APPENDIX D

CONCEPTUAL MODEL

APPENDIX D – CONCEPTUAL MODEL

INTRODUCTION

This section includes the details of the analysis of ambient air monitoring data and air dispersion modeling studies to better understand the current air quality situation near the Exide site.

MONITORING DATA ANALYSIS

TCEQ reviewed and analyzed monitoring data from the Eubanks (AIRS ID 480850009), Parkwood Street (AIRS ID 480850003) and the Ash Street (AIRS ID 480850007) monitors for the period 2006-2010. All three monitors are located near the Exide site. None of the three monitors near the Exide site report meteorological data, e.g. wind speed and wind direction, so meteorological data from the nearest monitor, Frisco CAMS (AIRS ID 480850005) was used.

Analysis by Wind Direction

Table D-1: *Wind Direction Percentage During Sampling Periods for 2006-2010* lists the number of hours during sampling periods for 2006-2010 the wind direction (Wd) was within specified ranges.

Table D-1: Wind Direction Percentage During Sampling Periods for 2006-2010

Wind Direction	Criteria	Number of Hours	Percentage of Total
N	337.5° < Wd < 22.5°	779	11.29%
NE	22.5° < Wd < 67.5°	342	4.96%
E	67.5° < Wd < 112.5°	829	12.02%
SE	112.5° < Wd < 157.5°	1391	20.17%
S	157.5° < Wd < 202.5°	2020	29.27%
SW	202.5° < Wd < 247.5°	381	5.53%
W	247.5° < Wd < 292.5°	321	4.65%
NW	292.5° < Wd < 337.5°	837	12.13%

Analysis By Wind Speed

Figure D-1: *Chart of 24-hour concentrations v. 24-Hour Average Wind Speed, 2006-2010* depicts the relationship between 24-hour sampled concentrations and 24-hour average wind speed for each monitor near the Exide site. Correlation trend lines for each set of data are plotted on the graph. For these data, the best correlation was a linear fit of the data. The coefficients of determination, R^2 value, for Ash Street and Parkwood Street data sets, show that there is no correlation between concentration and wind speed. For the Eubanks data set, there is a weak correlation between concentration and wind speed.

