Design Value Modeling Analysis in Support of the Revision to the Herculaneum, Missouri Lead SIP

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1.0 Introduction

1.1 Project Description

The Doe Run Company operates a primary lead smelter in Herculaneum, Missouri, located approximately 25 miles south of St. Louis, Missouri, adjacent to the Mississippi River. The city of Herculaneum was designated as non-attainment for lead in 1991. The Missouri Department of Natural Resources submitted a revised SIP in 1994, which failed to meet the quarterly lead National Ambient Air Quality Standard (NAAQS). An additional SIP revision was submitted in 2001, which established an attainment date of August 14, 2002. Following the August 2002 attainment date, lead monitoring in Herculaneum indicated that the lead NAAQS was met for ten consecutive quarters. However, measured lead concentrations at the Broad Street monitor site exceeded the lead standard for the first three quarters of 2005. Violations have also occurred in the 1^{st} and 3rd quarters during 2006. Based on these violations of the lead NAAQS, the Missouri lead SIP must be revised so the Herculaneum area will be in attainment of the lead standard.

An integral part of developing the revision to the lead SIP is the development of the ambient dispersion modeling study. The purpose of this report is to discuss in detail the methodology that has been used in the development of the design value atmospheric dispersion modeling analysis. The report has been broken out into six sections. The first section provides an introduction and brief overview of the project and facility. The second section provides a summary of the lead emissions included in the analysis. The meteorological data and compilation methodology has been documented in section three and the model input parameters have been discussed in section four. The model performance evaluation has been provide in section 5 and the results of the analysis have been summarized in section 6. In order to make the report as “readable” as possible, all tables and figures have been included at the end of each section.

In general, this study relies on emission testing results and modeling methodology utilized in the last State Implementation Plan revision (specifically the attainment demonstration portion). The previously approved documents should be consulted for background information and reference purposes. These technical reference documents were developed by Shell Engineering and Missouri Department of Natural Resources staff and were subsequently reviewed by Environmental Protection Agency Region VII staff. This review resulted in refinements and improvements of the methodology and documentation for the project.

1.2 Facility Description

As previously mentioned, the smelter is located in Herculaneum, Missouri. A map showing the general location of the facility has been provided as Figure 1-1 and the general facility layout has been depicted in Figure 1-2.

Lead concentrate, which contains approximately 75% lead by weight, is delivered to the facility by truck. The trucks currently come down main street and enter on the south end of the plant north of the strip rolling mill. The trucks dump the concentrate into a hopper and the material is then conveyed to a storage pile. The concentrate is then picked up using a front end loader and dumped into a railcar. The railcar transports the concentrate to the rotary dumper where it is unloaded and transferred to the mixing bins. The concentrate, secondary feed constituents, and return sinter are then crushed and mixed before being sent to the sinter machine. The material coming off of the sinter machine is screened. The overs (sinter) are crushed using a smooth roll crusher (in the sinter plant) and are then ready to be fed to the blast furnace. The fines (material that needs additional contact time on the sinter machine) are cooled and crushed before returning to the sinter machine for additional processing. The fines drop from the screen to a conveyor that feeds the sinter cooler. The cooled sinter then drops onto the CV-30 belt that fills the 130 ton return fines bin. The CV-37A belt transports the fines from the bin to the smooth roll crusher which feeds the CV-37B belt. Material on the CV-37B belt puts the material back to the sinter machine feed line.

The sintered material, which contains approximately 50% lead, is mixed with coke and fed to the blast furnace. Molten lead exits the bottom of the blast furnace and is transferred to the drossing plant in pots using overhead cranes. Slag is also tapped off of the blast furnace. The slag is granulated and then is either used as a feedstock to the sinter machine or is hauled to storage.

In the drossing department, the molten lead is cooled and impurities are skimmed from the surface. The lead is approximately 97% pure when it exits the drossing plant for the refinery. In the refinery, the remaining trace amounts of impurities are removed producing a refined lead that is greater than 99.999% pure. The lead is then sent to either the casting machine or the strip rolling mill to put it into its final form.

Figure 1-1. General Facility Location

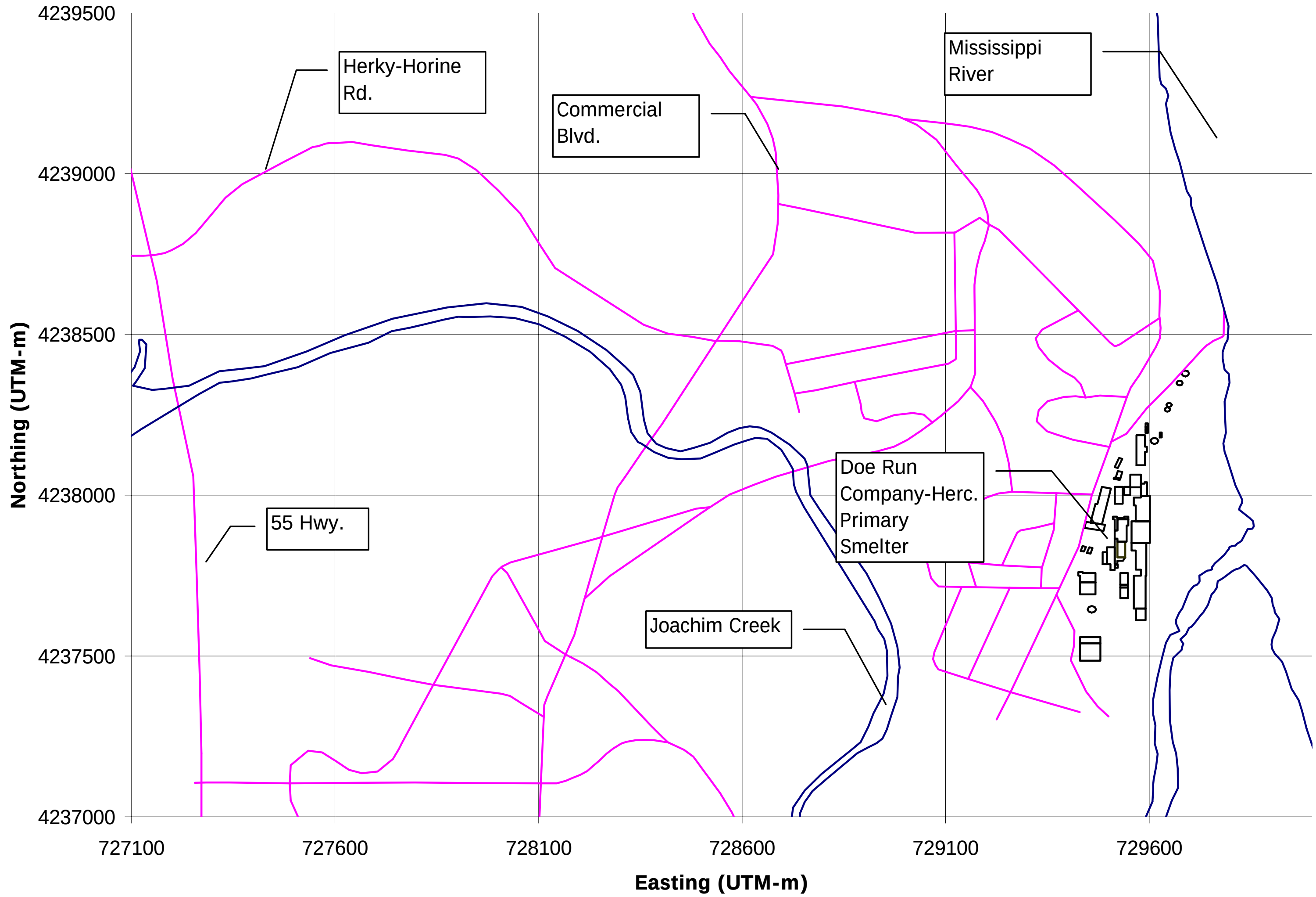
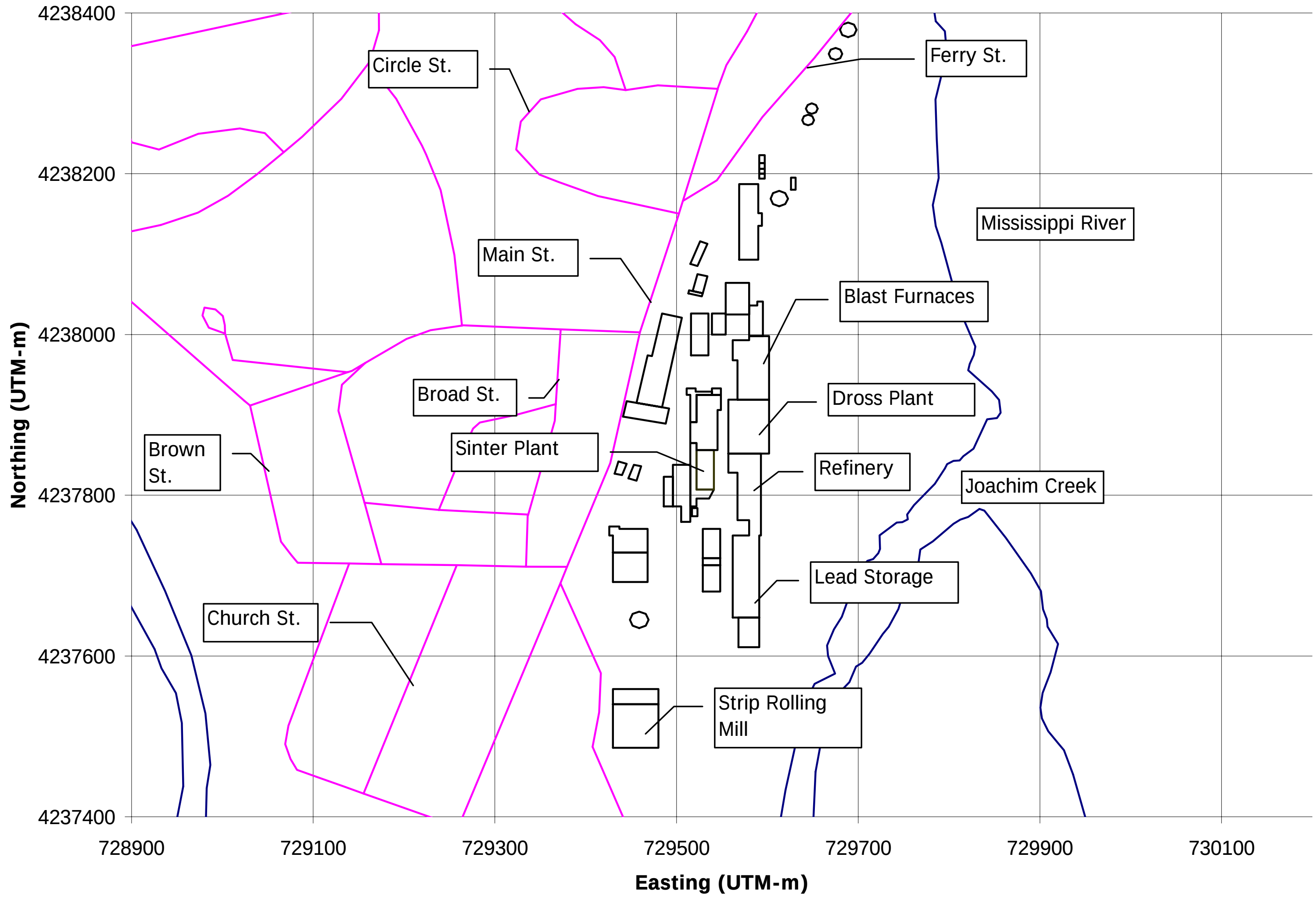


Figure 1-2. General Facility Layout



2.0 Lead Emissions

Emission estimates were required for two scenarios:

1. The actual hourly emissions for the year of 2005 and
2. The maximum hourly emissions for use in the design value and control strategy analyses.

The 2005 actual hourly emissions were modeled for all days that on-site meteorological data and measured ambient lead concentrations near the facility existed. The results of this analysis were then used to determine how well the model predicted the ambient lead concentrations near the smelter. If the actual value analysis is able to replicate the measured concentrations, additional confidence can be placed on the results of the design value analysis which is used in the development of the control strategy.

The design value lead emissions have been summarized for each source in Table 2-1 and the emission factors have been documented in Table 2-2. In general, the actual value emissions are based on daily production records at the facility and were modeled based on the "average" temporal profile given in Table 2-1. For the dispersion modeling, there is an hourly emissions file that contains information for each source.

Refer to "2005 Hourly Lead Emission Inventory for the Doe Run Company's Herculaneum, Missouri Smelter" for a detailed description of the emission calculations for each source.

Table 2-1. Lead Emission Summary

Source ID	Source Description	MHDR (Units/ hr)	Typical Start Hour	Typical End Hour	Factor ID No.	Pb Emission Factor (lb/Unit)	Emission Factor Units	No. of Points	Based on Traffic? (Y/N)	Max Hrly Pb Emiss (lb/hr)	Max Qtrly Pb Emiss (lb/qtr)
10001A	Dump-Concentrate-Hopper/Dump-Concentrate-Storage	50	1	24	1	1.63E-03	Tons-Concentrate-Handled	2	Y	1.63E-01	352
10001B	Load-Concentrate-Railcar/Dump-Concentrate-Unloader	200	7	12	1	1.63E-03	Tons-Concentrate-Handled	2	N	6.52E-01	352
20001	Load-Sinter-Railcar/Dump-Sinter-Unloader	12.4	7	12	3	1.15E-05	Tons-Sinter-Handled	2	N	2.85E-04	0.15
20002/3	Load-Sinter-Truck/Dump-Sinter-Storage	8.57	1	24	3	1.15E-05	Tons-Sinter-Handled	2	Y	1.97E-04	0.43
20004	Load-Fume-Railcar	0.5	7	12	2	7.06E-03	Tons-Fume-Handled	1	N	3.53E-03	2
20005	Sinter Plant Mix Room Fugitives-Concentrate Handling	200	7	12	1	1.63E-03	Tons-Concentrate-Handled	1	N	3.26E-01	176

Source ID	Source Description	MHDR (Units/ hr)	Typical Start Hour	Typical End Hour	Factor ID No.	Pb Emission Factor (lb/Unit)	Emission Factor Units	No. of Points	Based on Traffic? (Y/N)	Max Hrly Pb Emiss (lb/hr)	Max Qtrly Pb Emiss (lb/qtr)
20005	Sinter Plant Mix Room Fugitives-Fume Handling	0.5	7	12	2	7.06E-03	Tons-Fume-Handled	1	N	3.53E-03	2
20006	Sinter Plant Building Fugitives	90	1	24	4	3.40E-03	Tons-Sinter-Produced	1	N	3.06E-01	661
20007	Baghouse No. 3 Fugitives	90	1	24	5	3.28E-05	Tons-Sinter-Produced	1	N	2.95E-03	6
30001	Main Stack	206	1	24	6	5.70E-02	(Tons-Sinter-Produced)+(Tons-Lead Bearing Material-Charged to the Blast Furnace)	1	N	1.17E+01	25359
30002	Blast Furnace Fugitves	116	1	24	7	4.10E-03	Tons-Lead Bearing Material-Charged to the Blast Furnace	1	N	4.76E-01	1027
30011-13	Baghouse No. 5 Vents	116	1	24	8	1.70E-05	Tons-Lead Bearing Material-Charged to the Blast Furnace	3	N	5.92E-03	13
40004/5	Dross Kettle Heat Stacks	52.5	1	24	9	5.19E-04	Tons-Drossed Lead-Produced	1	N	2.72E-02	59
40006	Dross Plant Fugitives	52.5	1	24	10	6.55E-03	Tons-Drossed Lead-Produced	1	N	3.44E-01	743

Source ID	Source Description	MHDR (Units/ hr)	Typical Start Hour	Typical End Hour	Factor ID No.	Pb Emission Factor (lb/Unit)	Emission Factor Units	No. of Points	Based on Traffic? (Y/N)	Max Hrly Pb Emiss (lb/hr)	Max Qtrly Pb Emiss (lb/qtr)
40007	Baghouse No. 7	116	1	24	11	9.48E-03	Tons-Lead Bearing Material-Charged to the Blast Furnace	1	Y	1.10E+00	2375
50006	Refinery Plant Fugitives	37	1	24	12	6.80E-03	Tons-Refined Lead-Produced	1	N	2.52E-01	543
50007	Baghouse No. 8	37	1	24	13	1.27E-02	Tons-Refined Lead-Produced	1	N	4.69E-01	1012
50008	Baghouse No. 9	37	1	24	14	8.58E-02	Tons-Refined Lead-Produced	1	N	3.17E+00	6854
50011-18	Kettle Setting Heat Stacks	37	1	24	15	7.09E-04	Tons-Refined Lead-Produced	8	N	2.10E-01	453
60001/2	Strip Mill Heat Stacks	4.2	1	24	16	2.13E-04	Tons-Lead Strip-Produced	2	N	1.79E-03	4
60003	Strip Mill Baghouse	4.2	1	24	17	1.12E-05	Tons-Lead Strip-Produced	1	N	4.70E-05	0.10
60004	Low Alpha Baghouse	0.04	7	12	18	3.58E-01	Tons-Lead Bearing Material-Charged to the Low Alpha Furnace	1	N	1.43E-02	8
60005-8	Strip Mill Roof Vents	4.2	1	24	19	2.21E-03	Tons-Lead Strip-Produced	4	N	3.71E-02	80
70001	Fugitive Dross Handling	3.4	7	18	20	Varies	Tons-Material-Handled	1	N		7
70007	Fugitive Slag Handling	2.4	7	18	20	Varies	Tons-Material-Handled	1	N		0.09

Source ID	Source Description	MHDR (Units/ hr)	Typical Start Hour	Typical End Hour	Factor ID No.	Pb Emission Factor (lb/Unit)	Emission Factor Units	No. of Points	Based on Traffic? (Y/N)	Max Hrly Pb Emiss (lb/hr)	Max Qtrly Pb Emiss (lb/qtr)
70009	Fugitive Secondaries Handling	4.3	7	18	20	Varies	Tons-Material-Handled	1	N		1
70002	Dross Storage Fugitive Wind Erosion	464.52	1	24	21	Varies	m2-hr	1	N		0
70004	Conc. Storage Fugitive Wind Erosion	1161.29	1	24	21	Varies	m2-hr	1	N		0
70006	Sinter Storage Fugitive Wind Erosion	1741.93	1	24	21	Varies	m2-hr	1	N		0
70008	Slag Storage Fugitive Wind Erosion	72565	1	24	21	Varies	m2-hr	1	N		49
70010	Sec Storage Fugitive Wind Erosion	464.52	1	24	21	Varies	m2-hr	1	N		0
70100	Hwy 55 to Joachim Bridge Exit (Segment A-B)	6.47	1	24	22	0.0034	Vehicle-Miles-Traveled	1	Y	2.23E-02	48
70150	Joachim Bridge Exit to Plant Entrance (Segment B-C)	17.71	1	24	22	0.0124	Vehicle-Miles-Traveled	1	Y	2.19E-01	473

Source ID	Source Description	MHDR (Units/ hr)	Typical Start Hour	Typical End Hour	Factor ID No.	Pb Emission Factor (lb/Unit)	Emission Factor Units	No. of Points	Based on Traffic? (Y/N)	Max Hrly Pb Emiss (lb/hr)	Max Qtrly Pb Emiss (lb/qtr)
70250	Plant Entrance to NW Corner of Strip Mill Building (Segment C-D)	0.64	1	24	22	0.0226	Vehicle-Miles-Traveled	1	Y	1.45E-02	31
70300	NW Corner of Strip Mill Building to Concentrate Hopper (Segment D-E)	0.06	1	24	22	0.0397	Vehicle-Miles-Traveled	1	Y	2.27E-03	5
70350	Concetrate Hopper to SW Corner of Strip Mill Building (Segment E-F)	0.40	1	24	22	0.0150	Vehicle-Miles-Traveled	1	Y	6.02E-03	13
70400	NW Corner of Strip Mill Building to SW Corner of Strip Mill Building (Segment D-F)	0.55	1	24	22	0.0171	Vehicle-Miles-Traveled	1	Y	9.30E-03	20
70450	SW Corner of Strip Mill Building to North End of Slag Haul Road (Segment F-G)	0.30	1	24	22	0.0247	Vehicle-Miles-Traveled	1	Y	7.34E-03	16

Source ID	Source Description	MHDR (Units/ hr)	Typical Start Hour	Typical End Hour	Factor ID No.	Pb Emission Factor (lb/Unit)	Emission Factor Units	No. of Points	Based on Traffic? (Y/N)	Max Hrly Pb Emiss (lb/hr)	Max Qtrly Pb Emiss (lb/qtr)
70500	North End of Slag Haul Road to Refinery Dock (Segment G-H)	0.87	1	24	23	0.0301	Vehicle-Miles-Traveled	1	Y	2.62E-02	57
70550	South Slag Haul Road (Paved) (Segment G-K)	0.03	1	24	22	0.0383	Vehicle-Miles-Traveled	1	Y	9.61E-04	2
70600	North End of Main Building to Refinery Dock (Unpaved) (Segment H-L)	0.11	1	24	22	1.1263	Vehicle-Miles-Traveled	1	Y	1.26E-01	272
70650	Sinter Plant to Sinter Storage (Segment I-J)	0.45	1	24	22	0.0383	Vehicle-Miles-Traveled	1	Y	1.71E-02	37
70700	South Slag Haul Road (Unpaved) (Segment K-M)	0.04	1	24	23	0.318	Vehicle-Miles-Traveled	1	Y	1.27E-02	27
										Total	**41144**

A. Traffic Scalars

Hour	Scalar	Hour	Scalar
1	0.0021	12	0.0729
2	0.0031	13	0.0729
3	0.0031	14	0.0729
4	0.0031	15	0.0729
5	0.0052	16	0.0729
6	0.0208	17	0.0729
7	0.0521	18	0.0729
8	0.0729	19	0.0729
9	0.0729	20	0.0208
10	0.0729	21	0.0052
11	0.0729	22	0.0031
12	0.0729	23	0.0031
13	0.0729	24	0.0031

Table 2-2. Emission Factor References

Factor ID No.	Emission Factor Description	Pb Emission Factor (lb/Unit)	Emission Factor Units	Emission Factor Derivation Description
1	Concetrate Handling	1.63E-03	Tons-Concentrate-Handled	Test at the trestle operation (73.75 gr-Pb/100ton-Concentrate-Dumped)
2	Fume Handling	7.06E-03	Tons-Fume-Handled	Test at the trestle operation (3202.22 gr-Pb/100ton-Fume-Dumped) Fume is now dumped wet (>8% moisture). Emissions estimated to be 1/10 of the dry emissions.
3	Sinter Handling	1.15E-05	Tons-Sinter-Handled	Test at the trestle operation
4	Sinter Plant Building Fugitives	3.40E-03	Tons-Sinter-Produced	Personnel Sampling (2000 SIP value times 4 per model reconcilliation work) (0.00085*4=0.0034 lb/ton)
5	Baghouse No. 3 Fugitives	3.28E-05	Tons-Sinter-Produced	In-house testing for the No. 5 Baghouse Vents (1981)
6	Main Stack	5.70E-02	(Tons-Sinter-Produced)+(Tons-Lead Bearing Material-Charged to the Blast Furnace)	2004 Stack Test
7	Blast Furnace Fugitives	4.10E-03	Tons-Lead Bearing Material-Charged to the Blast Furnace	30002-5 2000 SIP pre-control emission factor (8.23E-02 lb/ton) with a 95% capture efficiency
8	Baghouse No. 5 Vents	1.70E-05	Tons-Lead Bearing Material-Charged to the Blast Furnace	In-house testing for the No. 5 Baghouse Vents (1981)
9	Dross Kettle Heat Stacks	5.19E-04	Tons-Drossed Lead-Produced	Stack test of No. 4 kettle heat stack (1999)
10	Dross Plant Fugitives	6.55E-03	Tons-Drossed Lead-Produced	40001-3 2000 SIP pre-control emission factor (1.31E-01 lb/ton) with a 95% capture efficiency

Factor ID No.	Emission Factor Description	Pb Emission Factor (lb/Unit)	Emission Factor Units	Emission Factor Derivation Description
11	Baghouse No. 7	9.48E-03	Tons-Lead Bearing Material-Charged to the Blast Furnace	2002 Stack Test
12	Refinery Plant Fugitives	6.80E-03	Tons-Refined Lead-Produced	50001-2,4-5 2000 SIP pre-control emission factor (1.36E-01 lb/ton) with a 95% capture efficiency
13	Baghouse No. 8	1.27E-02	Tons-Refined Lead-Produced	2002 Stack Test
14	Baghouse No. 9	8.58E-02	Tons-Refined Lead-Produced	2002 Stack Test
15	Kettle Setting Heat Stacks	7.09E-04	Tons-Refined Lead-Produced	Stack test of No. 3 kettle heat stack (1999)
16	Strip Mill Heat Stacks	2.13E-04	Tons-Lead Strip-Produced	Stack test of No. 3 kettle heat stack (1999) proportioned down to the size of the unit (30% of the refinery unit). 0.000709 lb/ton * 0.3
17	Strip Mill Baghouse	1.12E-05	Tons-Lead Strip-Produced	Uncontrolled emission factor from AP-42, Table 2.3-2 (0.0007 lb/ton). A 98.4% control efficiency for the fabric filter was then utilized (AP-42, Table 2.3-5).
18	Low Alpha Baghouse	3.58E-01	Tons-Lead Bearing Material-Charged to the Low Alpha Furnace	Stack Testing (1999). Note that the emission factor used in the 2000 SIP was based on lb-Pb per lb-charge. This was updated to a lb/ton basis for consistency with other sources.
19	Strip Mill Roof Vents	2.21E-03	Tons-Lead Strip-Produced	Personnel Sampling. Emission factor is for each vent.
20	Fugitive Material Handling	Varies	Tons-Material-Handled	AP42, Section 13.2.4

Factor ID No.	Emission Factor Description	Pb Emission Factor (lb/Unit)	Emission Factor Units	Emission Factor Derivation Description
21	Storage Fugitive Wind Erosion	Varies	m^2-hr	AP42, Section 13.2.5
22	Paved Haul Roads	Varies	Vehicle-Miles-Traveled	AP42, Section 13.2.1
23	Unpaved Haul Roads	Varies	Vehicle-Miles-Traveled	AP42, Section 13.2.2

3.0 Meteorological Data

As with all meteorological data development, the data are reviewed and the best available data set is selected for use in the modeling exercise. Therefore, the two sources of data used in the development of the meteorological input files were: on-site data from the river site located east of the plant and twice-daily upper air soundings from Lincoln, Illinois. The initial meteorological database used to establish acceptable model performance evaluation included data from 2005 to represent conditions that occurred during the latest quarterly violating periods.

