 < <= 50
	50 < <= 55
	55 < <= 60
	60 < <= 65
	65 < <= 70
	70 < <= 75
	75 < <= 80
	80 < <= 85
	85 <

Scale 1:10000



COWI