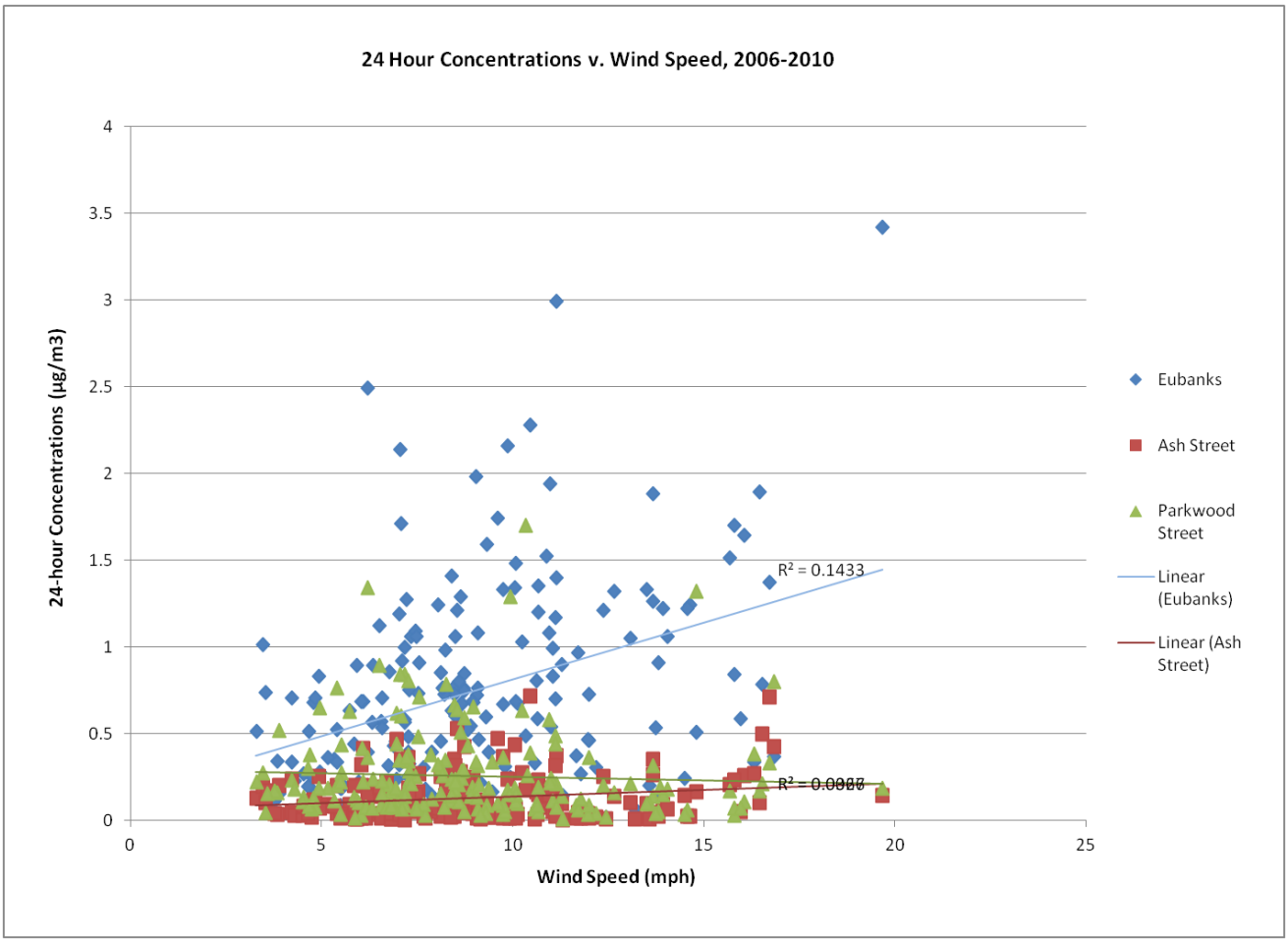

Figure D-1: Chart of 24-hour concentrations v. 24-Hour Average Wind Speed, 2006-2010

Analysis Comparing Monitor to Monitor

Figure D-2: *Monitor to Monitor Concentration Comparison, 2006-2010* depicts monitor to monitor comparisons. The data depicted are the 24-hour concentrations from one monitor divided by the 24-hour concentration of a second monitor during the sampling period. The purpose of this analysis is to determine if a certain set of conditions impact one monitor in a similar way as another monitor. Correlation trend lines for each set of data are plotted on the graph. For these data, the best correlation was an exponential fit of the data. The R^2 value for the Eubanks to Ash Street comparison shows a moderate to weak correlation. The R^2 value for the

Eubanks to Parkwood Street comparison shows a weak correlation. The R^2 value for the Ash Street to Parkwood Street comparison shows a moderate to weak correlation.