However, the primary meteorological parameters (wind speed, wind direction, and temperature) were completely or partially missing on 119 of the 365 days and were not included in the final database. There is one exception to this statement discussed below (March 22, 2005).

The SRDT (Solar Radiation/Delta-T) method was chosen as the preferred method for estimating the hourly P-G stability class. The SRDT method estimates the daytime stability class from the incoming solar radiation and wind speed. The nighttime stability class is calculated from the low level vertical temperature difference and wind speed. Solar radiation and temperature gradient data was available for 122 days during 2005.

For 124 days during the year of 2005, the primary parameters were available, but either the solar radiation or temperature difference was missing for at least part of the day. For these days, the sigma-A method was utilized to calculate the stability class. The sigma-A method uses the standard deviation of the horizontal wind direction and 10-meter wind speed to estimate the stability class.

The ISCST meteorological database was then compiled for the 246 days mentioned above. Mixing height data from Lincoln, Illinois (WBAN 04833) was used.

Based on the available data, the study period was broken out into twelve blocks. The blocks of data have been summarized in Table 3-1.

The onsite data contained a missing two-hour block of data for March 22, 2005. The winds were persistent on either side of the data gap and the maximum temperature and radiation had already been reached earlier in the day. Therefore, the data gap was filled using simple interpolation between the preceding and succeeding hours. A summary of the fill procedure has been provided as Table 3-2. This interpolation allowed for usable data for the entire first quarter of 2005 and ultimately provided 247 days of on-site meteorological data to be used in the model performance evaluation.

A statistical analysis was performed on the on-site data. Frequency histograms for the 10m wind speed, 10m wind direction, and 2m temperature have been provided as Figures 3-1, 3-2, and 3-3, respectively.

The dataset utilized in the model performance evaluation represents the best available local meteorological conditions and does not utilize “distant”/less representative regional airport data.

The design value and attainment demonstration modeling utilized the first quarter of 2005 and the approved meteorological data used in the previous attainment demonstration (April 1997-March 1999). The rationale for this selection is straightforward. The use of the older more complete dataset provided confidence that the controls selected for the attainment demonstration will be effective over a large variety of meteorological conditions. In addition, the use of the more recent data provided additional confidence that these controls will be effective during one of the most recent violating quarters. A total of nine quarters of meteorological data were modeled for the design value analysis. This composite represents the best available data for the project and meets the EPA guidelines for meteorological data use.

The Land-Use and Land-Characterization (LULC) data have been summarized in Tables 3-4 through 3-5. The LULC data was analyzed for eight, forty-five degree sectors beginning at true-north. The LULC data was obtained from the USGS in a Composite Theme Grid (CTG) format. All nodes were analyzed within 3km of the main stack.

Table 3-1. Meteorological Block Descriptions

Block	Start	End	Days	Comment
1	1/1/2005	1/9/2005	9	No data missing, use SRDT
2	1/10/2005	3/22/2005	72	SRDT missing, use Sigma
3	3/23/2005	3/23/2005	1	Primary parameters missing for 2 hours, filled by interpolation. SRDT missing, use Sigma.
4	3/24/2005	5/5/2005	43	SRDT missing, use Sigma
5	5/6/2005	5/30/2005	25	No data missing, use SRDT
6	5/31/2005	6/22/2005	23	Primary parameters missing, day not modeled
7	6/23/2005	8/21/2005	60	No data missing, use SRDT
8	8/22/2005	8/26/2005	5	Primary parameters missing, day not modeled
9	8/27/2005	9/5/2005	10	No data missing, use SRDT
10	9/6/2005	10/5/2005	30	Primary parameters missing, day not modeled
11	10/6/2005	11/1/2005	27	No data missing, use SRDT
12	11/2/2005	12/31/2005	60	Primary parameters missing, day not modeled

Table 3-2. Gap Filling Summary for 3/22/05

Year	Month	Day	Hour	Spd mph 10	Dir Deg 10	Sigma Deg 10	Temp F 2	Inso Lang/mn	NetRad W/m2	BP InHg	Rain In
2005	3	23	1	6.82	5.03	16.27	41.51	0	-2.7	29.14	0.04
2005	3	23	2	7.07	14.65	14.12	41.66	0	-2.55	29.13	0.02
2005	3	23	3	6.72	353.5	15.46	41.56	0	-2.41	29.11	0.05
2005	3	23	4	5.53	337.3	16.44	41.53	0	-2.6	29.11	0.06
2005	3	23	5	5.63	329.9	18.93	41.47	0	-2.97	29.12	0.06
2005	3	23	6	5.69	323.3	18.83	41.18	0	-3.2	29.14	0.13
2005	3	23	7	6.62	318.4	19.47	40.35	0	-3.55	29.16	0.03
2005	3	23	8	7.24	317.4	19.03	39.83	0.004	-1.51	29.19	0.01
2005	3	23	9	6.77	323.5	19.8	39.49	0.02	12.36	29.22	0
2005	3	23	10	6.74	323.8	19.97	39.81	0.05	28.36	29.24	0
2005	3	23	11	7.68	330	20.79	40.23	0.12	63.38	29.26	0
2005	3	23	12	8.06	313.7	20.41	40.42	0.14	74	29.28	0
2005	3	23	13	8.76	306.4	20	40.37	0.11	61.72	29.31	0
2005	3	23	14	7.62	308.1	22.47	40.47	0.11	61.7	29.32	0
2005	**3**	**23**	**15**	**7.27**	**312**	**22.5**	**40.42**	**0.09**	**50.06**	**29.33**	**0**
2005	**3**	**23**	**16**	**6.92**	**315**	**22.53**	**40.37**	**0.07**	**38.42**	**29.34**	**0**
2005	3	23	17	6.57	318.4	22.56	40.32	0.05	26.78	29.35	0
2005	3	23	18	6.23	330.6	18.96	40.3	0.02	9	29.36	0
2005	3	23	19	5.03	318.7	19.92	40.35	0.007	-0.13	29.39	0
2005	3	23	20	4.66	313.1	17.19	40.19	0	-4.18	29.4	0
2005	3	23	21	3.74	312.3	20.87	39.65	0	-4.47	29.42	0
2005	3	23	22	3.84	288.4	17.11	39.32	0	-3.68	29.44	0.01
2005	3	23	23	3.02	291.4	22.38	39.14	0	-3.2	29.45	0.01
2005	3	23	24	3.78	281.9	19.33	39.01	0	-3.37	29.45	0

Figure 3-1. 10m Wind Speed Frequency Histogram

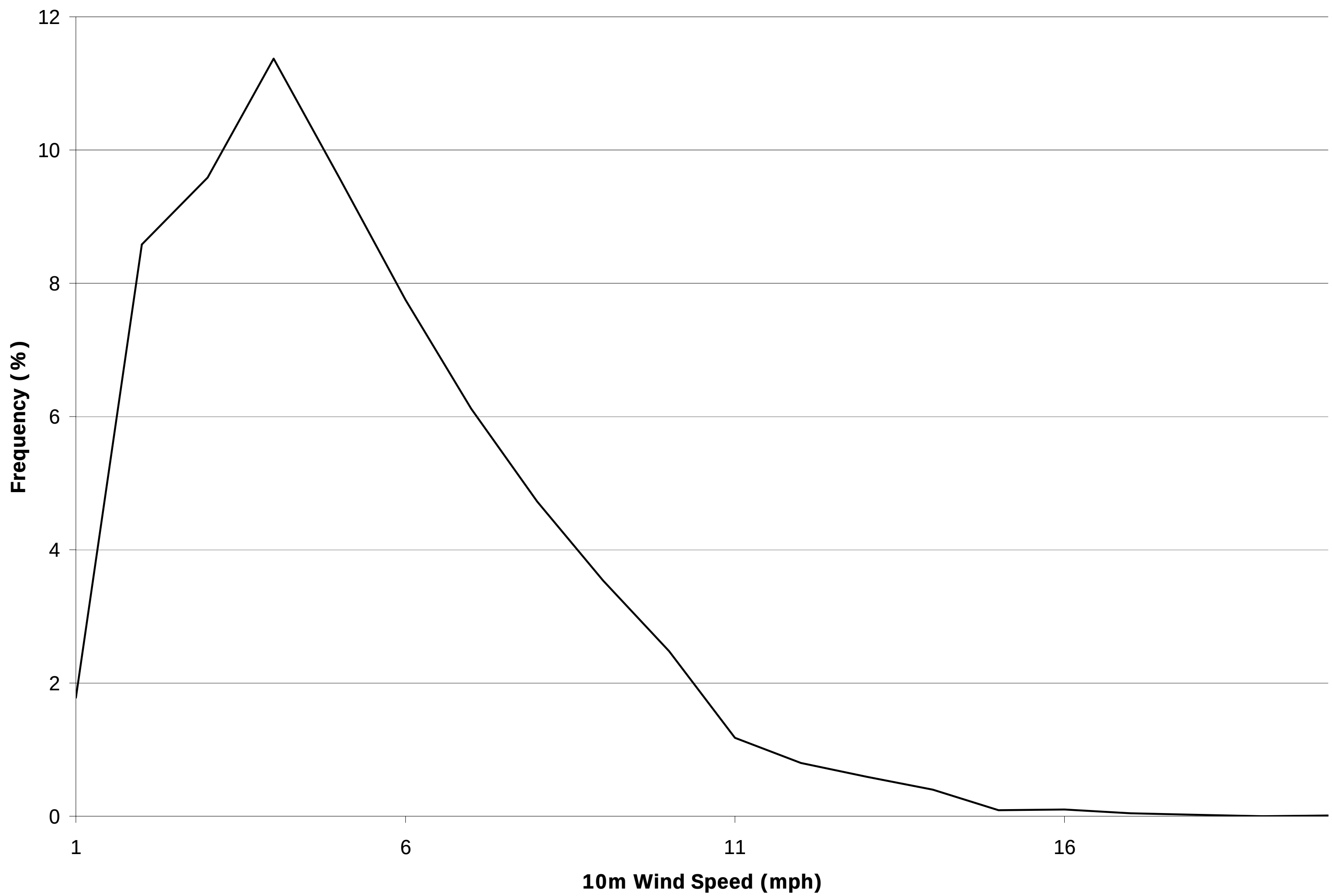


Figure 3-2. 10m Wind Direction Frequency Histogram

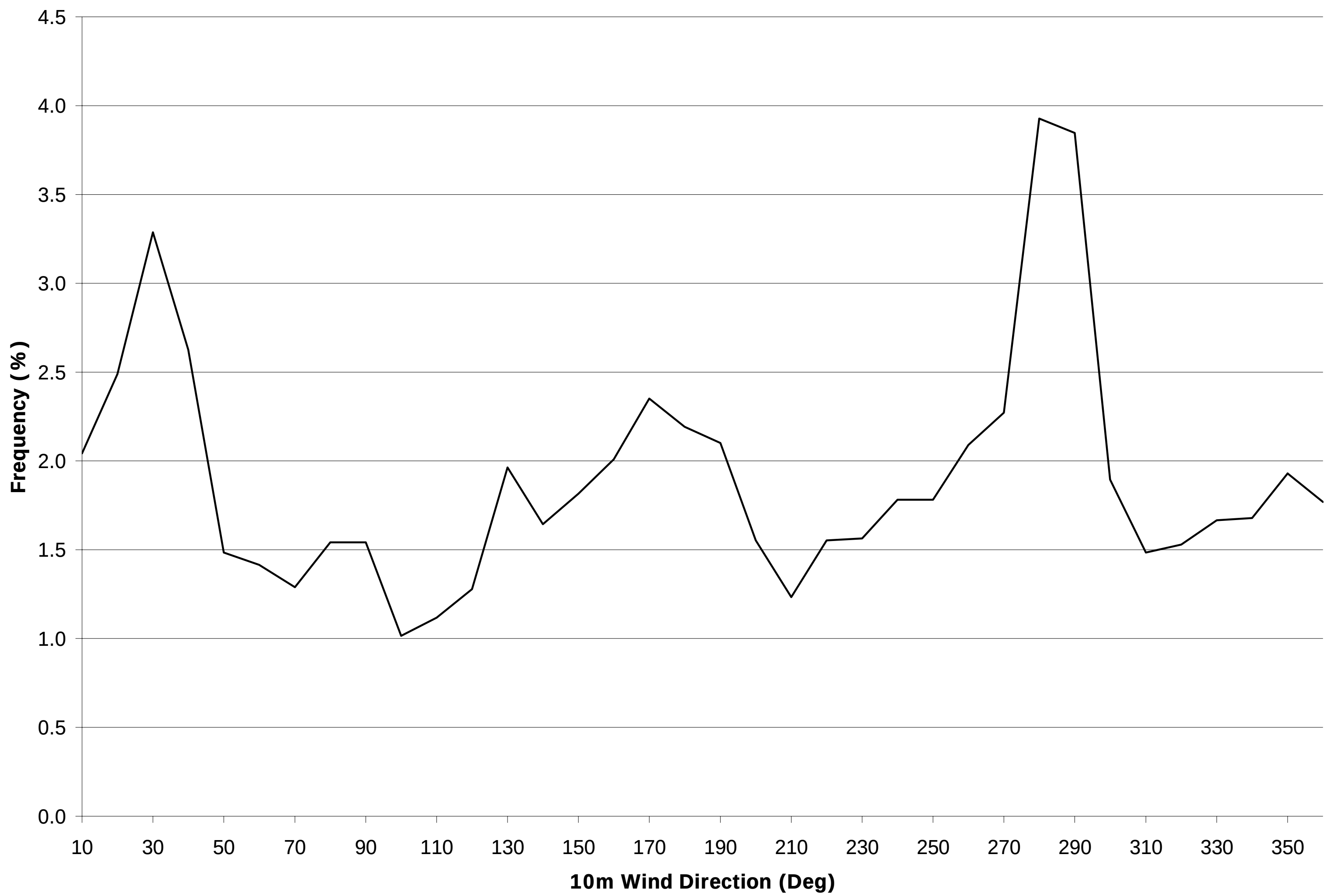


Figure 3-3. 2m Temperature Frequency Histogram

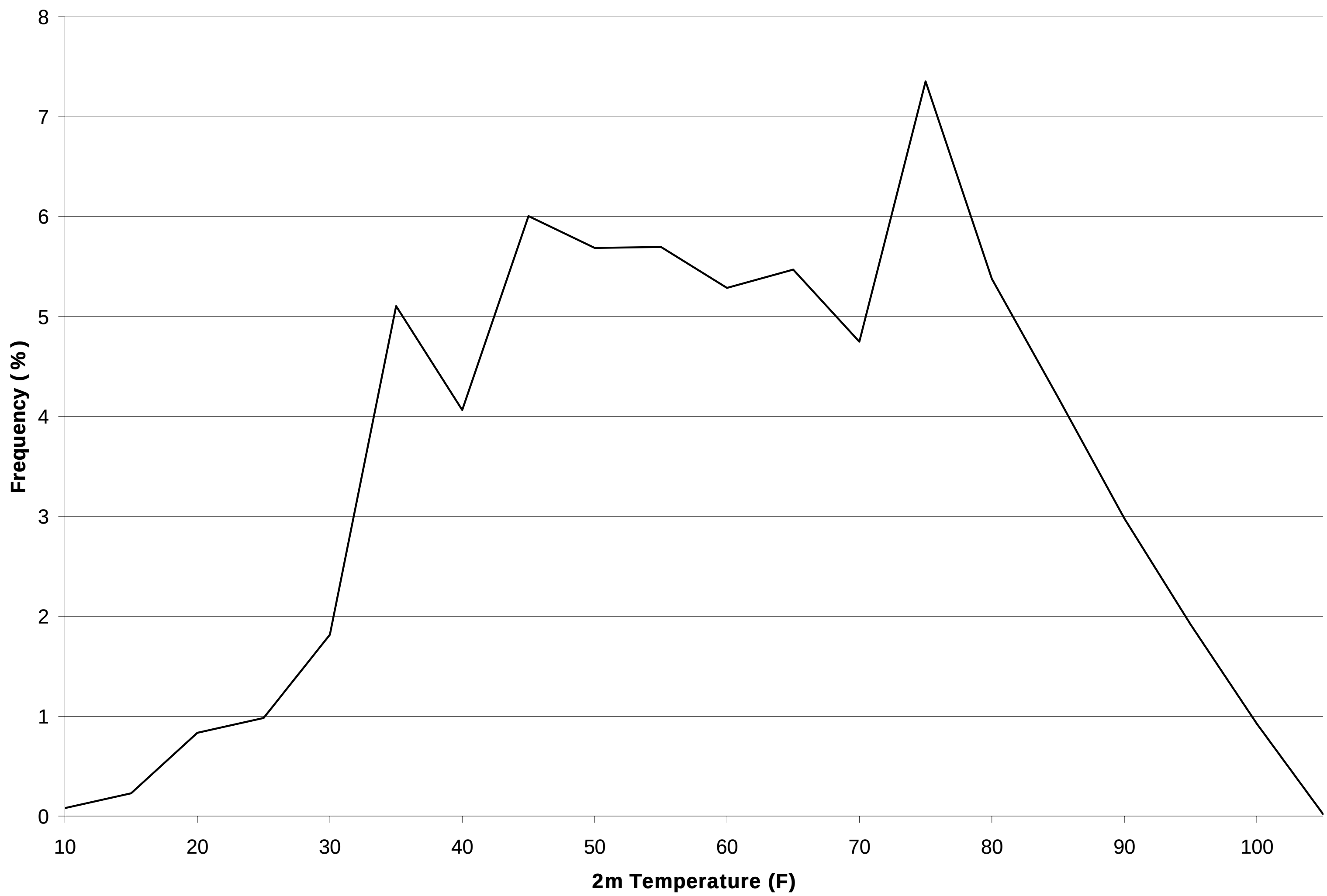


Table 3-3. USGS LULC Code Summary

USGS, Level 1		USGS, Level 2		MPRM / Armlet LULC Code
Code	Description	Code	Description	
1	Urban or built-up land	11	Residential	7
		12	Commercial and services	7
		13	Industrial	7
		14	Transportation, communication and utilities	7
		15	Industrial and commercial complexes	7
		16	Mixed urban	7
		17	Other urban	7
2	Agricultural land	21	Cropland and pasture	5
		22	Orchards, groves, vineyards, nurseries and ornamental horticulture	5
		23	Confined feeding operations	5
		24	Other agricultural land	5
3	Rangeland	31	Herbaceous rangeland	6
		32	Shrub and brush rangeland	6
		33	Mixed rangeland	6
4	Forest land	41	Deciduous forest land	2
		42	Evergreen forest land	3
		43	Mixed forest land	2
5	Water	51	Streams and canals	1
		52	Lakes	1
		53	Resevoirs	1
		54	Bays and estuaries	1
6	Wetland	61	Forested wetland	2
		62	Nonforested wetland	4
7	Barren land	71	Dry salt flats	8
		72	Beaches	8
		73	Sandy areas other than beaches	8
		74	Bare exposed rock	8
		75	Strip mines, quarries and gravel pits	8
		76	Transitional areas	8
		77	Mixed barren land	8
8	Tundra	81	Shrub and brush tundra	N/A
		82	Herbaceous tundra	N/A
		83	Bare ground	N/A
		84	Wet tundra	N/A
		85	Mixed tundra	N/A

Table 3-4. MPRM / AERMET LULC Code Summary and Seasonal Parameter Values

MPRM / AERMET LULC Code	MPRM / AERMET LULC Code Description	Season				Annual
		Winter	Spring	Summer	Autumn	
Albedo						
1	Water Surface	0.2	0.12	0.1	0.14	0.1400
2	Deciduous Forest	0.5	0.12	0.12	0.12	0.2150
3	Coniferous Forest	0.35	0.12	0.12	0.12	0.1775
4	Swamp	0.3	0.12	0.14	0.16	0.1800
5	Cultivated Land	0.6	0.14	0.2	0.18	0.2800
6	Grassland	0.6	0.18	0.18	0.2	0.2900
7	Urban	0.35	0.14	0.16	0.18	0.2075
8	Desert Scrubland	0.45	0.3	0.28	0.28	0.3275
Daytime Bowen Ratio (Average)						
1	Water Surface	1.5	0.1	0.1	0.1	0.4500
2	Deciduous Forest	1.5	0.7	3	1	1.5500
3	Coniferous Forest	1.5	0.7	0.3	0.8	0.8250
4	Swamp	1.5	0.1	0.1	0.1	0.4500
5	Cultivated Land	1.5	0.3	0.5	0.7	0.7500
6	Grassland	1.5	0.4	0.8	1	0.9250
7	Urban	1.5	1	2	2	1.6250
8	Desert Scrubland	6	3	4	6	4.7500
Surface Roughness Length (m)						
1	Water Surface	0.0001	0.0001	0.0001	0.0001	0.0001
2	Deciduous Forest	0.5	1	1.3	0.8	0.9000
3	Coniferous Forest	1.3	1.3	1.3	1.3	1.3000
4	Swamp	0.05	0.2	0.2	0.2	0.1625
5	Cultivated Land	0.01	0.03	0.2	0.05	0.0725
6	Grassland	0.001	0.05	0.1	0.01	0.0403
7	Urban	1	1	1	1	1.0000
8	Desert Scrubland	0.15	0.3	0.3	0.3	0.2625
Leaf Area Index						
1	Water Surface	0	0	0	0	0.0000
2	Deciduous Forest	1	4	5	4	3.5000
3	Coniferous Forest	4	4	4	4	4.0000
4	Swamp	0.0001	0.0001	0.0001	0.0001	0.0001
5	Cultivated Land	0.0001	2	3.5	2	1.8750
6	Grassland	2	2	2	2	2.0000
7	Urban	0.0001	0.0001	0.0001	0.0001	0.0001
8	Desert Scrubland	0.0001	0.0001	0.0001	0.0001	0.0001

A. Albedo values from MPRM User's Guide, Table 3-4.
B. Daytime Bowen Ratio Values (Avg. Conditions) from MPRM User's Guide, Table 3-5.
C. Surface Roughness Length values from MPRM User's Guide, Table, 3-6.
D. Leaf area index values adapted from the Addendum to the MPRM User's Guide.