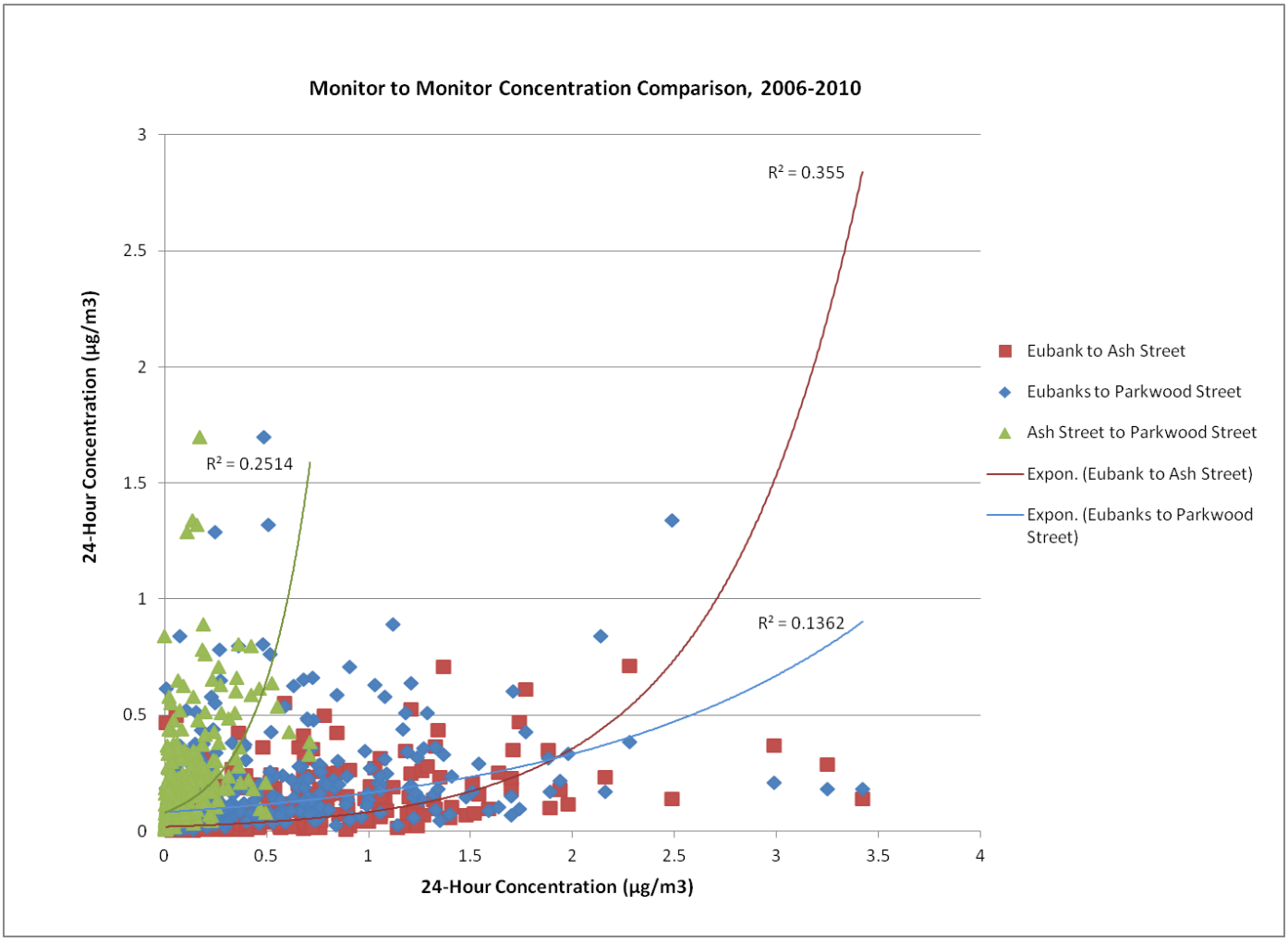

Figure D-2: Monitor to Monitor Concentration Comparison, 2006-2010

Spatial Analysis of Monitoring Data

Statistical analyses of data are used to determine relationships and correlations between one set of data and another. When observing spatial relationships between objects, such as the location of an emission source relative to an ambient air monitor, the correlation between monitored concentrations and wind direction is easily explained. TCEQ staff analyzed data from the three monitors near the Exide site by visually observing reported 24-hour concentrations, hourly wind directions and wind speeds, and the spatial relationship between sources at the Exide site and the nearby monitors. Data from selected 24-periods included in this analysis.

Table D-2: 24-*Hour Concentrations from Selected Monitoring Periods, 2006-2010* contains a listing of the selected 24-periods from 2006-2010. The data in the table are the 24-hour monitored concentrations at each monitor, the average wind speed during the 24-hour sampling

period, and notes of interest during the sampling period. The graphics following in Figures D-3 through D-10 depict the location of the monitors, the Exide site process area, 24-hour concentration at each monitor, and graphical representations of the hourly wind direction and wind speeding during the sampling period. The hourly winds are depicted as lines pointing into each monitor. The orientation of the lines represents the hourly wind direction. The length of each line is proportional to the wind speed. Since each sampling period is 24 hours long, there are 24 lines representing each hour of wind direction and wind speed. The lines representing the wind direction and speed are colored according to the color scheme used for the monitored 24-hour lead concentration.

Table D-2: 24-Hour Concentrations from Selected Monitoring Periods, 2006-2010

Date	Eubanks (µg/m^3)	Ash Street (µg/m^3)	Park Street (µg/m^3)	Wind Speed (mph)	Note
March 18, 2006	0.061	0.006	No Data	13.2	Impact from landfill
March 13, 2008	0.019	0.006	0.017	12.4	Site not operating
April 24, 2008	1.22	0.088	0.147	13.9	
April 30, 2008	1.89	0.101	0.17	16.5	
May 30, 2008	1.94	0.178	0.217	11.0	
June 5, 2008	3.42	0.14	0.181	19.7	Highest monitored concentration
December 2, 2008	1.4	0.059	0.073	11.1	
March 9, 2010	0.486	0.174	1.7	10.3	Southwest wind

Figure D-3: *Depiction of Conditions Ideal for Landfill Impact on Monitored Concentrations, March 18, 2006* depicts conditions that would be representative of emissions from the site landfill impacting the Eubanks monitor. Having a 24-hour sampling period with winds being consistently from the east, i.e. blowing from the landfill to the Eubanks monitor, was very rare. However, this figure graphically depicts ideal conditions that would show the landfill emissions impact on monitored lead concentrations. The winds that day were moderately high. The monitored 24-hour concentrations at the Eubanks (0.061 µg/m^3) and Ash Street (0.006 µg/m^3) monitors were well below the 0.15 µg/m^3. There were no data reported for the Parkwood monitor that day.

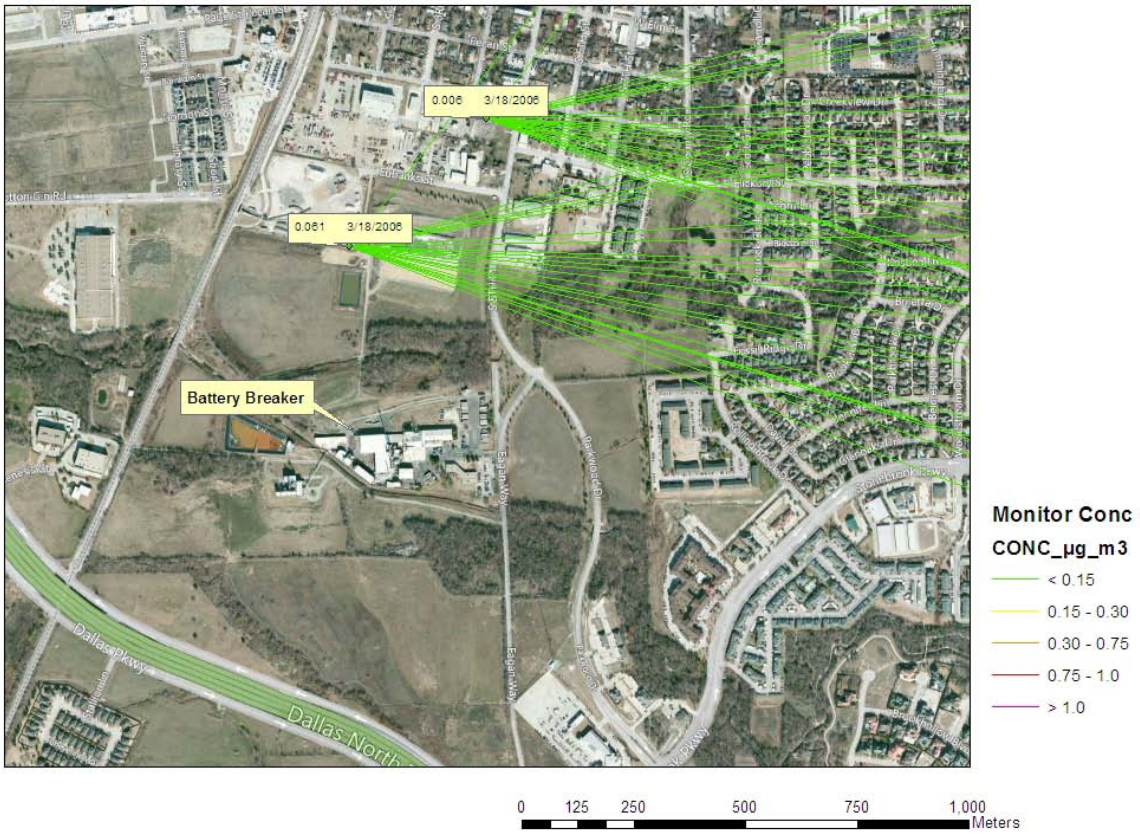

Figure D-3: Depiction of Conditions Ideal for Landfill Impact on Monitored Concentrations, March 18, 2006