Table 3-5. LULC Node Frequency Count

MPRM / AERMET LULC Code	Sector (45 Deg. Intervals, Starting at True North)								Total
	1	2	3	4	5	6	7	8	
Node Count for Each Sector and LULC Code									
1	43	11	15	30	0	0	3	4	106
2	11	0	11	39	54	51	40	33	239
3	0	0	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	38	84	51	7	4	0	12	0	196
6	0	0	0	0	0	0	0	0	0
7	6	5	0	4	22	25	45	58	165
8	0	0	0	0	0	0	0	2	2
Total	**98**	**100**	**77**	**80**	**80**	**76**	**100**	**97**	**708**
LULC Code Fraction (%) for Each Sector									
1	43.88	11.00	19.48	37.50	0.00	0.00	3.00	4.12	14.97
2	11.22	0.00	14.29	48.75	67.50	67.11	40.00	34.02	33.76
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
5	38.78	84.00	66.23	8.75	5.00	0.00	12.00	0.00	27.68
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
7	6.12	5.00	0.00	5.00	27.50	32.89	45.00	59.79	23.31
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	2.06	0.28
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Additional Parameters (Not Affected by Seasonal Differences)									
MOL	**3.4286**	**2.9300**	**2.7532**	**6.3000**	**13.7250**	**14.9342**	**15.4900**	**18.3505**	**9.7556**
SHF	**0.1543**	**0.1535**	**0.1500**	**0.1535**	**0.1693**	**0.1730**	**0.1815**	**0.1919**	**0.1663**

A. MOL - Monin-Obukhov Length (m)
   LULC Code = 7, MO Length = 25m
   LULC Code = 2 or 3, MO Length = 10m
   LULC Code = 4 or 5, MO Length = 2m

B. SHF - Surface Heat Flux
   LULC Code = 7, SHF = 0.22
   Rural LULC Code (Not equal to 7), SHF = 0.15

4.0 Model Input Information

4.1 Model Description

Based on a series of discussions with EPA Region VII, the ISCST3-PRIME model (Version 04269) was chosen as the primary tool for this modeling analysis. The ISCST3-PRIME is the best modeling tool based on the available data and the extensive amount of model reconciliation work performed with the ISCST3 model in the previous State Implementation Plan. The PRIME downwash algorithms are a scientific improvement over the previous ISCST3 version and will provide the most realistic representation of the sources at the Herculaneum smelter. Also, performance with the ISCST3-PRIME system was very good especially for the monitoring locations with high concentrations during the 2005 study period.

The AERMAP pre-processor will be used to calculate the receptor elevations for input into the ISCST3-PRIME model.

4.2 Model Control Options

Three model options were selected for the modeling: regulatory default options, dry depletion calculations, and rural land use classification.

The regulatory default option was included in the modeling options control pathway. The regulatory defaults include the following options:

1. Stack-tip downwash is used, except when Schulman-Scire downwash algorithms are being used.
2. Buoyancy-induced dispersion is used, except when Schulman-Scire downwash algorithms are being used.
3. Calms processing routines are used.

4. When super-squat buildings influence point sources, the upper-bound concentration estimates are used.
5. Gradual plume rise is not to be used unless building downwash is taken into account.
6. Default wind profile exponents are to be used during regulatory modeling.
7. Default vertical potential temperature gradients are to be used during regulatory modeling.

Dry depletion will be taken into account in the calculations due to modeling experience from the last State Implementation Plan. Without dry depletion, the ISCST3 model dramatically overpredicted lead concentrations at the monitoring sites in the previous analyses.

The rural land use classification was developed based on the Auer method. The Auer method states that the land within a 3-km radius of the source is used to determine classification. If more than 50% of the land within the circle can be classified as heavy industrial, light industrial, commercial, or compact residential then the area is classified as urban. Otherwise, the area is classified as rural. A qualitative analysis was performed on the area using a topographic map and it was determined that the area should be classified as rural.

In summary, all the modeling options have been previously approved as part of the last State Implementation Plan revision.

4.3 Source Parameters

Two hundred and twenty-one sources are included in the analysis: 22 point sources, 28 volume sources, and 172 area sources.

Point sources were used to model the stacks at the facility. The point source parameters have been summarized in Table 4-1. The location (easting and northing) and elevation data refer to the location of the center of the base of the stack. A map showing the locations of all of the point sources has been provided as Figure 4-1. It should be noted that the height of the main stack (30001) exceeds the regulatory GEP limit, however, for the purpose of the model reconciliation work the actual stack height was used.

The volume source parameters have been summarized in Table 4-2 and a map showing the locations of the sources has been provided as Figure 4-2.

The storage pile area source parameters have been summarized in Table 4-3. The slag pile has been modeled as two distinct rectangular area sources due to its complex shape. It was assumed that there would be no initial dispersion of the plume.

The haul road parameters have been summarized in Table 4-4. The release was assumed to be at ground level with an initial vertical dispersion of 1.4 meters. The 1.4m initial vertical dispersion is equal to the truck height of 3 meters divided by 2.15. Maps showing the locations of the haul roads have been provided as Figures 4-3 to 4-5. NOTE: The addition of “outside” haul roads is a signifcant difference between this modeling analysis and the previous attainment demonstration for the Herculaneum area.

4.4 Building Profile Information

The Building Profile Input Program for PRIME (BPIPPRM) (Version 04274) was used to calculate direction specific building profile data for input into the ISCST3 model. Since the sources will be located in close proximity to a number of buildings at the facility, building downwash will affect the dispersion of the plume. The degree downwash affects the plume depends on the size and orientation of the buildings close to the stack. The ISCST3-PRIME model takes as input direction specific building heights, projected building widths, along-flow and across-flow distances from the stack to the center of the upwind face of projected building.

The BPIP first identifies what type of structure is being examined. It recognizes four types of structures:

1. Low simple structures
2. Tall simple structures
3. Multi-tiered structures
4. Groups of structures

Next, the BPIPPRM processor determines if any part of the multi-tier structure is close enough to affect the dispersion of the plume. The BPIP then looks at the buildings of influence and picks a dominant building for each wind direction (USEPA, 1993). The building heights, projected building widths, and location of the dominant building are then input into the ISCST3 model to calculate building downwash.

The locations and heights of each building included in the analysis have been provided in Table 4-5. Every significant building/structure at the facility was included in the analysis for estimating downwash. It should be noted that the buildings incorporated in this analysis and identical to the previously approved modeling exercise for this facility.

A map showing the location of each building included in the analysis has been provided as Figure 4-6.

4.5 Particle Size Information

The particle parameters required for the dry depletion calculations have been summarized in Tables 4-6 through 4-13.

The sinter plant, blast furnace, dross plant and refinery particle data were provided by Doe Run as part of the 2000 SIP. The rest of the particle data was obtained from AP-42.

4.6 Receptor Information

For the purposes of the model performance evaluation, receptors were placed at monitoring locations operating during the study period and evaluated for each day that data is collected.

For the purposes of the design value and attainment demonstration exercise, receptors were placed at 50m intervals along the property boundary surrounding the facility. Receptors were also placed at 50m intervals along the new buffer zone boundary west of the facility. A 100m grid was extended out to approximately 1km from the facility and a 500m grid used out to about 5km. Additionally, receptors were placed at each of the lead monitoring sites.

The NAD 27 datum has been used for the location of receptors, sources, and buildings.

Table 4-1. Point Source Parameters

Source ID	Source Description	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-asl)	Stack Height (m)	Stack Gas Temp. (K)	Exit Velocity (m/s)	Inner Diameter (m)
30001	Main Stack	729534	4237767	132	167.60 100.75 GEP	346.67	5.81	10.31
40004	Dross Kettle Heat Stacks	729588	4237885	131	21.30	391.50	0.69	0.76
40005		729587	4237895	131	21.30	391.50	0.69	0.76
40007	Baghouse No. 7	729596	4237792	131	30.48	276.11	34.57	3.05
50007	Baghouse No. 8	729596	4237797	131	30.48	285.56	7.13	2.59
50008	Baghouse No. 9	729596	4237792	131	30.48	276.11	34.57	3.05
50011	Kettle Setting Heat Stacks	729579	4237787	131	18.80	989.30	5.96	0.61
50012		729579	4237796	131	18.80	989.30	5.96	0.61
50013		729579	4237805	131	18.80	989.30	5.96	0.61
50014		729579	4237813	131	18.80	989.30	5.96	0.61
50015		729579	4237822	131	18.80	989.30	5.96	0.61
50016		729579	4237831	131	18.80	989.30	5.96	0.61
50017		729579	4237840	131	18.80	989.30	5.96	0.61
50018		729579	4237849	131	18.80	989.30	5.96	0.61
60001	Strip Mill Heat Stacks	729434	4237560	129	21.30	699.80	2.73	0.56
60002		729475	4237560	131	21.30	699.80	2.73	0.56
60003	Strip Mill Baghouse	729456	4237562	131	7.60	297.00	7.70	1.08
60004	Low Alpha Baghouse	729477	4237483	128	6.10	327.60	17.50	0.25
60005	Strip Mill Roof Vents	729440	4237549	129	16.80	297.00	5.00	0.56
60006		729450	4237549	129	16.80	297.00	5.00	0.56
60007		729460	4237549	131	16.80	297.00	5.00	0.56
60008		729470	4237549	131	16.80	297.00	5.00	0.56

Figure 4-1. Point Source Locations

Table 4-2. Volume Source Parameters

Source ID	Source Description	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-asl)	Release Height (m)	Sigma Y (m)	Sigma Z (m)
10001A1	Dump-Concentrate-Hopper	729460	4237585	131	0.61	0.28	0.28
10001A2	Dump-Concentrate-Storage	729520	4237550	130	4.27	0.21	0.28
10001B1	Load-Concentrate-Railcar	729520	4237585	130	4.27	0.57	0.28
10001B2	Dump-Concentrate-Unloader	729547	4238029	133	6.40	2.33	10.60
20001A	Load-Sinter-Railcar	729520	4237585	130	4.27	0.57	0.28
20001B	Dump-Sinter-Unloader	729560	4237920	132	6.40	2.33	10.60
20002	Load-Sinter-Truck	729520	4237935	133	3.66	0.57	0.28
20003	Dump-Sinter-Storage	729550	4237550	129	4.27	0.21	0.28
20004	Load-Fume-Railcar	729540	4237980	133	4.27	0.57	0.28
20004B	Railcar Fume Unloading (At Storage)	729544	4237429	125	0.91	0.57	0.43
20004C	Railcar Fume (South, Front End Loader)	729538	4237429	125	3.66	0.57	0.28
20005A	Sinter Plant Mix Room Fugitives	729519	4237854	132	18.30	5.11	8.50
20005B		729519	4237843	132	18.30	5.11	8.50
20005C		729519	4237832	132	18.30	5.11	8.50
20005D		729519	4237821	132	18.30	5.11	8.50
20005E		729519	4237810	132	18.30	5.11	8.50
20005F		729519	4237799	132	18.30	5.11	8.50
20006	Sinter Plant Building Fugitives	729546	4237904	132	20.00	0.20	18.00
20007	Baghouse No. 3 Fugitives	729540	4237699	131	21.30	0.30	10.10
30002	Blast Furnace Fugitves	729583	4237960	131	9.30	18.60	8.65
30011	Baghouse No. 5 Vents	729524	4238016	133	21.30	0.30	12.70
30012		729524	4237999	133	21.30	0.30	12.70
30013		729524	4237982	133	21.30	0.30	12.70
40006	Dross Plant Fugitives	729578	4237885	131	7.62	15.12	7.09
50006	Refinery Plant Fugitives	729578	4237810	131	5.49	18.60	5.10
70001	Fugitive Handling-Dross	729636	4238220	128	2.00	2.33	0.00
70007	Fugitive Handling-Slag	729239	4237241	119	2.00	2.33	0.00

Source ID	Source Description	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-asl)	Release Height (m)	Sigma Y (m)	Sigma Z (m)
70009	Fugitive Handling-Secondaries	729492	4237630	130	2.00	2.33	0.00

Figure 4-2. Volume Source Locations

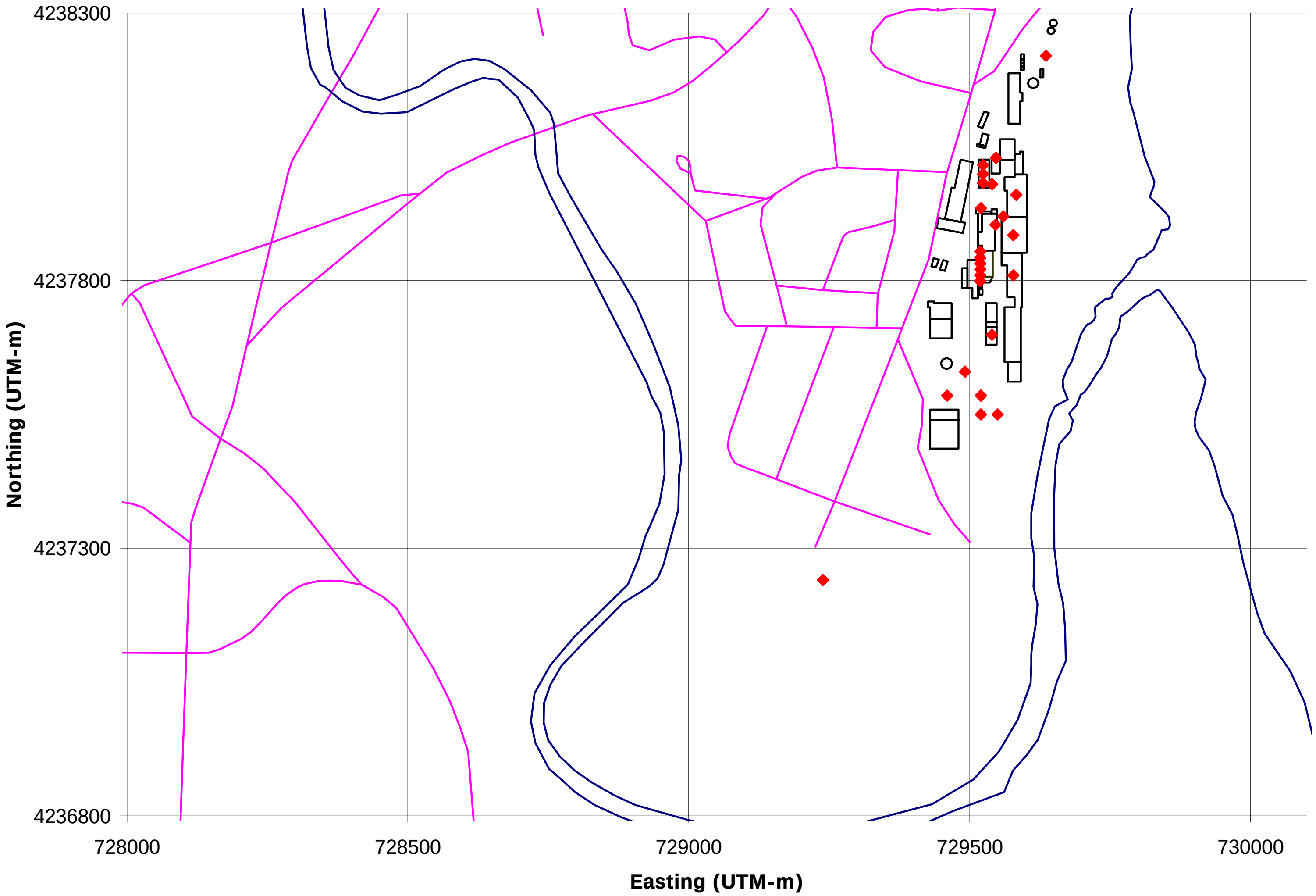


Table 4-3. Storage Pile Parameters

Source ID	Source Description	Source Type	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X Dimension (m)	Y Dimension (m)	Angle (Deg.)	Initial Vertical Dispersion (m)
70002	Dross Storage Pile	AREA	729620	4238201	130	2.00	30.00	40.00	0.00	0.00
70004	Concentrate Storage Pile	AREA	729515	4237391	125	2.00	15.00	150.00	0.00	0.00
70006	Sinter Storage Pile	AREA	729537	4237395	125	2.00	15.00	150.00	0.00	0.00
70008A	Slag Storage Pile	AREA	728878	4237050	128	2.00	166.00	275.00	51.00	0.00
70008B		AREA	729150	4237150	128	2.00	75.00	175.00	51.00	0.00
70010	Secondaries Storage Pile	AREA	729482	4237609	130	2.00	20.00	40.00	0.00	0.00

Table 4-4. Haul Road Parameters

Segment	Source ID	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X-Dimension (m)	Y-Dimension (m)	Angle	Sigma-Z (m)
A-B	70100	727276	4237113	133	0.00	10.00	64.48	90.01	1.40
	70101	727340	4237103	131	0.00	74.17	10.00	1.24	1.40
	70102	727415	4237101	128	0.00	74.17	10.00	1.24	1.40
	70103	727489	4237110	129	0.00	10.00	58.12	86.83	1.40
	70104	727547	4237113	132	0.00	10.00	58.12	86.83	1.40
	70105	727605	4237116	132	0.00	10.00	64.48	90.01	1.40
	70106	727669	4237116	133	0.00	10.00	64.48	90.01	1.40
	70107	727734	4237106	134	0.00	54.90	10.00	3.36	1.40
	70108	727788	4237103	139	0.00	54.90	10.00	3.36	1.40
	70109	727844	4237110	144	0.00	10.00	62.86	90.01	1.40
	70110	727906	4237110	138	0.00	10.00	62.86	90.01	1.40
	70111	727969	4237110	125	0.00	10.00	49.97	90.01	1.40
	70112	728019	4237110	125	0.00	10.00	49.97	90.01	1.40
	70113	728069	4237110	124	0.00	10.00	38.69	90.01	1.40
	70114	728103	4237105	126	0.00	10.00	77.39	2.39	1.40
	70115	728106	4237182	129	0.00	10.00	51.57	1.79	1.40
	70116	728108	4237234	130	0.00	10.00	51.57	1.79	1.40
	70117	728109	4237285	135	0.00	10.00	61.21	0.00	1.40
	70118	728109	4237348	136	0.00	10.00	86.75	15.08	1.40
	70119	728132	4237432	133	0.00	10.00	76.58	22.26	1.40
	70120	728161	4237502	130	0.00	10.00	84.57	17.76	1.40
	70121	728187	4237583	132	0.00	10.00	72.68	12.81	1.40
	70122	728203	4237653	129	0.00	10.00	32.85	11.32	1.40
B-C	70150	728209	4237686	129	0.00	10.00	50.46	13.69	1.40
	70151	728221	4237735	134	0.00	10.00	50.46	13.69	1.40
	70152	728233	4237784	130	0.00	10.00	55.89	12.66	1.40
	70153	728246	4237838	130	0.00	10.00	55.89	12.66	1.40
	70154	728258	4237893	129	0.00	10.00	49.99	11.57	1.40

Segment	Source ID	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X-Dimension (m)	Y-Dimension (m)	Angle	Sigma-Z (m)
	70155	728268	4237942	126	0.00	10.00	49.99	11.57	1.40
	70156	728278	4237992	125	0.00	10.00	74.83	22.77	1.40
	70157	728307	4238061	124	0.00	10.00	65.31	29.64	1.40
	70158	728340	4238118	122	0.00	10.00	65.31	29.64	1.40
	70159	728372	4238175	114	0.00	10.00	63.25	28.39	1.40
	70160	728402	4238230	112	0.00	10.00	63.25	28.39	1.40
	70161	728432	4238286	119	0.00	10.00	94.58	26.58	1.40
	70162	728474	4238370	119	0.00	10.00	50.33	29.14	1.40
	70163	728499	4238414	119	0.00	10.00	50.33	29.14	1.40
	70164	728523	4238458	120	0.00	10.00	52.79	24.96	1.40
	70165	728545	4238506	121	0.00	10.00	52.79	24.96	1.40
	70166	728568	4238554	122	0.00	10.00	50.82	28.83	1.40
	70167	728592	4238599	119	0.00	10.00	50.82	28.83	1.40
	70168	728617	4238643	121	0.00	10.00	65.74	28.32	1.40
	70169	728648	4238700	124	0.00	10.00	52.91	22.26	1.40
	70170	728668	4238749	137	0.00	10.00	43.73	14.75	1.40
	70171	728679	4238790	139	0.00	10.00	75.98	5.05	1.40
	70172	728681	4238963	147	0.00	98.04	10.00	87.40	1.40
	70173	728676	4239030	154	0.00	66.93	10.00	86.18	1.40
	70174	728668	4239120	151	0.00	90.59	10.00	84.36	1.40
	70175	728646	4239176	163	0.00	62.01	10.00	68.95	1.40
	70176	728617	4239238	166	0.00	68.72	10.00	65.08	1.40
	70177	728621	4239236	166	0.00	53.87	10.00	7.11	1.40
	70178	728674	4239229	173	0.00	53.87	10.00	7.11	1.40
	70179	728727	4239222	175	0.00	97.42	10.00	10.53	1.40
	70180	728823	4239204	173	0.00	54.02	10.00	8.29	1.40
	70181	728877	4239197	172	0.00	54.02	10.00	8.29	1.40
	70182	728929	4239189	165	0.00	65.51	10.00	17.80	1.40
	70183	728992	4239169	166	0.00	51.82	10.00	8.64	1.40

Segment	Source ID	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X-Dimension (m)	Y-Dimension (m)	Angle	Sigma-Z (m)
	70184	729044	4239161	160	0.00	51.82	10.00	8.64	1.40
	70185	729095	4239153	163	0.00	91.32	10.00	12.67	1.40
	70186	729183	4239134	168	0.00	53.37	10.00	23.34	1.40
	70187	729232	4239112	167	0.00	53.37	10.00	23.34	1.40
	70188	729280	4239092	162	0.00	52.18	10.00	39.78	1.40
	70189	729320	4239059	166	0.00	52.18	10.00	39.78	1.40
	70190	729359	4239026	162	0.00	90.62	10.00	47.47	1.40
	70191	729420	4238959	165	0.00	52.17	10.00	50.17	1.40
	70192	729454	4238919	162	0.00	52.17	10.00	50.17	1.40
	70193	729487	4238879	162	0.00	83.81	10.00	50.37	1.40
	70194	729541	4238814	159	0.00	66.20	10.00	47.70	1.40
	70195	729585	4238766	154	0.00	57.75	10.00	62.43	1.40
	70196	729611	4238717	162	0.00	76.20	10.00	83.29	1.40
	70197	729620	4238642	155	0.00	73.49	10.00	88.26	1.40
	70198	729622	4238568	155	0.00	62.33	10.00	90.00	1.40
	70199	729609	4238447	157	0.00	10.00	61.78	12.49	1.40
	70200	729585	4238400	150	0.00	10.00	53.76	27.11	1.40
	70201	729560	4238352	148	0.00	10.00	53.76	27.11	1.40
	70202	729538	4238289	145	0.00	10.00	66.19	19.67	1.40
	70203	729522	4238227	145	0.00	10.00	64.25	14.05	1.40
	70204	729495	4238145	142	0.00	10.00	86.59	17.98	1.40
	70205	729482	4238084	141	0.00	10.00	61.57	12.54	1.40
	70206	729464	4238029	141	0.00	10.00	58.43	17.76	1.40
	70207	729448	4237982	141	0.00	10.00	49.28	18.45	1.40
	70208	729437	4237926	135	0.00	10.00	56.75	11.32	1.40
	70209	729428	4237881	134	0.00	10.00	45.40	11.32	1.40
	70210	729413	4237815	134	0.00	10.00	68.57	13.14	1.40
	70211	729393	4237764	133	0.00	10.00	54.98	21.39	1.40
	70212	729377	4237717	133	0.00	10.00	49.28	18.45	1.40

Segment	Source ID	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X-Dimension (m)	Y-Dimension (m)	Angle	Sigma-Z (m)
	70213	729375	4237713	133	0.00	10.00	5.45	26.90	1.40
C-D	70250	729367	4237692	132	0.00	10.00	21.62	19.93	1.40
	70251	729367	4237689	132	0.00	68.70	10.00	68.35	1.40
	70252	729393	4237625	131	0.00	51.46	10.00	68.07	1.40
D-E	70300	729416	4237574	129	0.00	46.05	10.00	12.23	1.40
E-F	70350	729461	4237564	131	0.00	23.47	10.00	9.61	1.40
	70351	729482	4237561	130	0.00	17.74	10.00	32.45	1.40
	70352	729495	4237555	130	0.00	21.78	10.00	77.98	1.40
	70353	729497	4237493	128	0.00	10.00	41.34	3.78	1.40
	70354	729497	4237493	128	0.00	29.47	10.00	89.12	1.40
	70355	729493	4237439	128	0.00	10.00	25.79	10.13	1.40
	70356	729479	4237432	126	0.00	10.00	18.62	55.95	1.40
	70357	729459	4237425	126	0.00	10.00	22.52	71.22	1.40
	70358	729434	4237423	129	0.00	10.00	26.67	83.72	1.40
D-F	70400	729411	4237555	128	0.00	10.00	22.81	2.40	1.40
	70401	729409	4237532	128	0.00	10.00	23.48	2.87	1.40
	70402	729405	4237505	128	0.00	10.00	28.02	9.32	1.40
	70403	729403	4237485	128	0.00	10.00	19.58	5.32	1.40
	70404	729404	4237482	130	0.00	24.35	10.00	65.80	1.40
	70405	729413	4237461	130	0.00	30.68	10.00	71.02	1.40
	70406	729423	4237431	128	0.00	16.78	10.00	68.49	1.40
F-G	70450	729429	4237416	129	0.00	23.40	10.00	68.39	1.40
	70451	729438	4237394	129	0.00	31.73	10.00	59.02	1.40
	70452	729454	4237366	125	0.00	28.05	10.00	55.52	1.40
	70453	729471	4237343	126	0.00	31.66	10.00	51.96	1.40
	70454	729490	4237318	125	0.00	10.98	10.00	51.69	1.40
G-H	70500	729587	4237602	128	0.00	29.96	10.00	79.53	1.40
	70501	729592	4237573	128	0.00	19.13	10.00	84.56	1.40
	70502	729593	4237528	127	0.00	10.00	27.21	1.91	1.40

Segment	Source ID	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X-Dimension (m)	Y-Dimension (m)	Angle	Sigma-Z (m)
	70503	729592	4237505	126	0.00	10.00	23.16	3.37	1.40
	70504	729589	4237478	124	0.00	10.00	27.29	4.77	1.40
	70505	729586	4237453	124	0.00	10.00	25.13	7.26	1.40
	70506	729583	4237425	124	0.00	10.00	27.67	5.64	1.40
	70507	729577	4237400	123	0.00	10.00	27.05	13.58	1.40
	70508	729569	4237384	125	0.00	10.00	18.86	27.20	1.40
	70509	729552	4237366	125	0.00	10.00	25.99	42.90	1.40
	70510	729540	4237351	125	0.00	10.00	18.70	39.12	1.40
	70511	729527	4237337	125	0.00	10.00	19.92	41.33	1.40
	70512	729514	4237323	121	0.00	10.00	19.24	45.02	1.40
	70513	729499	4237316	125	0.00	10.00	17.85	62.80	1.40
G-K	70550	729479	4237311	128	0.00	10.00	20.25	74.42	1.40
	70551	729460	4237298	126	0.00	10.00	21.51	55.33	1.40
	70552	729451	4237280	128	0.00	10.00	17.86	23.98	1.40
	70553	729450	4237278	128	0.00	24.48	10.00	90.00	1.40
H-L	70600	729611	4237950	130	0.00	10.00	23.58	1.10	1.40
	70601	729611	4237950	130	0.00	35.37	10.00	88.53	1.40
	70602	729612	4237883	129	0.00	10.00	31.74	0.82	1.40
	70603	729611	4237846	129	0.00	10.00	37.18	0.70	1.40
	70604	729610	4237821	129	0.00	10.00	24.97	3.12	1.40
	70605	729606	4237784	129	0.00	10.00	37.80	5.51	1.40
	70606	729606	4237753	129	0.00	10.00	29.92	0.87	1.40
	70607	729606	4237753	129	0.00	24.48	10.00	90.00	1.40
	70608	729605	4237693	128	0.00	10.00	35.82	1.45	1.40
	70609	729603	4237661	125	0.00	10.00	32.69	3.18	1.40
	70610	729601	4237635	128	0.00	10.00	25.94	5.02	1.40
	70611	729598	4237614	128	0.00	10.00	21.09	8.66	1.40
	70612	729591	4237604	128	0.00	10.00	14.00	29.07	1.40
I-J	70650	729512	4237946	133	0.00	10.00	17.32	82.58	1.40

Segment	Source ID	Easting (UTM-m)	Northing (UTM-m)	Elevation (m-msl)	Release Height (m)	X-Dimension (m)	Y-Dimension (m)	Angle	Sigma-Z (m)
	70651	729496	4237936	134	0.00	10.00	16.15	56.33	1.40
	70652	729493	4237904	134	0.00	10.00	28.36	1.51	1.40
	70653	729493	4237902	133	0.00	21.01	10.00	73.48	1.40
	70654	729493	4237859	133	0.00	10.00	26.79	12.88	1.40
	70655	729483	4237846	133	0.00	10.00	18.66	36.89	1.40
	70656	729473	4237826	133	0.00	10.00	21.02	27.49	1.40
	70657	729465	4237795	133	0.00	10.00	31.49	13.72	1.40
	70658	729465	4237792	133	0.00	17.22	10.00	72.34	1.40
	70659	729470	4237776	133	0.00	23.56	10.00	79.04	1.40
	70660	729474	4237753	132	0.00	28.24	10.00	77.79	1.40
	70661	729480	4237726	132	0.00	24.63	10.00	88.26	1.40
	70662	729481	4237701	132	0.00	20.90	10.00	87.95	1.40
	70663	729480	4237660	131	0.00	10.00	20.94	4.09	1.40
	70664	729480	4237659	131	0.00	19.45	10.00	85.60	1.40
	70665	729482	4237640	130	0.00	13.43	10.00	90.00	1.40
	70666	729482	4237626	130	0.00	19.37	10.00	74.35	1.40
	70667	729488	4237606	130	0.00	19.36	10.00	62.43	1.40
	70668	729497	4237588	130	0.00	20.08	10.00	47.99	1.40
	70669	729511	4237572	130	0.00	11.66	10.00	39.78	1.40
K-M	70700	729427	4237243	123	0.00	10.00	29.75	61.04	1.40
	70701	729386	4237233	128	0.00	10.00	43.12	75.53	1.40
	70702	729346	4237218	128	0.00	10.00	42.69	69.94	1.40
	70703	729322	4237207	128	0.00	10.00	25.49	65.68	1.40

Figure 4-3. Haul Roads

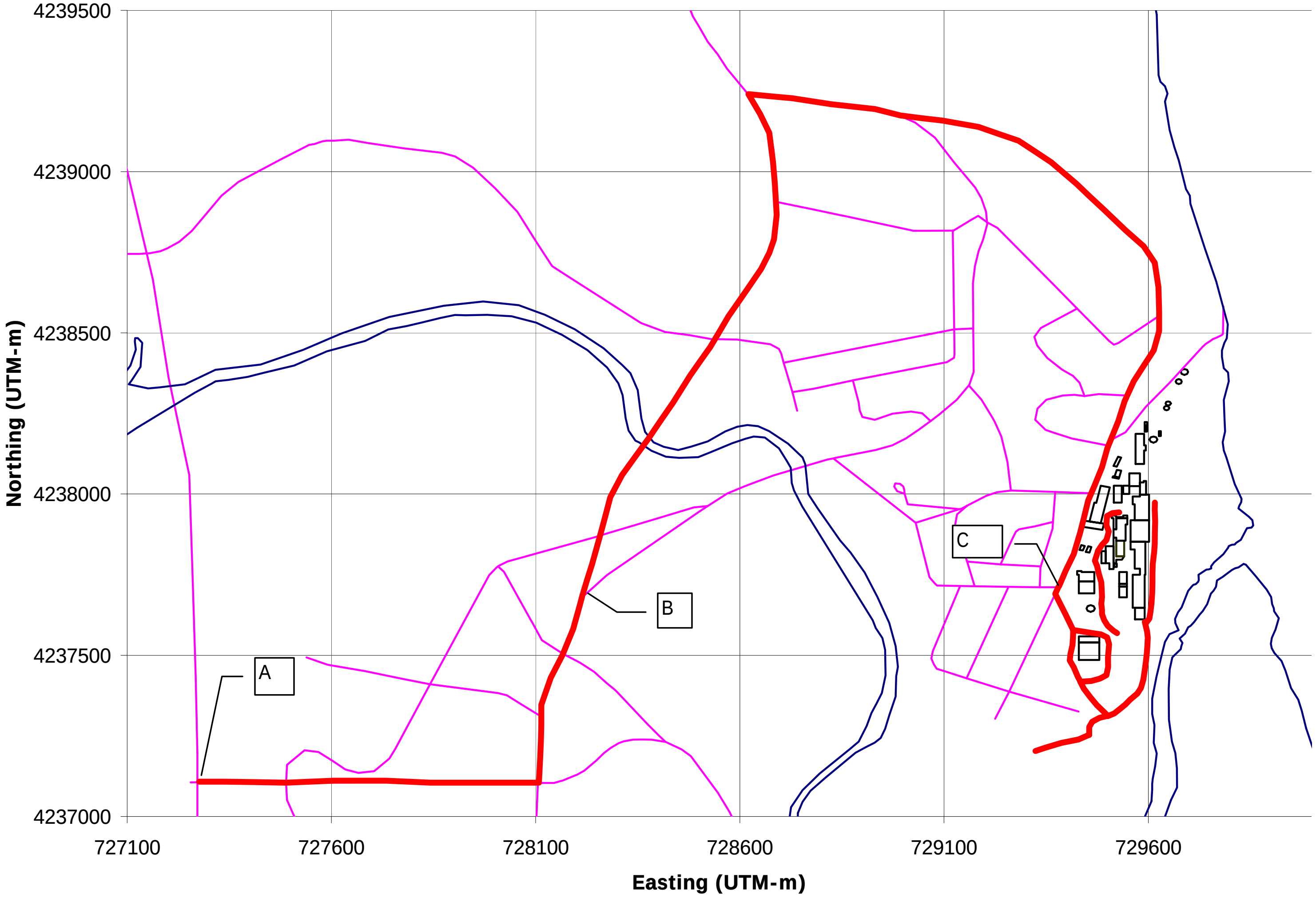


Figure 4-4. Haul Roads (Continued)

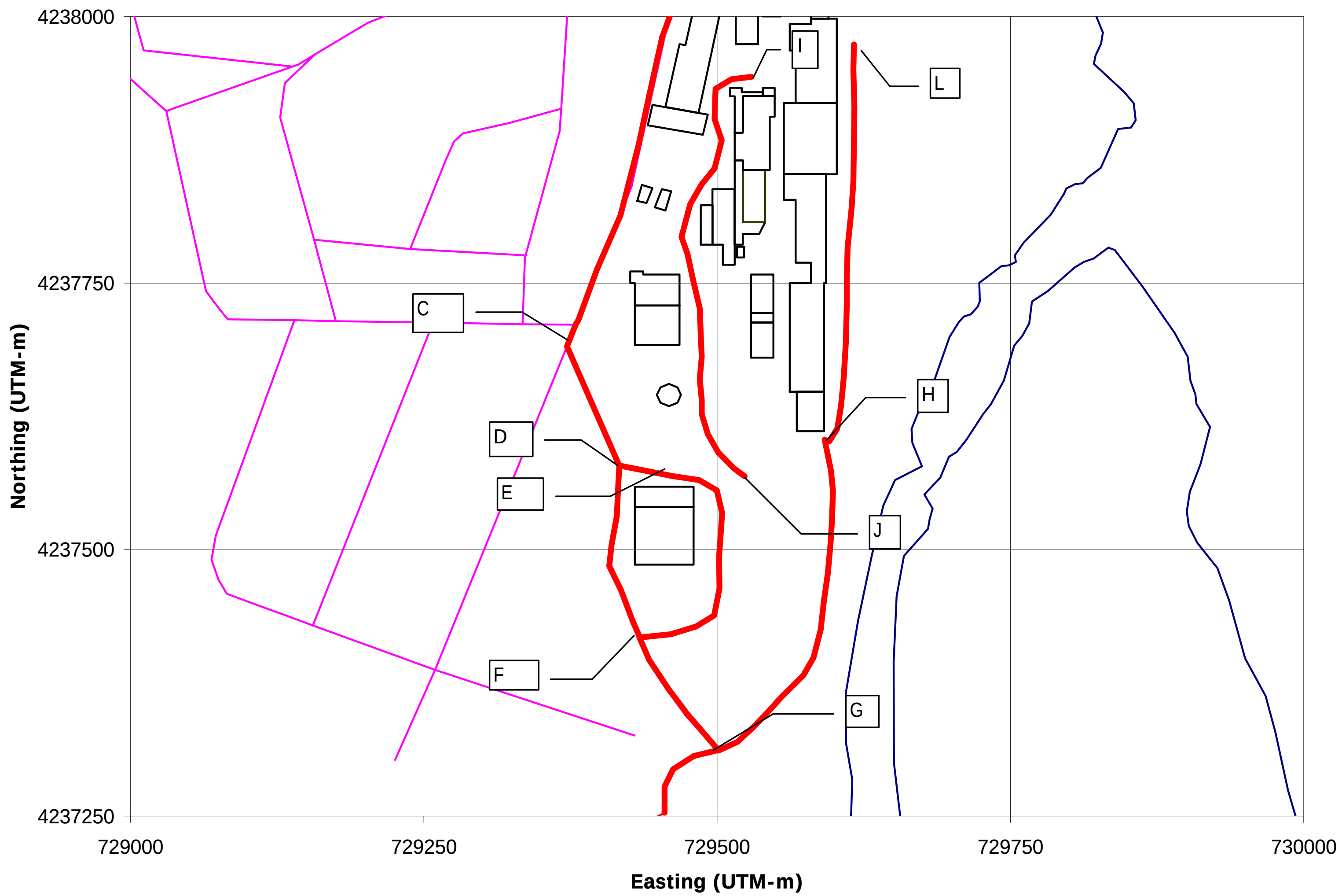


Figure 4-5. Haul Roads (Continued)

Table 4-5. Building Profile Information

BPIP ID	Description	No. of Tiers	Base Elevation (m-msl)	No. of Corners	Tier Height (m)	Tier Height (ft)	Easting (UTM-m)	Northing (UTM-m)
B1	Tank	1	125	8	15.24	50	729689	4238370
B2	Acid Tanks	1	126	8	12.20	40	729675	4238341
B3		1	127	8	9.14	30	729656	4238281
B4		1	127	8	9.14	30	729651	4238267
B5	Misc. Plant Buildings	4	130	4	6.10	20	729591	4238194
				4	15.24	50	729591	4238200
				4	21.30	70	729591	4238206
				4	15.24	50	729591	4238213
B6		1	128	4	9.14	30	729626	4238180
B7	Thaw House	1	130	8	9.14	30	729569	4238093
B8	Water Treatment Basin	1	129	8	12.20	40	729613	4238159
B9	Brick Storage	1	132	4	7.60	25	729515	4238088
B10	Round House	2	132	4	6.10	20	729513	4238051
				4	12.20	40	729518	4238054
B11	Lead Storage	7	123	4	9.14	30	729568	4237611
	Lead Storage/Refinery			12	18.30	60	729562	4237648
	Dross Plant			4	27.30	90	729557	4237852
	Blast Furnace			8	41.10	135	729567	4237919
	Power House			6	27.30	90	729580	4237998
				4	9.14	30	729554	4238025
	Unloader			4	22.86	75	729539	4238000
B12	No. 6 Baghouse	1	131	4	27.30	90	729516	4237974
B13	Maintenance Shop	2	131	6	9.14	30	729456	4237915
	Store House			4	10.67	35	729441	4237898
B14	Sinter Plant	7	130	4	7.60	25	729486	4237786
				6	9.14	30	729505	4237767
				8	18.30	60	729515	4237786
				4	22.86	75	729522	4237807

BPIP ID	Description	No. of Tiers	Base Elevation (m-msl)	No. of Corners	Tier Height (m)	Tier Height (ft)	Easting (UTM-m)	Northing (UTM-m)
				10	41.10	135	729522	4237856
				10	13.72	45	729515	4237891
				4	30.48	100	729539	4237925
B15		1	129	4	9.14	30	729517	4237774
B16	Doctor's Office	1	131	4	22.86	75	729432	4237827
B17	Garage	1	131	4	6.10	20	729447	4237821
B18	Change House	2	128	4	12.20	40	729430	4237692
				8	7.60	25	729430	4237729
B19	No. 3 Baghouse	3	128	4	21.30	70	729529	4237680
				4	27.43	90	729529	4237713
				4	21.30	70	729529	4237722
B20	Acid Tank	1	126	8	9.75	32	729459	4237635
B21	Strip Rolling Mill	2	127	4	6.71	22	729430	4237486
				4	15.24	50	729430	4237540

Figure 4-6. Building Locations

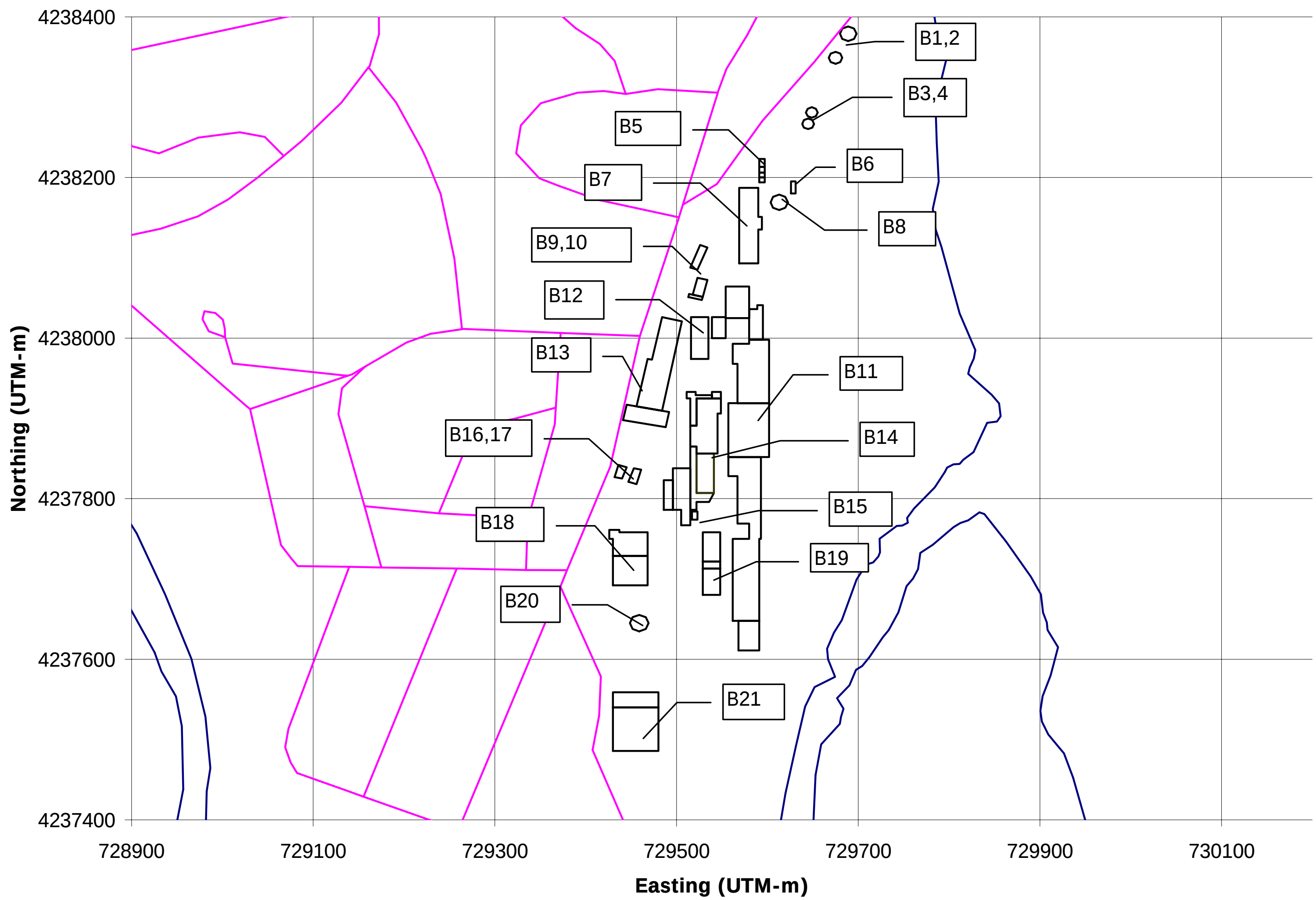


Table 4-6. Sinter Plant Particle Information

Particle Diameter Range (µm)	Particle Frequency Count	Average Particle Mass (µg)	Mass Mean Volume (µm^3)	Mass Mean Diameter (µm)	Cumulative Mass (µg)	Cumulative Mass (%)	Mass Fraction
0 - 2.5	0	---	---	---	0.0000	0.00	---
2.5 - 5	112	2.95E-04	55	4.72	0.0331	0.55	0.0055
5 - 10	694	1.01E-03	190	7.12	0.7371	12.20	0.1166
10 - 15	154	4.97E-03	928	12.08	1.5018	24.87	0.1266
15 - 20	54	1.39E-02	2606	17.04	2.2548	37.33	0.1247
20 - 30	44	3.89E-02	7267	23.97	3.9654	65.66	0.2833
30 - 40	10	1.10E-01	20496	33.86	5.0620	83.82	0.1816
40 - 50	4	2.44E-01	45674	44.21	6.0394	100.00	0.1618
>50	5					**Total**	**1.0000**

A. Particle Density = 5.35 g/cc

Table 4-7. Blast Furnace Particle Information

Particle Diameter Range (µm)	Particle Frequency Count	Average Particle Mass (µg)	Mass Mean Volume (μm^3)	Mass Mean Diameter (µm)	Cumulative Mass (µg)	Cumulative Mass (%)	Mass Fraction
0 - 2.5	0	---	---	---	0.0000	0.00	---
2.5 - 5	32	2.84E-04	57	4.77	0.0091	0.32	0.0032
5 - 10	313	9.97E-04	200	7.24	0.3213	11.25	0.1093
10 - 15	61	4.47E-03	896	11.94	0.5941	20.80	0.0955
15 - 20	23	1.45E-02	2897	17.65	0.9266	32.44	0.1164
20 - 30	16	3.67E-02	7362	24.08	1.5144	53.03	0.2058
30 - 40	7	1.14E-01	22815	35.09	2.3113	80.93	0.2790
40 - 50	3	1.82E-01	36379	40.99	2.8559	100.00	0.1907
>50	2					**Total**	**1.0000**

A. Particle Density = 4.99 g/cc

Table 4-8. Dross Plant Particle Information

Particle Diameter Range (µm)	Particle Frequency Count	Average Particle Mass (µg)	Mass Mean Volume (µm³)	Mass Mean Diameter (µm)	Cumulative Mass (µg)	Cumulative Mass (%)	Mass Fraction
0 - 2.5	0	---	---	---	0.0000	0.00	---
2.5 - 5	31	3.23E-04	56	4.76	0.0100	0.46	0.0046
5 - 10	373	1.02E-03	179	6.98	0.3914	17.88	0.1742
10 - 15	76	5.61E-03	981	12.30	0.8178	37.36	0.1948
15 - 20	23	1.48E-02	2582	16.98	1.1574	52.88	0.1552
20 - 30	11	3.95E-02	6913	23.58	1.5924	72.75	0.1987
30 - 40	5	1.19E-01	20859	34.06	2.1890	100.00	0.2725
40 - 50	0	0.00E+00	---	---	2.1890	100.00	---
>50	3					**Total**	**1.0000**

A. Particle Density = 5.72 g/cc

Table 4-9. Refinery Particle Information

Particle Diameter Range (μm)	Particle Frequency Count	Average Particle Mass (μg)	Mass Mean Volume (μm^3)	Mass Mean Diameter (μm)	Cumulative Mass (μg)	Cumulative Mass (%)	Mass Fraction
0 - 2.5	0	---	---	---	0.0000	0.00	---
2.5 - 5	37	3.40E-04	58	4.80	0.0126	0.22	0.0022
5 - 10	270	1.07E-03	183	7.04	0.3028	5.38	0.0516
10 - 15	86	5.37E-03	916	12.03	0.7644	13.59	0.0821
15 - 20	43	1.69E-02	2882	17.62	1.4906	26.50	0.1291
20 - 30	44	4.23E-02	7224	23.93	3.3533	59.63	0.3312
30 - 40	9	1.18E-01	20095	33.64	4.4132	78.47	0.1885
40 - 50	5	2.42E-01	41323	42.76	5.6239	100.00	0.2153
>50	4					**Total**	**1.0000**

A. Particle Density = 5.86 g/cc

Table 4-10. Fugitive Source Particle Information

Emission Source	Particle Diameter Range (µm)			Mass Mean Diameter (µm)	Particle Size Multiplier	Cumulative Mass Fraction (%)	Cumulative Mass Fraction < 30 µm	Mass Fraction < 30 µm
Material Handling/Wind Erosion	0	-	2.5	1.57	0.053	5.3	0.0716	0.0716
	2.5	-	5	3.88	0.2	20	0.2703	0.1986
	5	-	10	7.75	0.35	35	0.4730	0.2027
	10	-	15	12.63	0.48	48	0.6486	0.1757
	15	-	20	17.57		**60**	0.8108	0.1622
	20	-	30	25.25	0.74	74	1.0000	0.1892
Paved Haul Roads	0	-	2.5	1.57	0.004	4	0.0488	0.0488
	2.5	-	5	3.88		**9**	0.1000	0.0512
	5	-	10	7.75	0.016	18	0.1951	0.0951
	10	-	15	12.63	0.02	22	0.2439	0.0488
	15	-	20	17.57		**53**	0.5889	0.3450
	20	-	30	25.25	0.082	90	1.0000	0.4111
Unpaved Haul Roads	0	-	2.5	1.57	0.23	4	0.0469	0.0469
	2.5	-	5	3.88		**13**	0.1444	0.0975
	5	-	10	7.75	1.5	28	0.3061	0.1617
	10	-	15	12.63		**54**	0.6000	0.2939
	15	-	20	17.57		**72**	0.8000	0.2000
	20	-	30	25.25	4.9	90	1.0000	0.2000

A. For the haul roads, 90% of the suspended mass was assumed to have an aerometric diameter <30 um.
B. Particle diameters refer to their aerometric diameters.