Figure D-4: *Depiction of Conditions when Exide Site Operations Shutdown During Sampling Period, March 13, 2008* depicts conditions when the Exide site reported no production during a 24-hour sampling period. Having a 24-hour sampling period with winds being consistently from the southeast (i.e., blowing from the Exide site process area to the Eubanks monitor), and with the Exide site operations shut down was very rare. However, this figure graphically depicts ideal conditions that would show the impact of background sources and re-entrained emissions on monitored lead concentrations. The winds that day were moderately high. The Eubanks monitor recorded a 24-lead concentration of 0.019 µg/m^3, the Parkwood monitor recorded 0.017 µg/m^3, and the Ash Street monitor recorded 0.006 µg/m^3 that day.

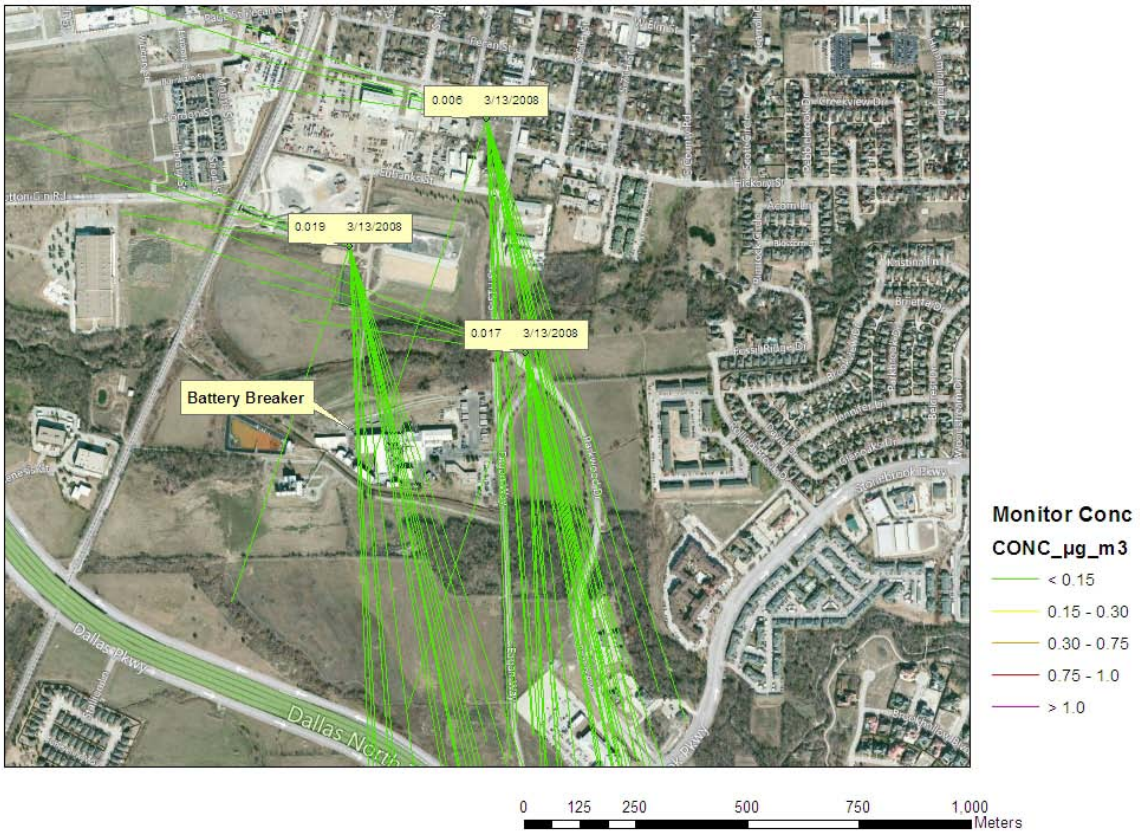

Figure D-4: Depiction of Conditions when Exide Site Operations Shutdown During Sampling Period, March 13, 2008