Table 4-11. Particle Diameter Summary

Minimum Diameter (µm):		0	2.5	5	10	15	20	30	40
Maximum Diameter (µm):		**2.5**	**5**	**10**	**15**	**20**	**30**	**40**	**50**
Particle Group ID	**Particle Group Description**	**Particle Diameter (µm)**							
1	Sinter Plant	**1.5742**	4.7193	7.1187	12.0808	17.0377	23.9721	33.8578	44.2126
2	Blast Furnace Operation	**1.5742**	4.7707	7.2446	11.9417	17.6475	24.0765	35.0884	40.9862
3	Dross Plant	**1.5742**	4.7563	6.9805	12.3047	16.9838	23.5772	34.0565	**45.0126**
4	Refinery Plant	**1.5742**	4.7998	7.0408	12.0274	17.6178	23.9251	33.6361	42.7628
5	Material Handling/Wind Erosion	1.5742	3.8788	7.7522	12.6324	17.5678	25.2473	---	---
6	Paved Haul Roads	1.5742	3.8788	7.7522	12.6324	17.5678	25.2473	---	---
7	Unpaved Haul Roads	1.5742	3.8788	7.7522	12.6324	17.5678	25.2473	---	---

Table 4-12. Particle Mass Fraction Summary

Minimum Diameter (µm):		0	2.5	5	10	15	20	30	40
Maximum Diameter (µm):		**2.5**	**5**	**10**	**15**	**20**	**30**	**40**	**50**
Particle Group ID	**Particle Group Description**	**Mass Fraction**							
1	Sinter Plant	0.0000	0.0055	0.1166	0.1266	0.1247	0.2833	0.1816	0.1618
2	Blast Furnace Operation	0.0000	0.0032	0.1093	0.0955	0.1164	0.2058	0.2790	0.1907
3	Dross Plant	0.0000	0.0046	0.1742	0.1948	0.1552	0.1987	0.2725	0.0000
4	Refinery Plant	0.0000	0.0022	0.0516	0.0821	0.1291	0.3312	0.1885	0.2153
5	Material Handling/Wind Erosion	0.0716	0.1986	0.2027	0.1757	0.1622	0.1892	---	---
6	Paved Haul Roads	0.0488	0.0512	0.0951	0.0488	0.3450	0.4111	---	---
7	Unpaved Haul Roads	0.0469	0.0975	0.1617	0.2939	0.2000	0.2000	---	---

Table 4-13. Particle Density Summary

Minimum Diameter (µm):		0	2.5	5	10	15	20	30	40
Maximum Diameter (µm):		2.5	5	10	15	20	30	40	50
Particle Group ID	Particle Group Description	Particle Density (g/cc)							
1	Sinter Plant	5.3500	5.3500	5.3500	5.3500	5.3500	5.3500	5.3500	5.3500
2	Blast Furnace Operation	4.9900	4.9900	4.9900	4.9900	4.9900	4.9900	4.9900	4.9900
3	Dross Plant	5.7200	5.7200	5.7200	5.7200	5.7200	5.7200	5.7200	5.7200
4	Refinery Plant	5.8600	5.8600	5.8600	5.8600	5.8600	5.8600	5.8600	5.8600
5	Material Handling/Wind Erosion	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	---	---
6	Paved Haul Roads	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	---	---
7	Unpaved Haul Roads	1.0000	1.0000	1.0000	1.0000	1.0000	1.0000	---	---

5.0 Model Performance Evaluation

5.1 Overview

The year of 2005 was used as the study period for the model performance evaluation, with special attention to the first quarter. The performance of the dispersion model was evaluated by comparing the daily predicted concentrations to the concentrations measured at the ambient monitors. In addition to the total concentration, the source contribution was also compared to contributions predicted using the Chemical Mass Balance (CMB) method.

A map showing the locations of the lead monitors near the primary smelter has been provided as Figure 5-1. The largest impacts have been historically measured at the Broad Street monitor, which is located approximately 1000 feet west of the sinter plant. The City Hall monitors are located north of the Broad Street location on the west side of the City Hall parking lot.

A summary of the 2005 high 3-month measured lead concentrations for each monitor near the smelter has been provided as Figure 5-2. As previously mentioned the greatest impacts were found at the Broad Street monitor which had a measured impact of 1.88 $\mu g/m^3$ at the MDNR site and 1.93 $\mu g/m^3$ at the collocated Doe Run site. The maximum impacts occurred during the first quarter. The second greatest impacts were at the City Hall monitors. The MDNR site had measured impacts of 1.09 $\mu g/m^3$ for the second and fourth quarters of 2005 and a maximum concentration of 1.12 $\mu g/m^3$ was measured at the Doe Run site during the fourth quarter of 2005. The rest of the monitors had measured high 3-month impacts less than 0.5 $\mu g/m^3$.

5.2 Broad Street Performance Evaluation

The first step of the analysis was to compare the measured concentrations from the collocated monitors. This is done inorder to ensure the accuracy of the measured data that will be compared to the concentrations predicted by the dispersion model. A QQ plot comparing the 24-hr average measured concentrations from the DNR and Doe Run monitors has been provided as Figure 5-3. The paired measured concentrations showed good agreement. The R-squared value of the linear regression was 0.9762 (1 = Perfect) and the slope and intercept were 1.0256 and 0.0651 $\mu g/m^3$, respectively.

Next, the difference between the concentration predicted by the dispersion model and the concentration measured at the MDNR monitor was calculated for each 24-hr period during the year of 2005. There were 245 days during the year of 2005 that had both measured concentrations and valid meteorological data (required for the dispersion model) that could be compared. The frequency histogram of the predicted to measured difference has been provided as Figure 5-4. The dispersion model predicted within 1 $\mu g/m^3$ on 77% of the days and within 3 $\mu g/m^3$ on 95% of the days. There were two obvious outliers: March 21st and 22nd. The measured concentration on March 21st was 32.89 $\mu g/m^3$ and the model predicted a concentration of 6.44 $\mu g/m^3$. Similarly, on March 22nd a concentration of 35.83 $\mu g/m^3$ was measured at the monitor and the dispersion model predicted 1.67 $\mu g/m^3$. Doe Run indicated that there were events at the Blast Furnace on the 21st and they had a major failure at their No. 5 baghouse during the morning of the 22nd.

A time series of the measured and predicted 24-hr lead concentrations has been provided as Figure 5-5 for the first quarter of 2005.

The paired QQ plot comparing the measured to predicted 24-hr average concentrations has been provided as Figure 5-6. The R-squared value of the linear regression was 0.5614 and the slope and intercept were 0.6525 and

0.3017 μg/m^3 , respectively. Additionally, the unpaired QQ plot has been provided as Figure 5-7. The R-squared value of the linear regression was 0.9664 and the slope and intercept were 0.8561 and 0.0459 μg/m^3 , respectively. This means that the 24-hr average predicted concentration distribution matches very closely to the measured data, and with the exception of the two outliers discussed previously, the model is able to predict the maximum 24-hr concentration quite reliably.

A plot showing the average measured and predicted concentration over different time blocks (first quarter of 2005, study period, January-May of 2005) has been provided as Figure 5-8. The average measured and predicted concentrations over the study period (3/21-22 removed) were 1.14 μg/m^3 and 1.17 μg/m^3. This means that with the exception of the two outliers mentioned above, the model predicted within 2.6% of the measured concentration over the study period.

5.3 City Hall Performance Evaluation

The first step of the analysis was to compare the measured concentrations from the collocated monitors. This is done inorder to ensure the accuracy of the measured data that will be compared to the concentrations predicted by the dispersion model. A QQ plot comparing the 24-hr average measured concentrations from the DNR and Doe Run monitors has been provided as Figure 5-9. The paired measured concentrations showed good agreement. The R-squared value of the linear regression was 0.9238 and the slope and intercept were 0.9783 and -0.0584 μg/m^3 , respectively.

Next, the difference between the concentration predicted by the dispersion model and the concentration measured at the MDNR monitor was calculated for each 24-hr period during the year of 2005. There were 232 days during the year of 2005 that had both measured concentrations and valid meteorological data (required for the dispersion model) that could be compared. The frequency histogram of the predicted to measured difference has been provided as Figure 5-10. The dispersion model predicted within 1 µg/m^3 on 86% of the days and within 3 µg/m^3 on 99% of the days.

A time series of the measured and predicted 24-hr lead concentrations has been provided as Figure 5-11 for the first quarter of 2005.

The paired QQ plot comparing the measured to predicted 24-hr average concentrations has been provided as Figure 5-12. The R-squared value of the linear regression was 0.6015 and the slope and intercept were 0.74929 and 0.2172 µg/m^3 , respectively. Additionally, the unpaired QQ plot has been provided as Figure 5-13. The R-squared value of the linear regression was 0.9731 and the slope and intercept were 0.953 and 0.0303 µg/m^3 , respectively.

A plot showing the average measured and predicted concentration over different time blocks (first quarter of 2005, study period, January-May of 2005) has been provided as Figure 5-14. The average measured and predicted concentrations over the study period were 0.88 µg/m^3 and 0.90 µg/m^3. This means that the model predicted within 2.3% of the measured concentration over the study period.

Figure 5-1. Lead Monitor Locations

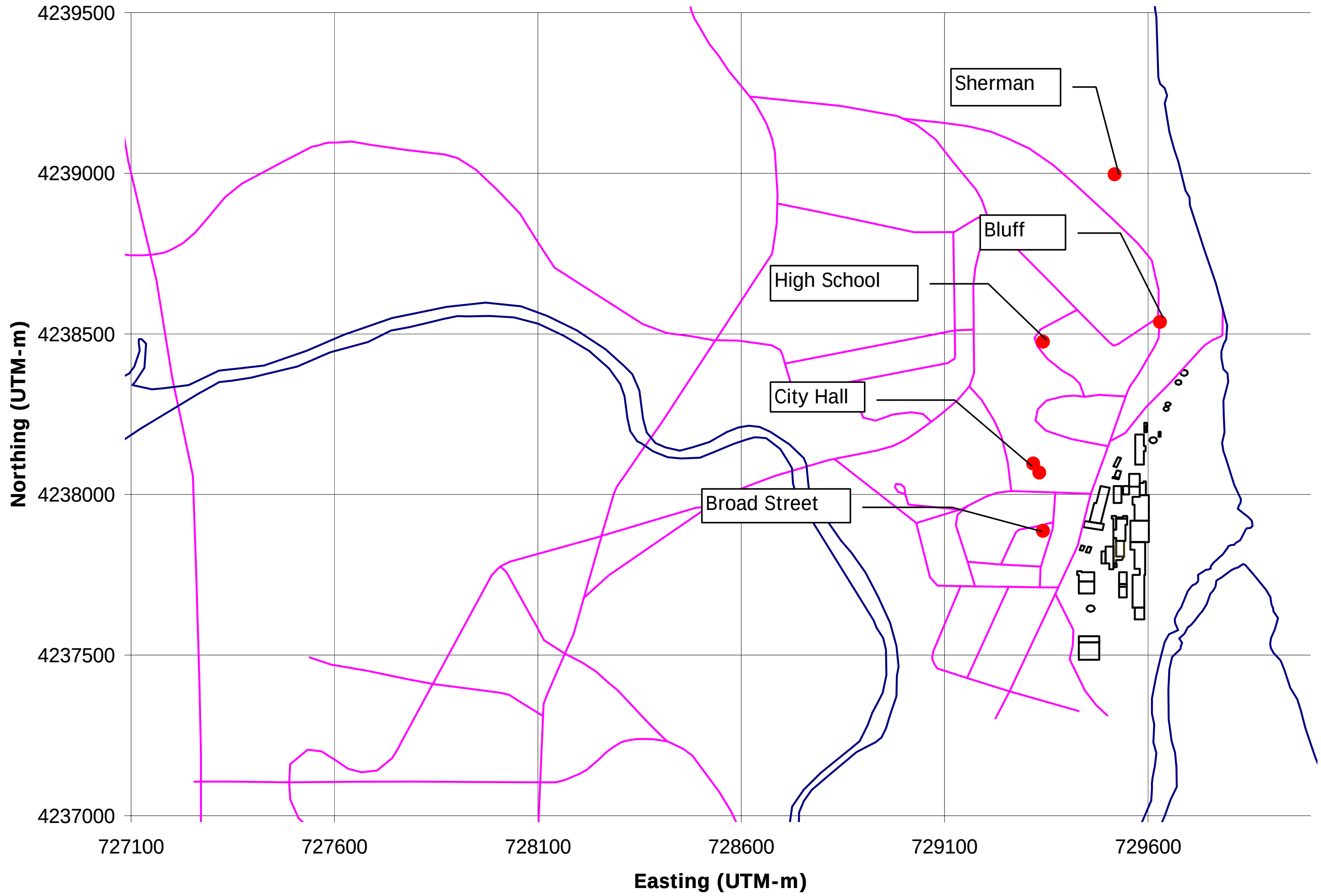


Figure 5-2. Summary of 2005 High 3-Month Average Measured Lead Concentrations

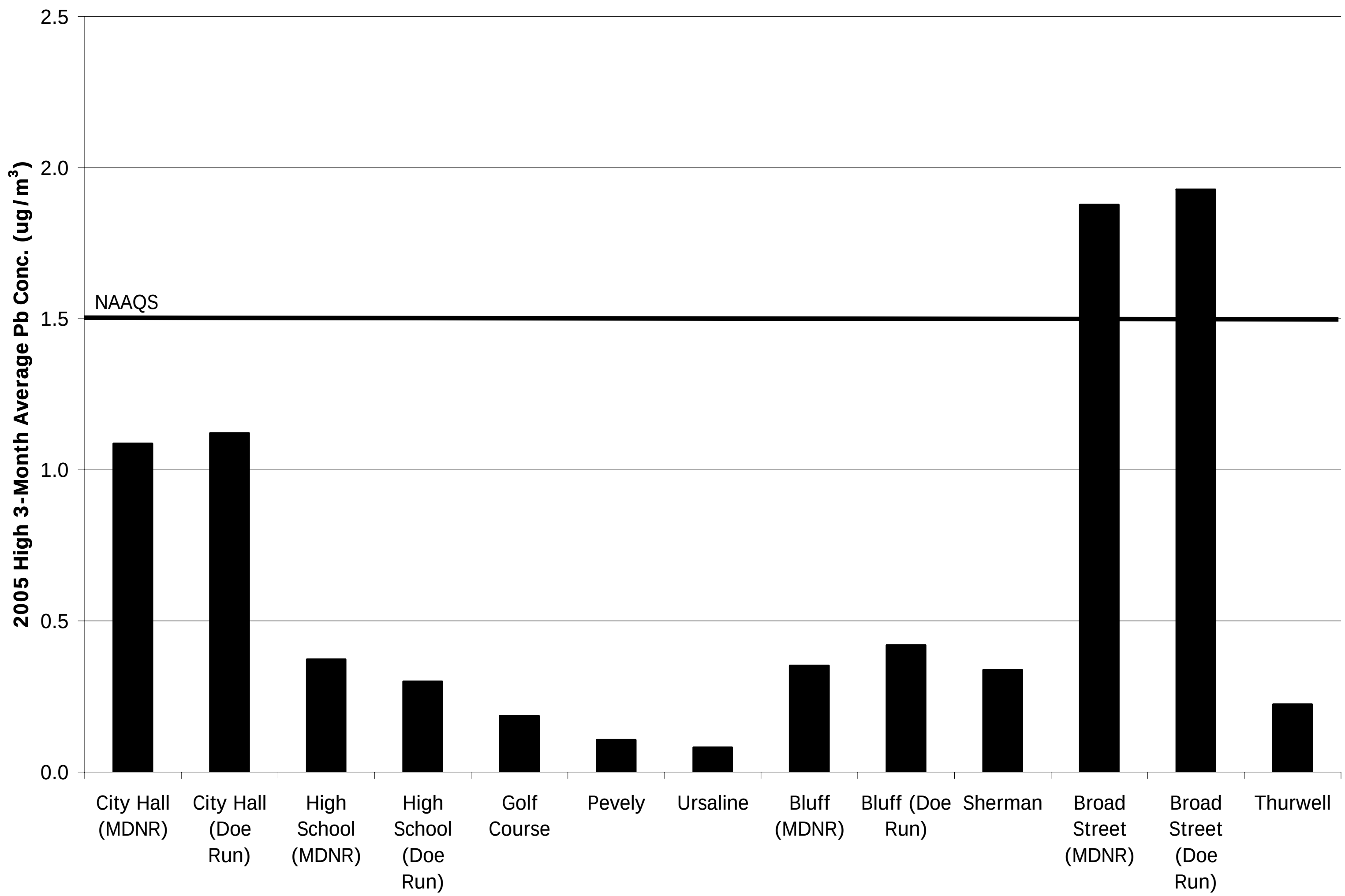


Figure 5-3. QQ Plot, Doe Run Measured – DNR Measured (Broad Street)

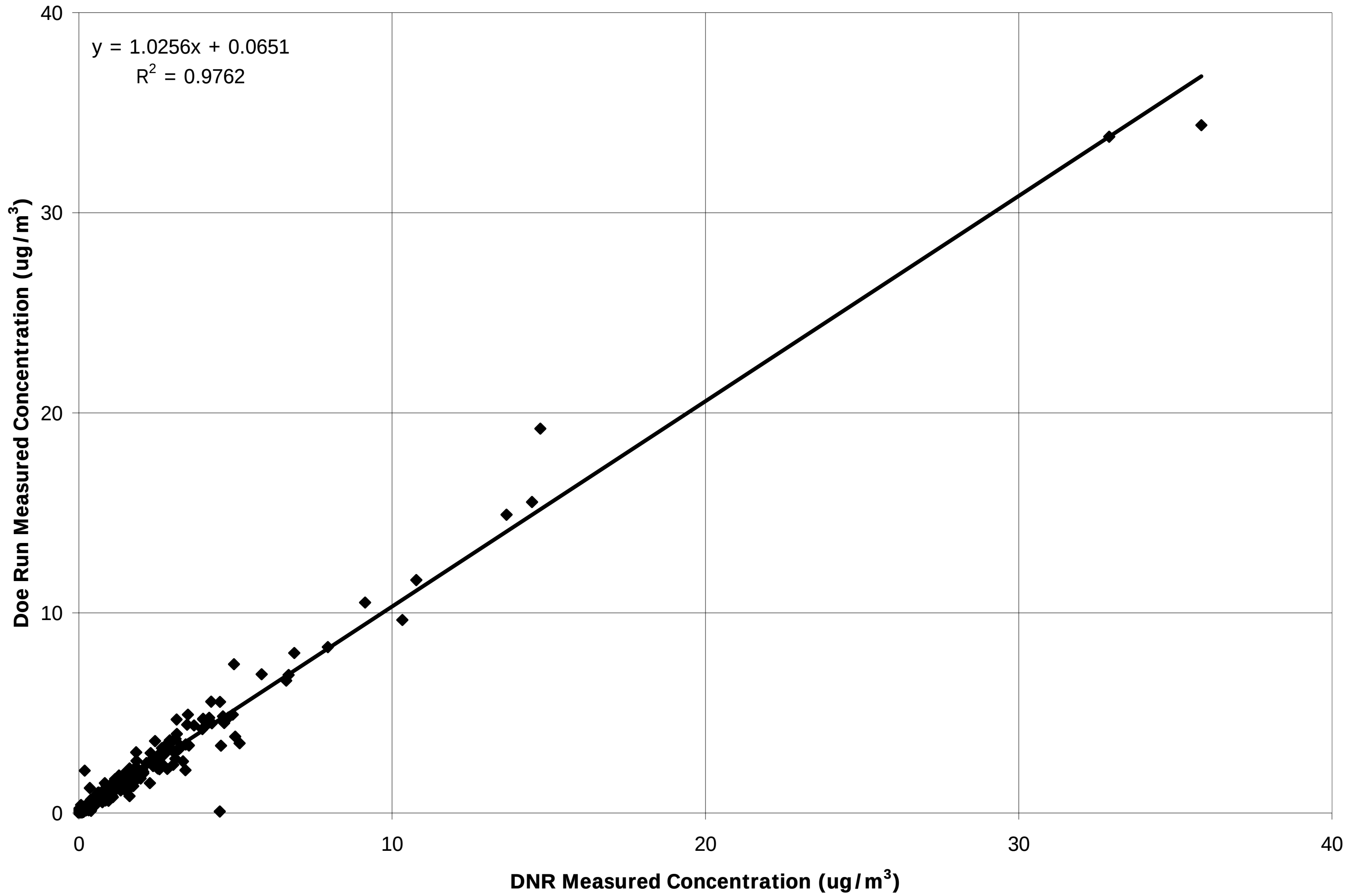


Figure 5-4. Frequency Histogram, Measured - Predicted Daily Conc. Differences (Broad Street)

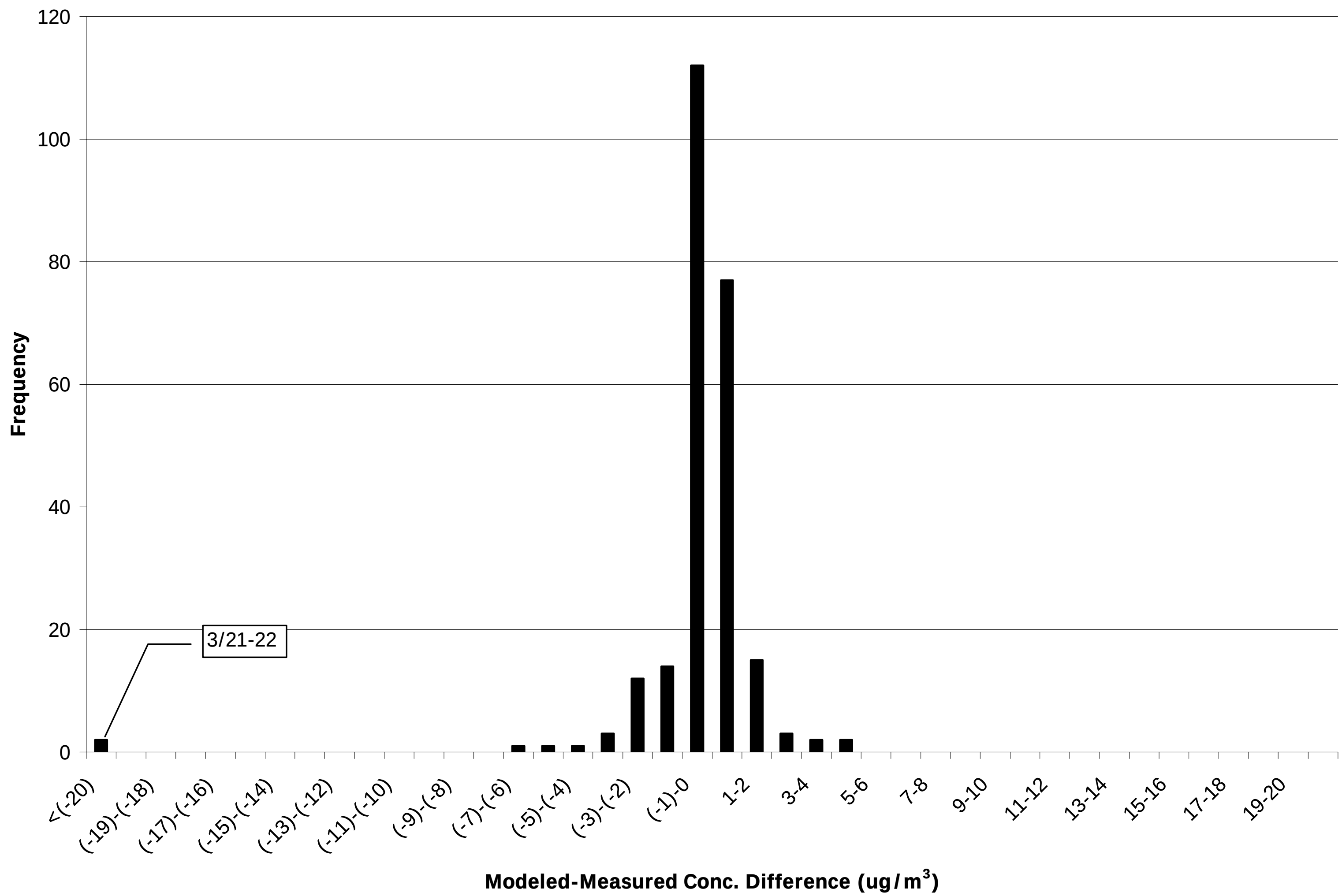


Figure 5-5. Time Series, First Quarter 2005 (Broad Street)

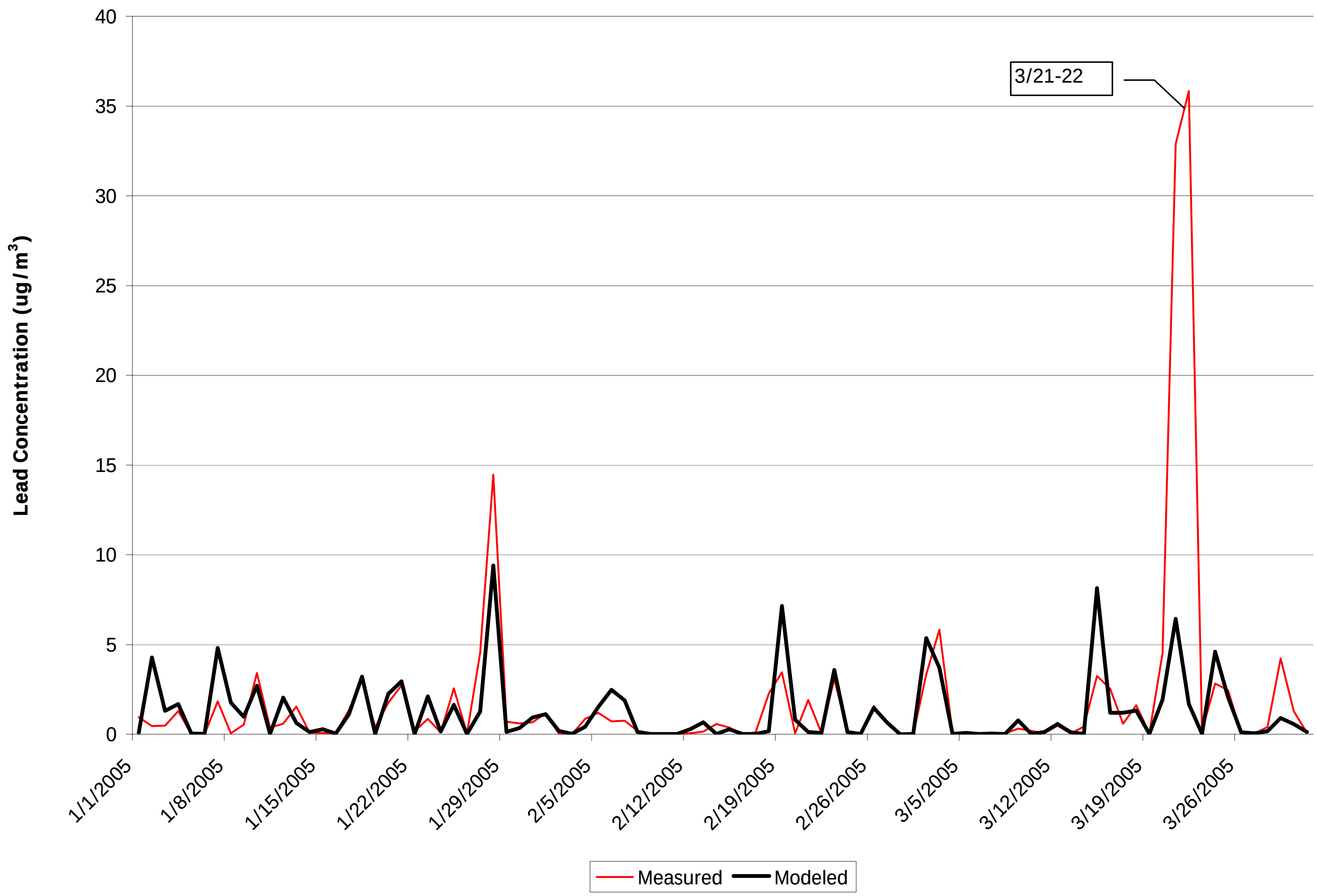


Figure 5-6. QQ Plot, Measured - Predicted, Paired (Broad Street)

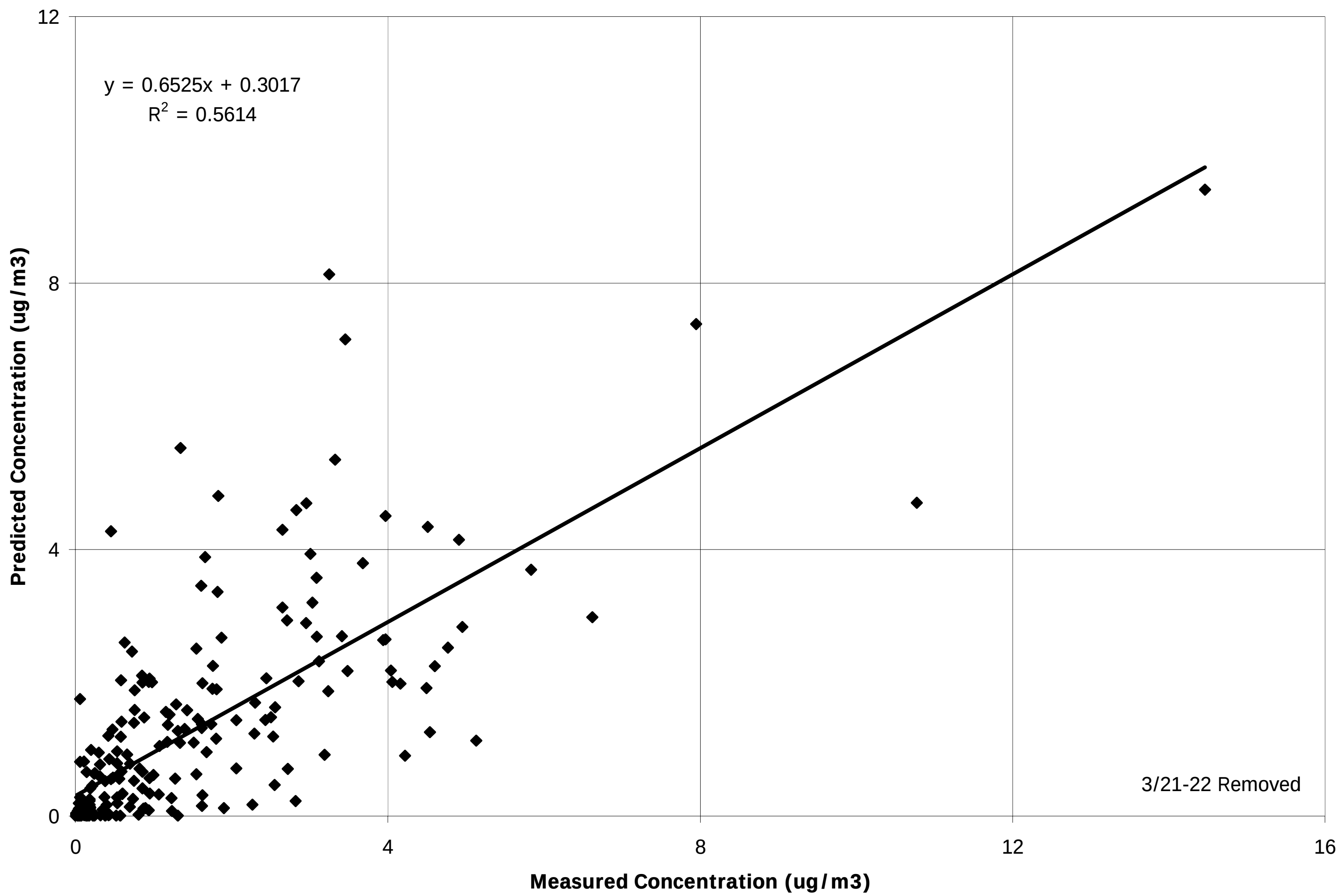


Figure 5-7. QQ Plot, Measured - Predicted, Unpaired (Broad Street)

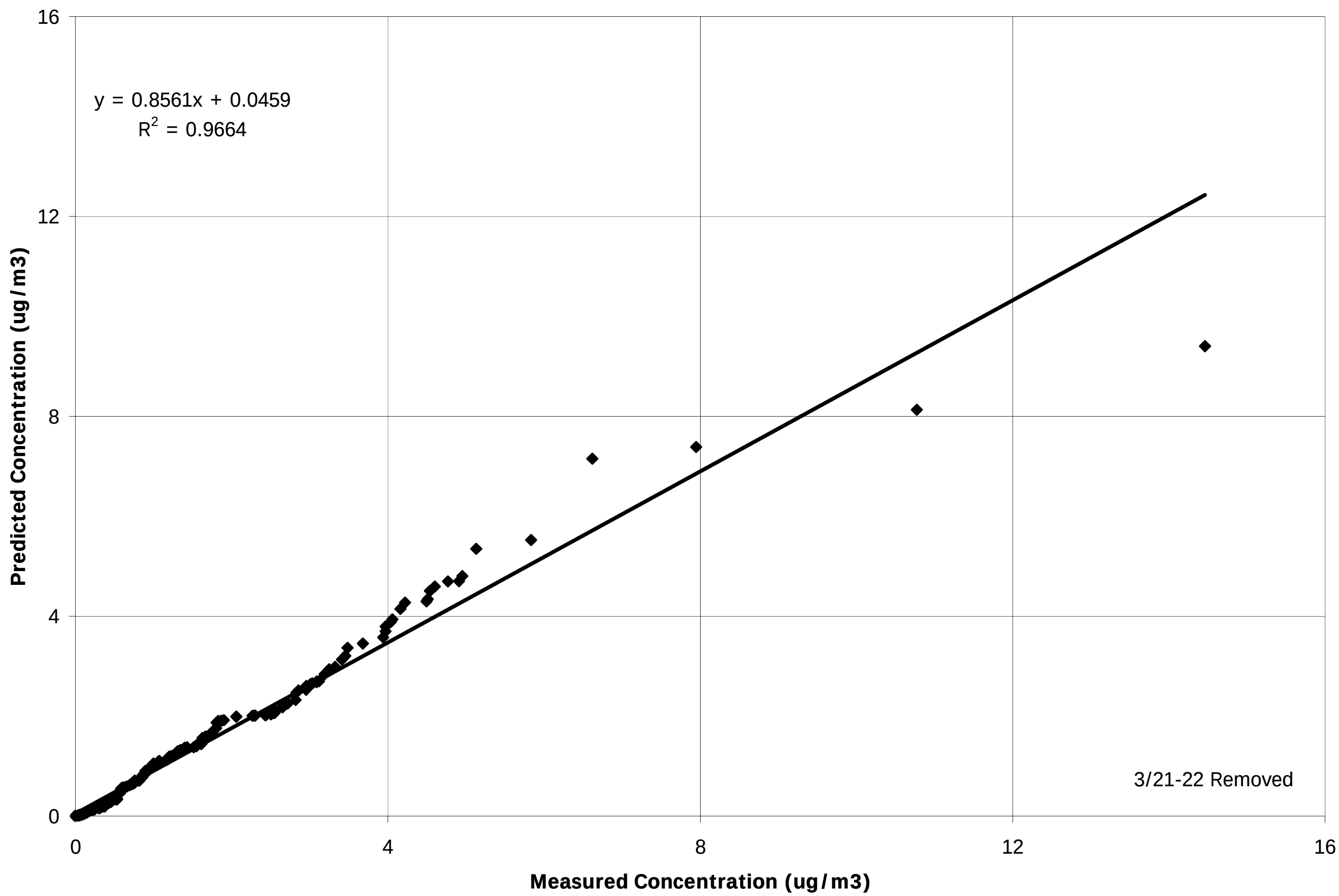


Figure 5-8. Average Concentrations for Different Time Blocks (Broad Street)

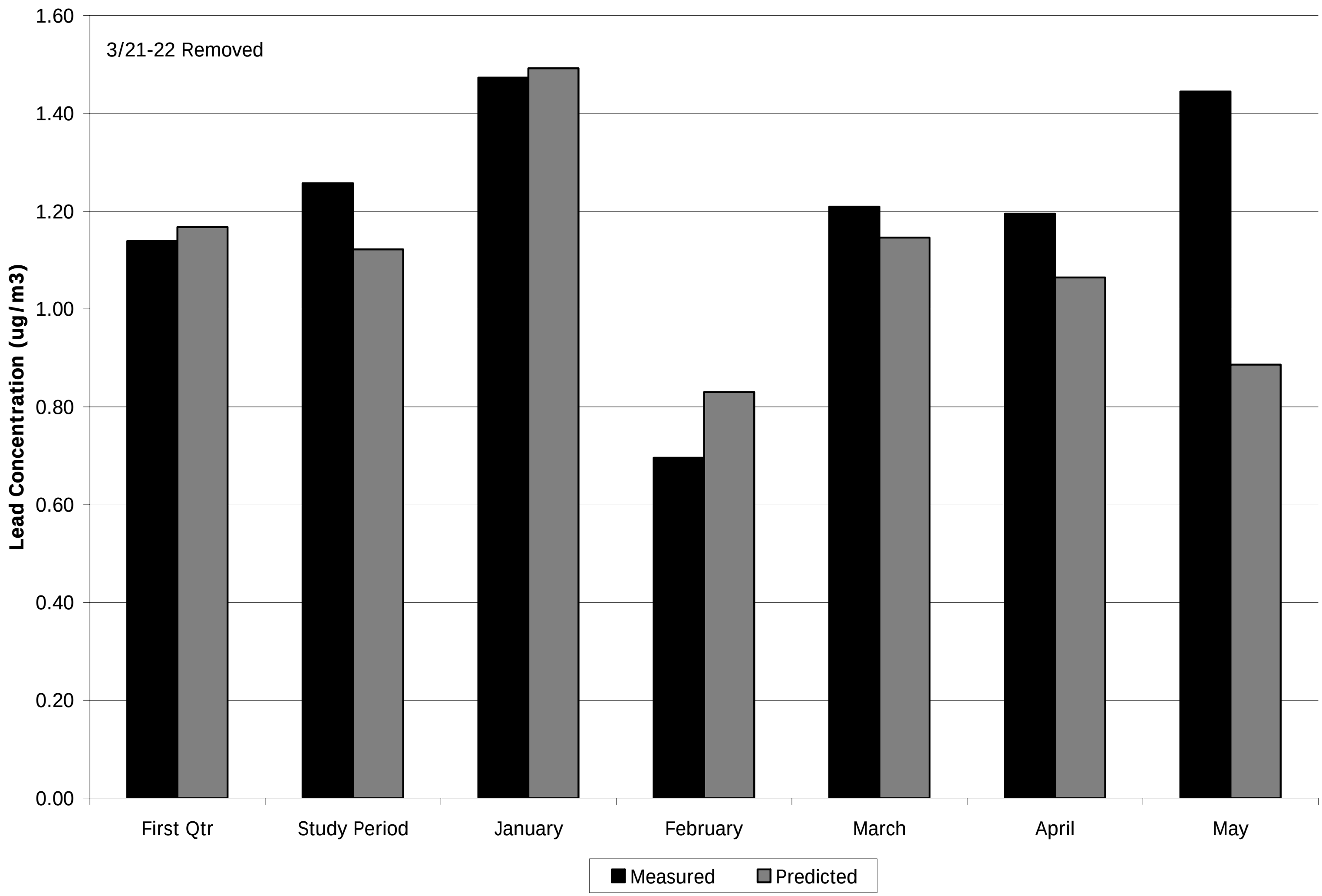


Figure 5-9. QQ Plot, Doe Run Measured – DNR Measured (City Hall)

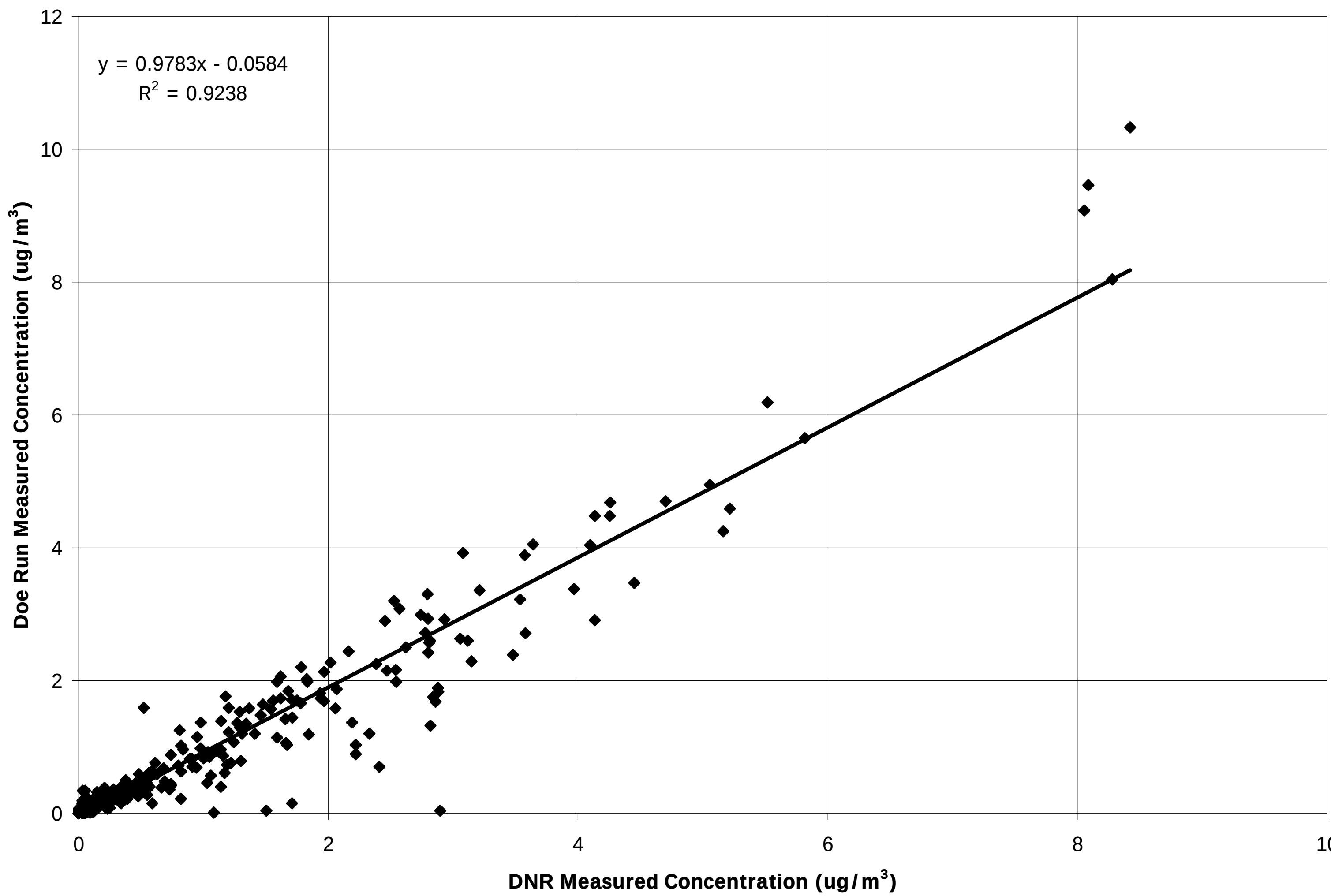


Figure 5-10. Frequency Histogram, Measured - Predicted Daily Conc. Differences (City Hall)

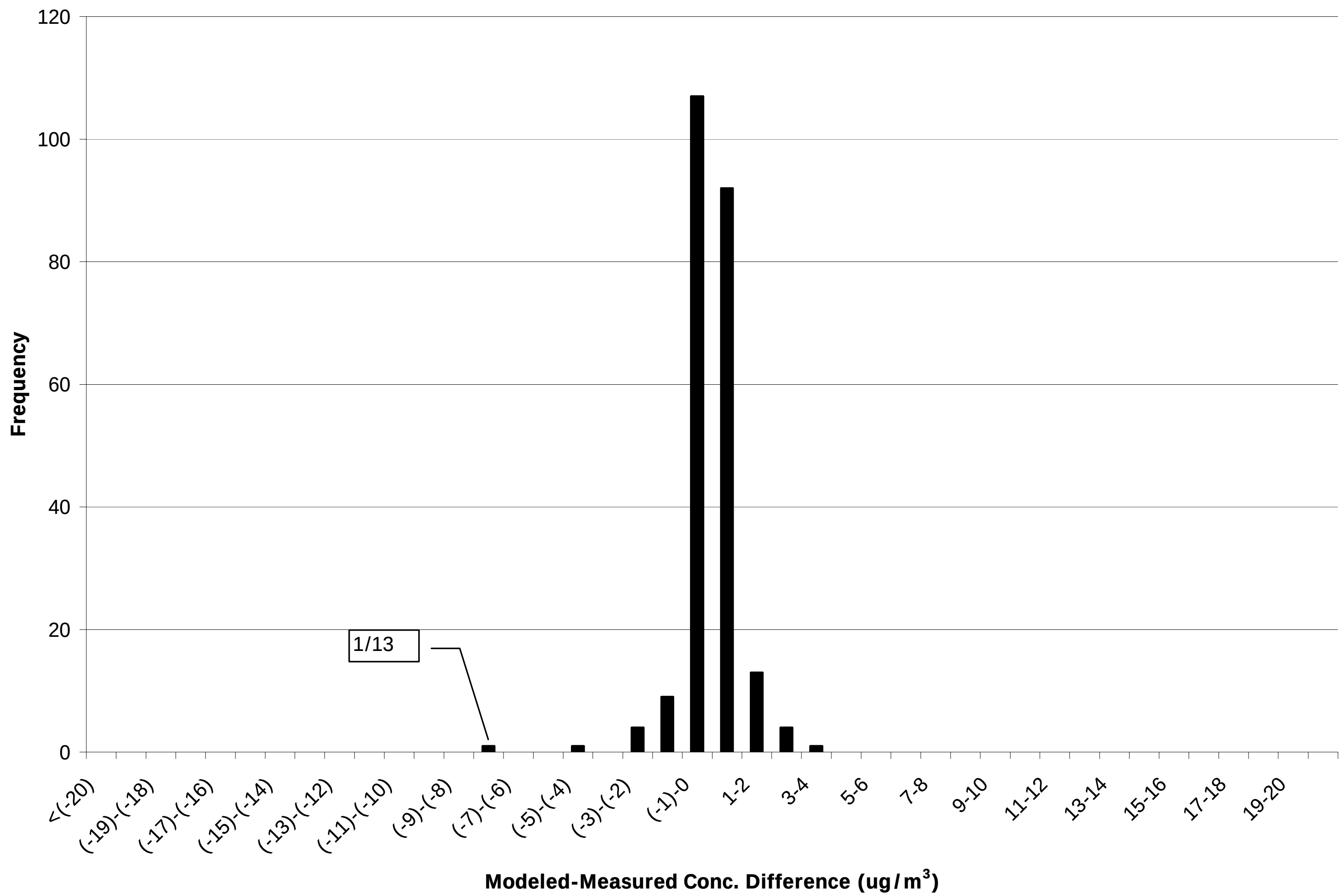


Figure 5-11. Time Series, First Quarter 2005 (City Hall)

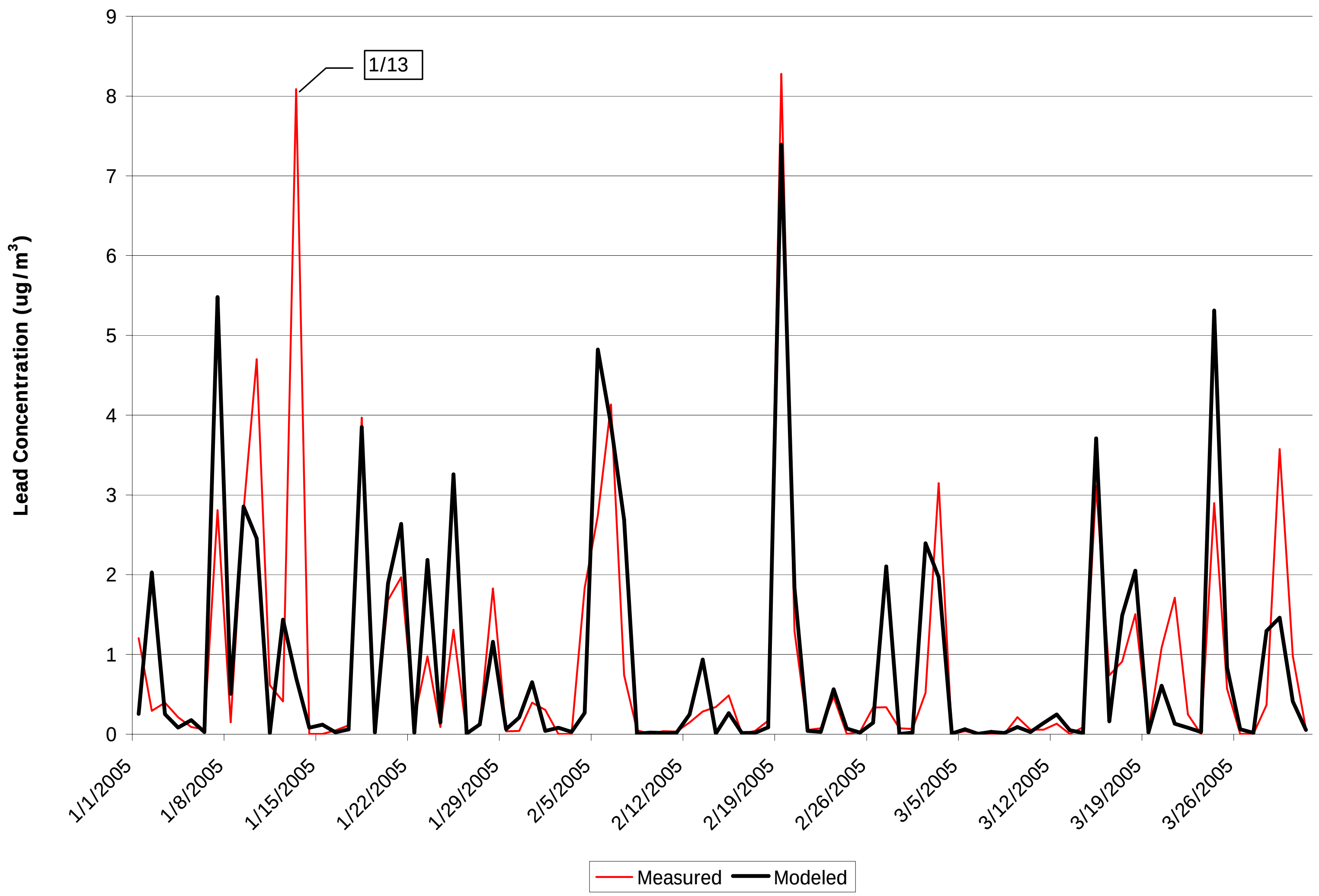


Figure 5-12. QQ Plot, Measured - Predicted, Paired (City Hall)

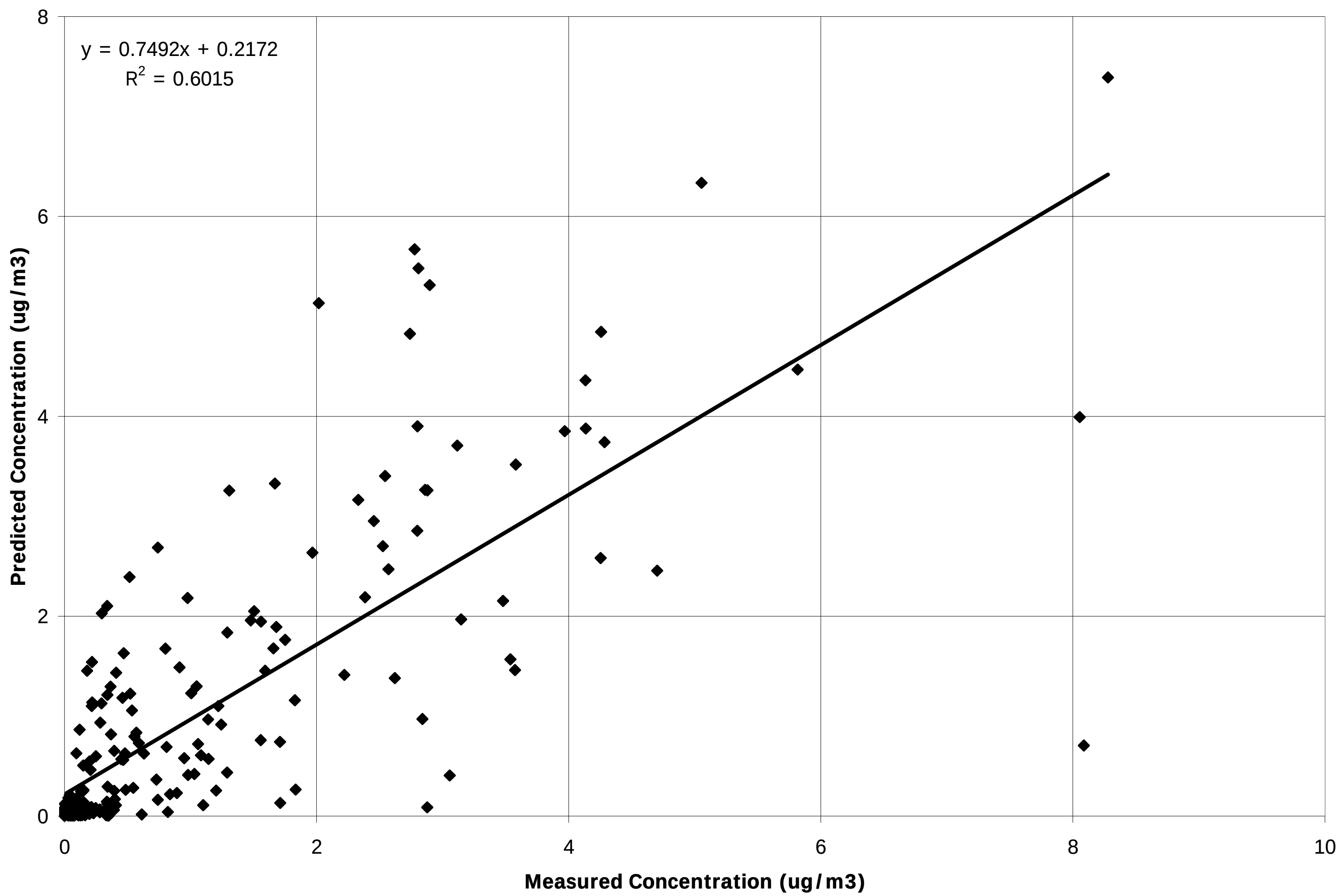


Figure 5-13. QQ Plot, Measured - Predicted, Unpaired (City Hall)

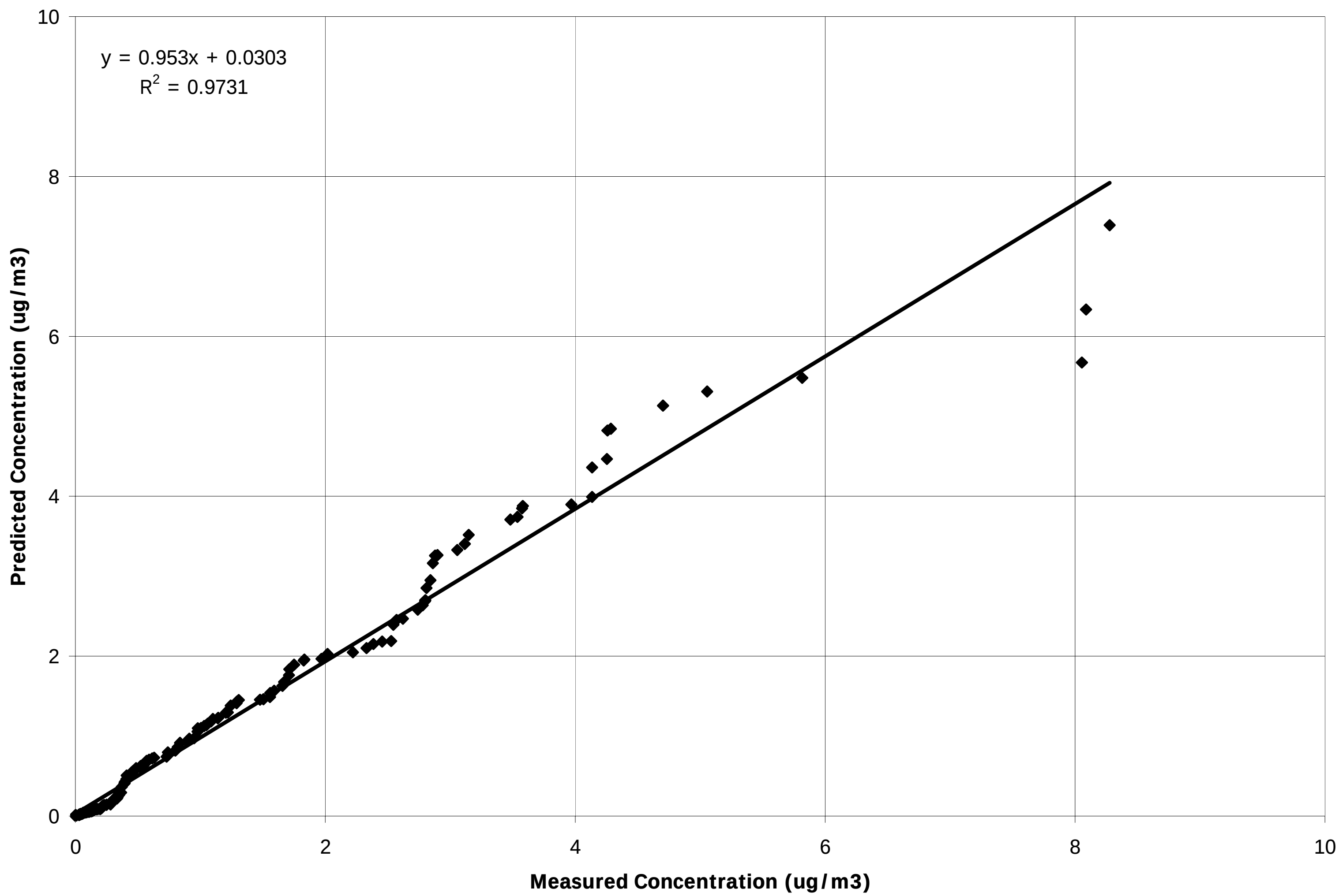
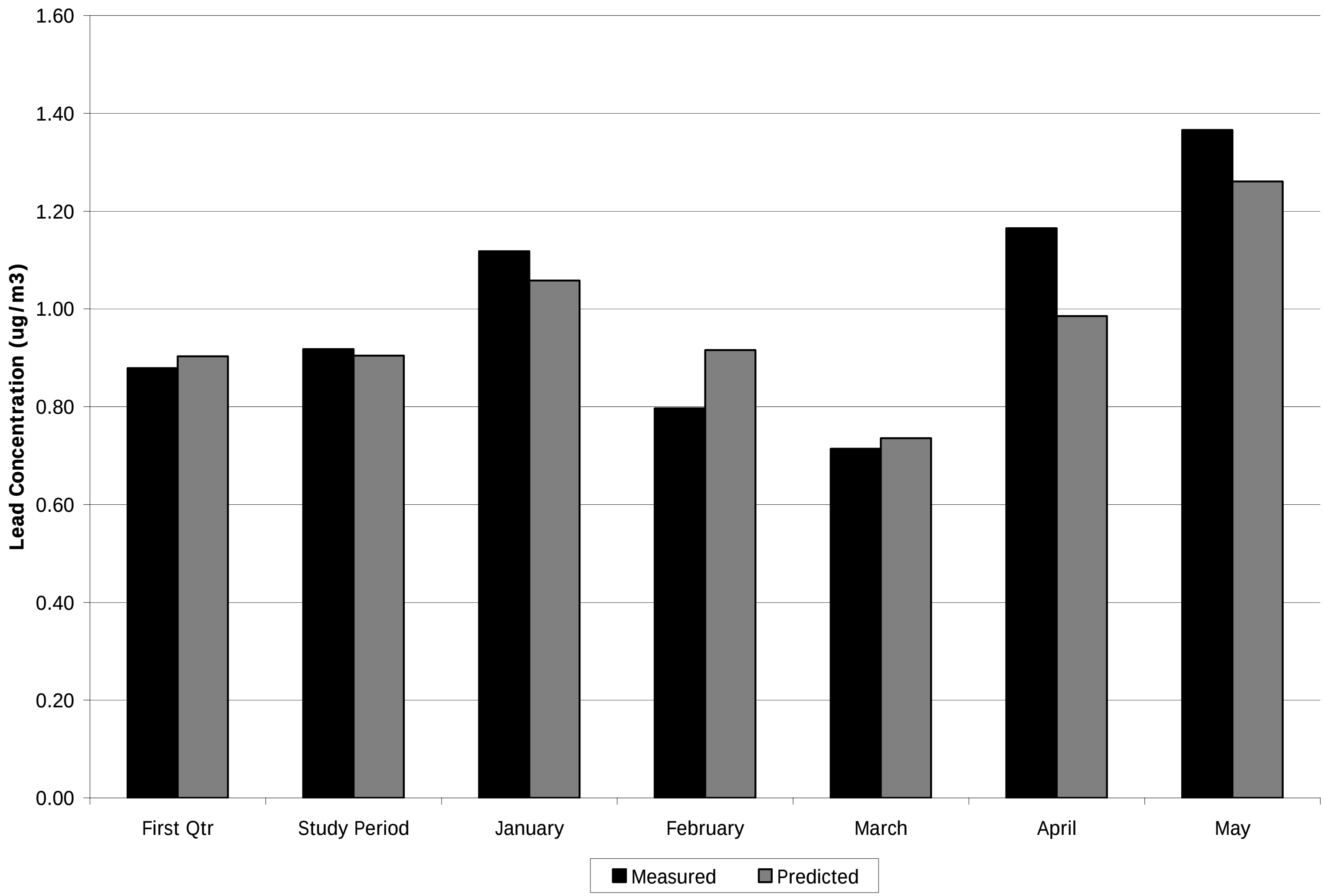


Figure 5-14. Average Concentrations for Different Time Blocks (City Hall)



6.0 Design Value Analysis

The maximum predicted 3-month lead concentration for all modeled receptors during the nine quarter period was 16 µg/m3 and occurred on the western property boundary along Main Street. The maximum impact was northwest of the sinter plant at 729456 meters to the east and 4237986 meters to the north. The maximum impact occurred during the third quarter of 1998. A map showing the location of maximum impact has been provided as Figure 6-1.

For the design value analysis, maximum 3-month lead concentrations were predicted for 19 different receptor groups:

- Eleven Ambient Lead Monitor Locations
- The boundary on the west side of the facility along Main Street
- The new buffer zone boundary west of the facility
- The facility boundary on the north, east and south sides of the facility
- The wastewater plant inside the facility property boundary
- 100m grid outside of the new buffer zone
- 100m grid inside the new buffer zone
- 250m grid
- 500m grid

The maximum predicted 3-month lead concentrations for each receptor group have been summarized in Figure 6-2.

Frequency histograms showing the distribution of the high predicted 3-month lead concentrations for each receptor have been provided as Figures 6-3 and 6-4. Sixty-nine percent (69%) of the receptor locations had 3-month high predicted lead concentration less than 1 $\mu g/m^3$ and 85% of the concentrations were less than 2 $\mu g/m^3$.

Maps showing the locations of receptors with maximum impacts over 1 $\mu g/m^3$, 5 $\mu g/m^3$, and 10 $\mu g/m^3$ have been provided as Figures 6-5, 6-6, and 6-7, respectively.

A plot of the maximum predicted 3-month lead concentration as a function of the distance from the maximum impact has been provided as Figure 6-8. The predicted lead concentration drop rapidly out to about 500m from the property boundary.

The source contributions for the high receptors have been summarized in Figure 6-9.

Figure 6-1. Maximum 3-Month Lead Concentration (All Receptors)

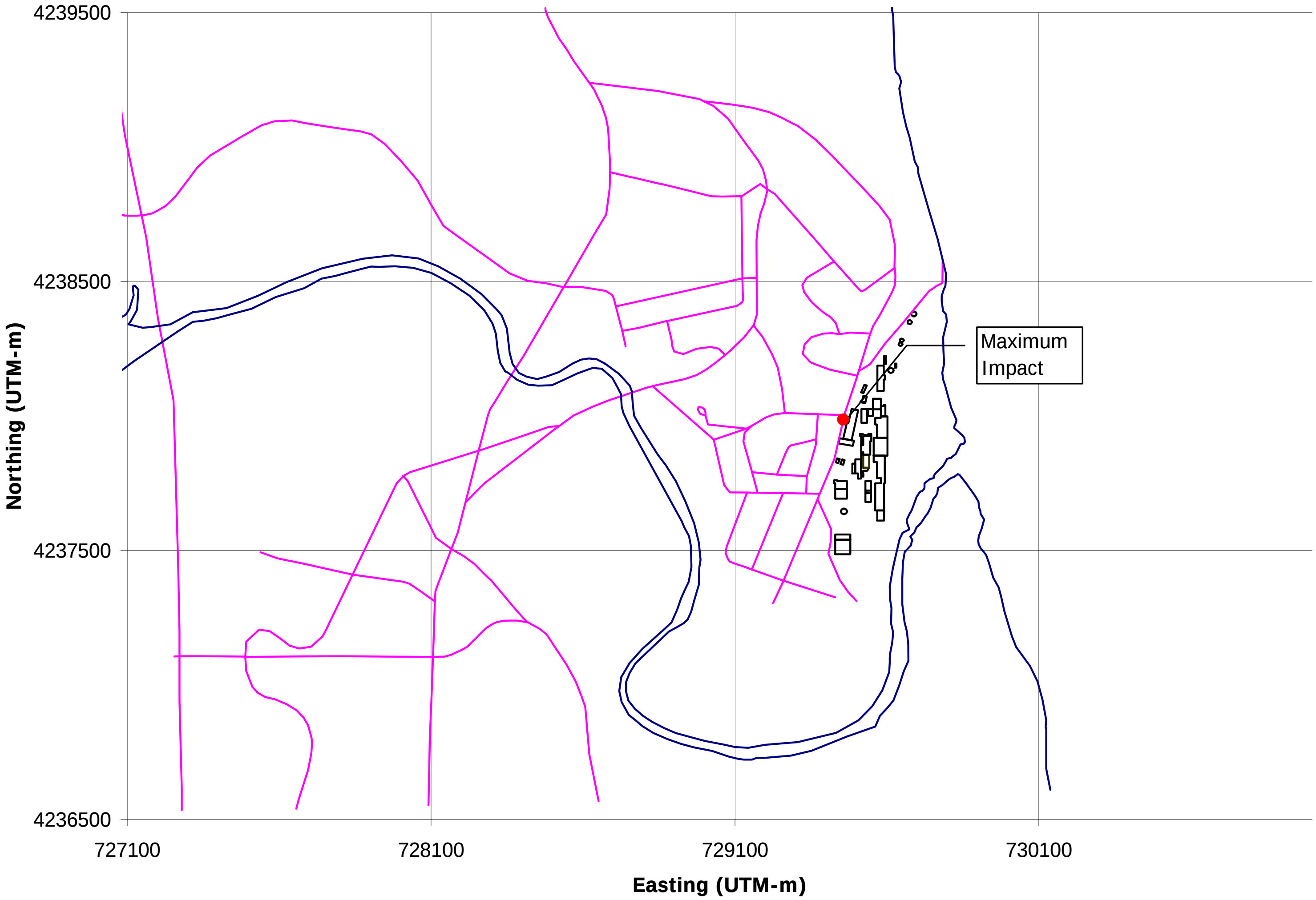


Figure 6-2. Maximum 3-Month Lead Concentration for Each Receptor Group

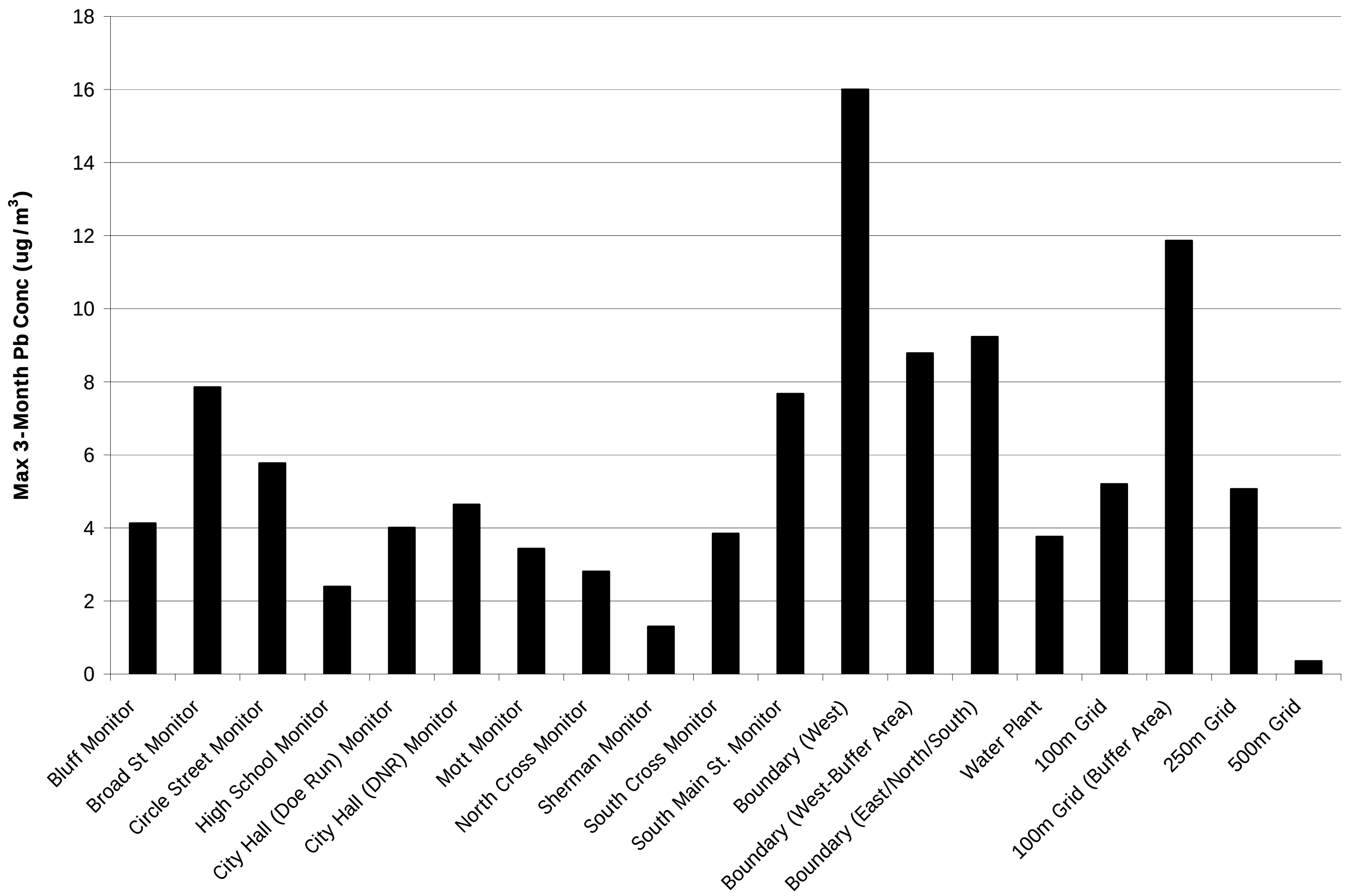


Figure 6-3. Maximum 3-Month Lead Concentration Frequency Histogram

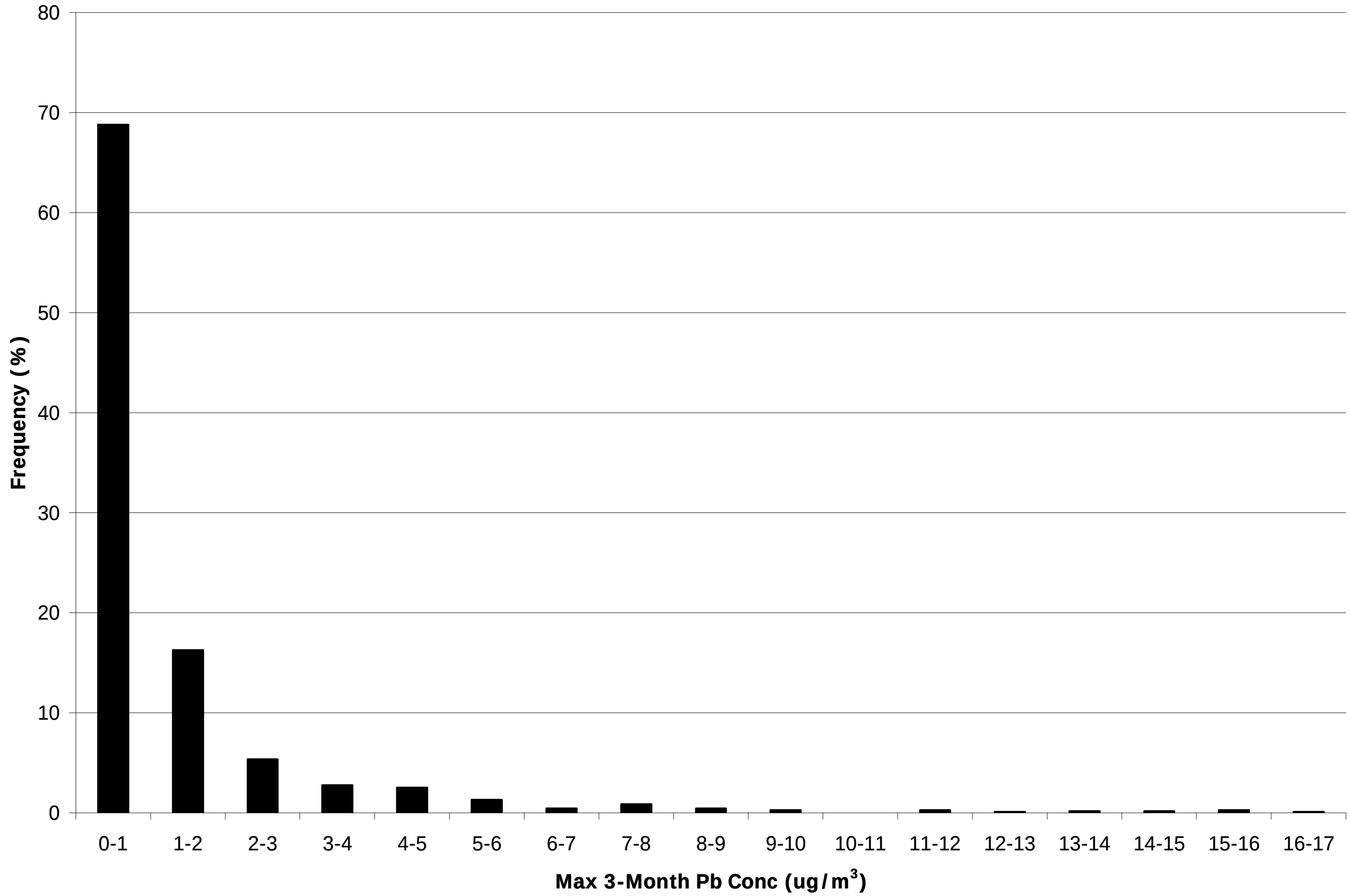


Figure 6-4. Maximum 3-Month Lead Concentration Frequency Histogram (Receptors <= 1.5 µg/m^3)

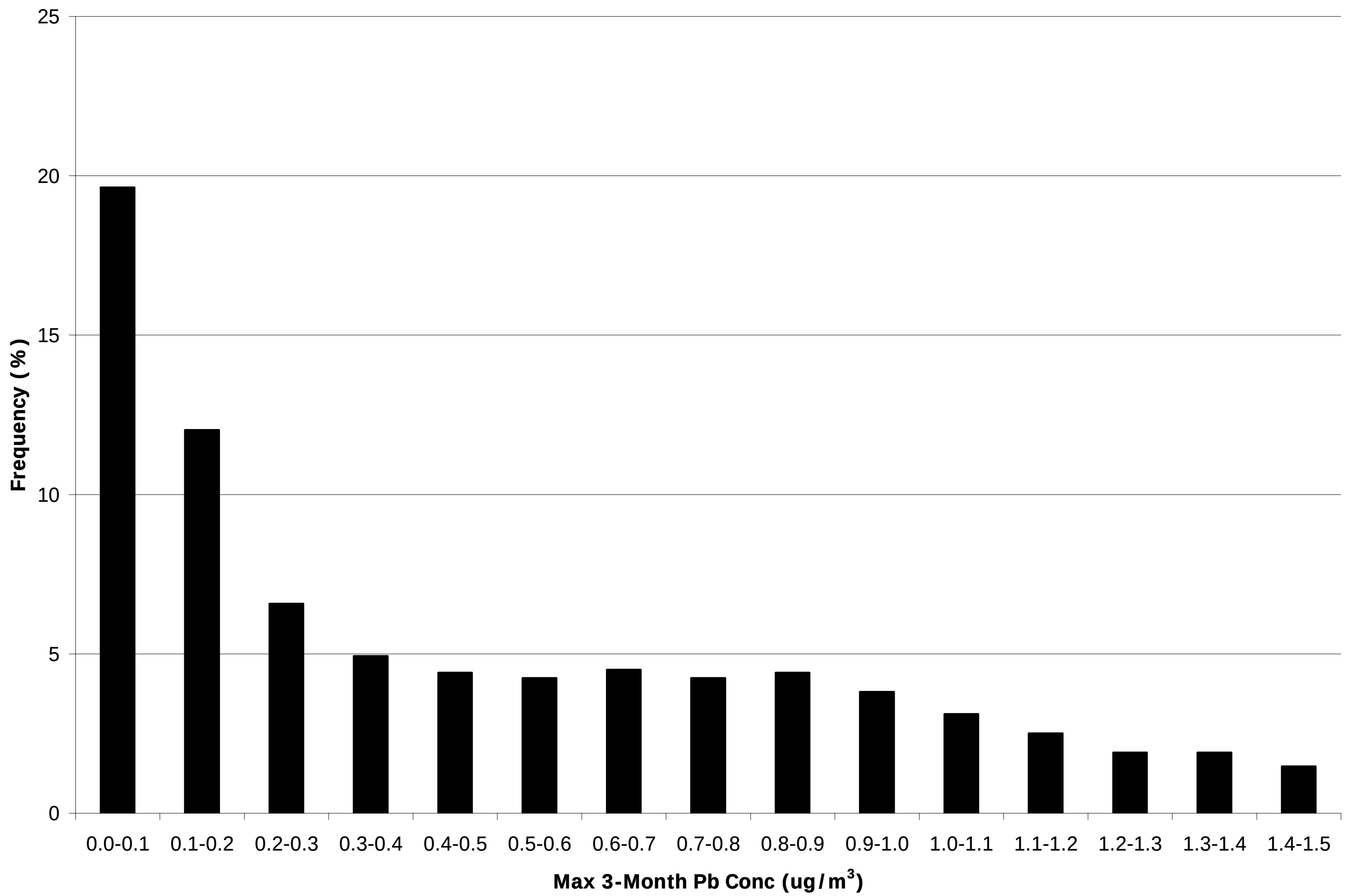


Figure 6-5. Maximum 3-Month Lead Concentrations Over 1 µg/m^3

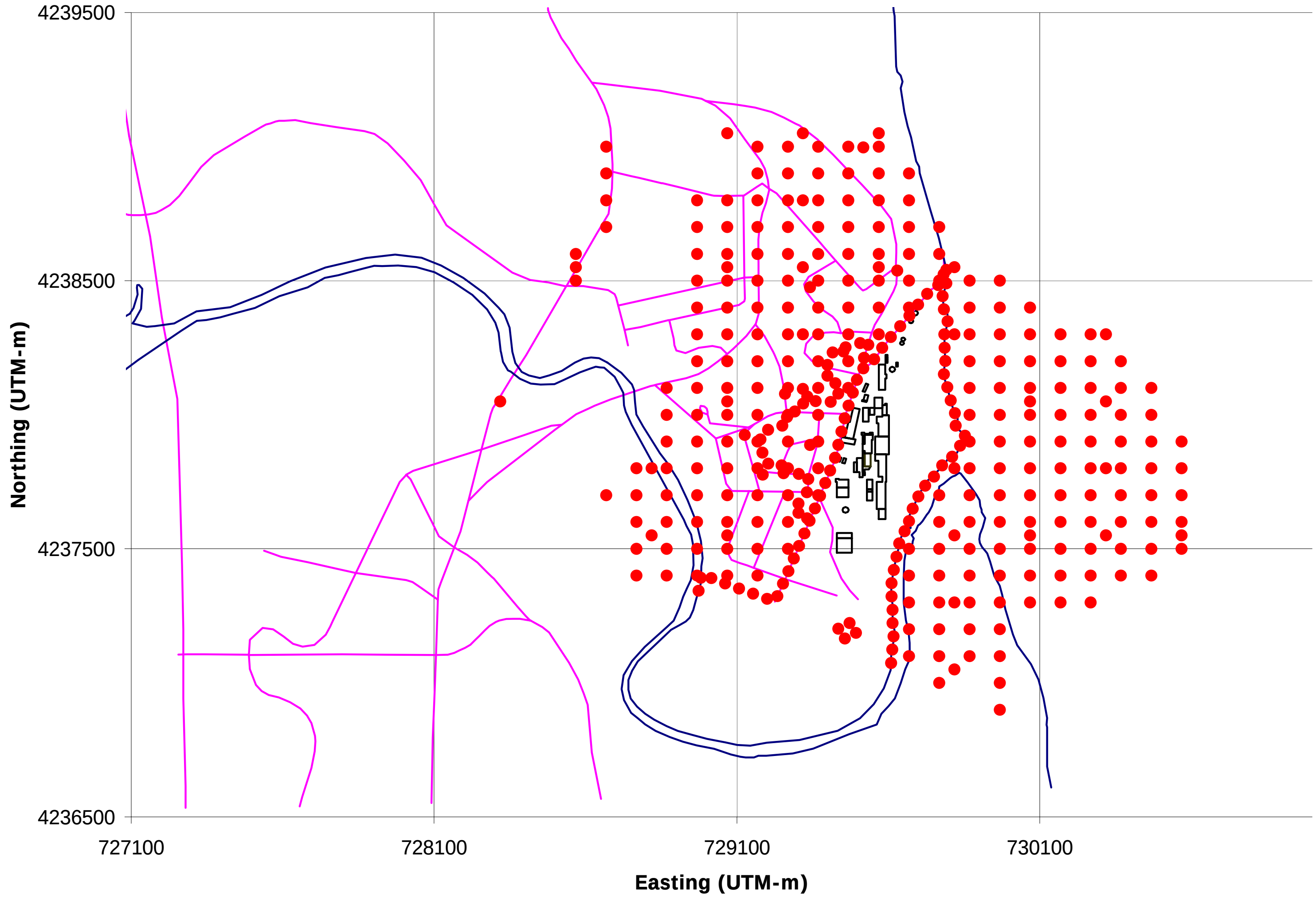


Figure 6-6. Maximum 3-Month Lead Concentrations Over 5 µg/m³

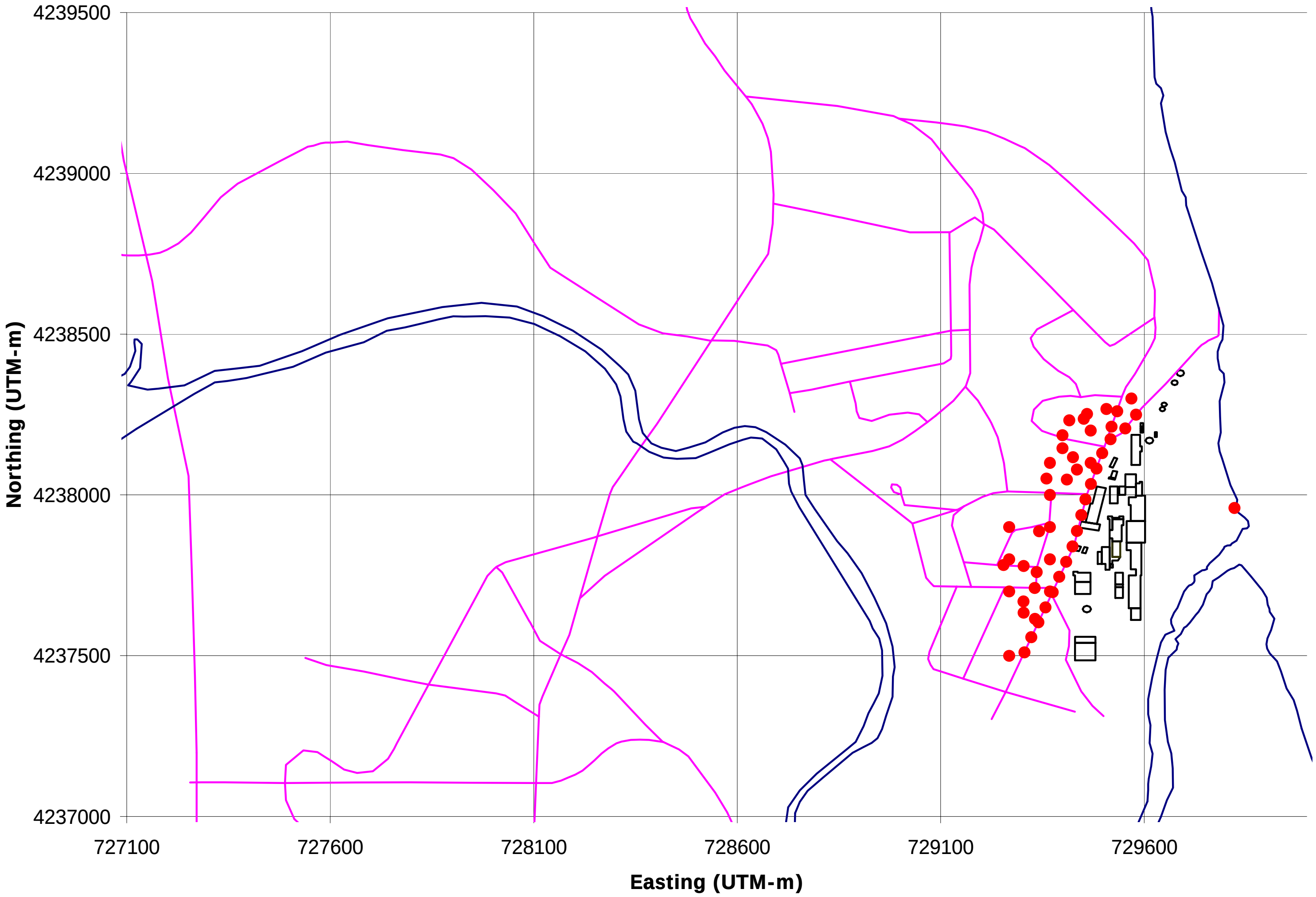


Figure 6-7. Maximum 3-Month Lead Concentrations Over 10 μg/m^3

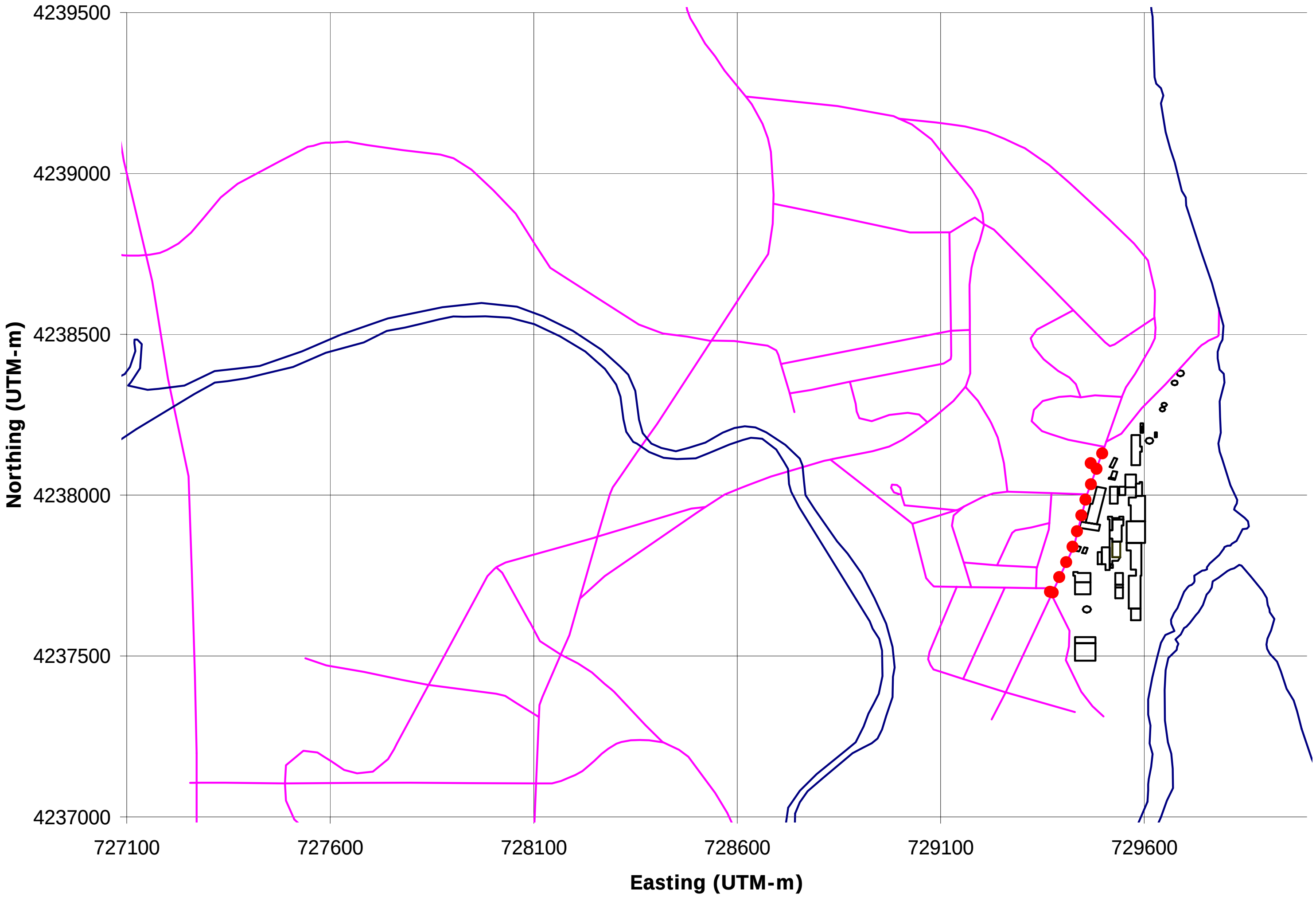


Figure 6-8. Maximum 3-Month Lead Concentration as a Function of Distance from the Maximum Impact

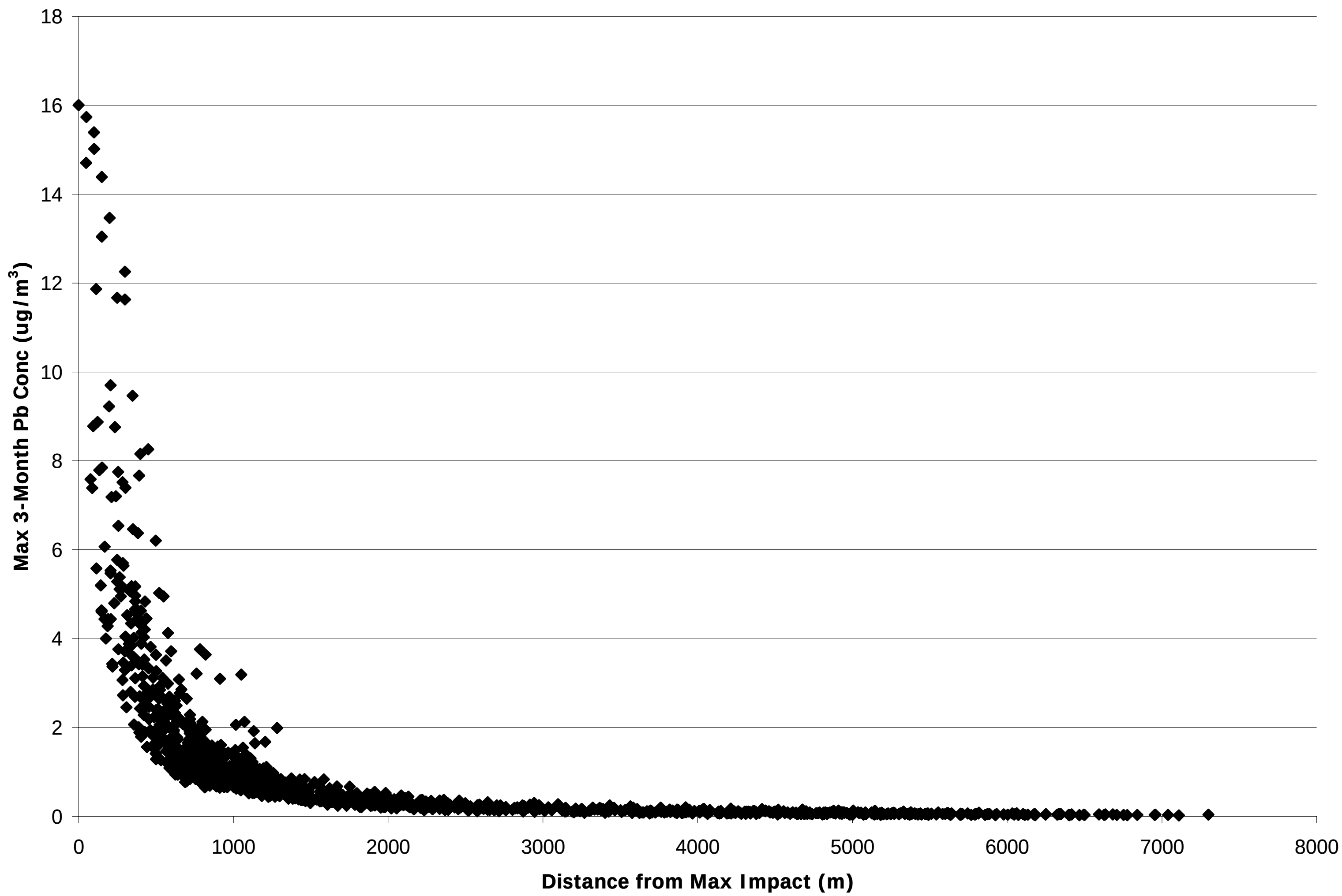


Figure 6-9. Source Contribution for High Receptors