Figures D-5 through D-10 depict conditions that occurred on days when sampled concentrations were highest. In all cases, except one which occurred March 3, 2010, the winds were from the south to southeast during the entire sampling period and the highest monitor reading was at the Eubanks monitor. On March 3, 2010, the winds were from the south to southwest and the highest reading was at the Parkwood Street monitor. In all cases, the highest monitored reading was significantly higher than readings at the other two monitors. Figure D-8: *Depiction of Conditions June 5, 2008. Maximum Monitored 24-Hour Concentration 3.24 µg/m³* depicts the conditions for June 5, 2008 which recorded the highest concentration for the period 2006-2010.

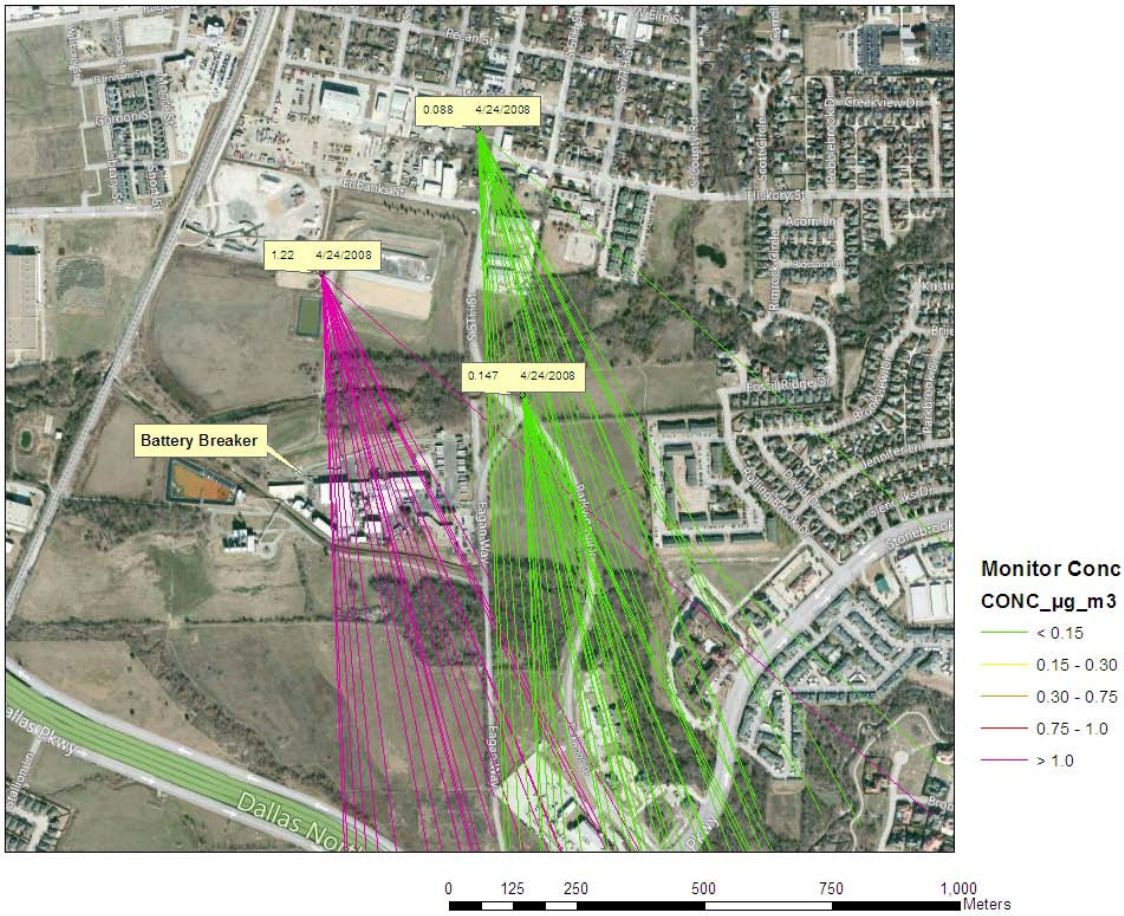

Figure D-5: Depiction of Conditions April 24, 2008. Maximum Monitored 24-Hour Concentration 1.22 µg/m³

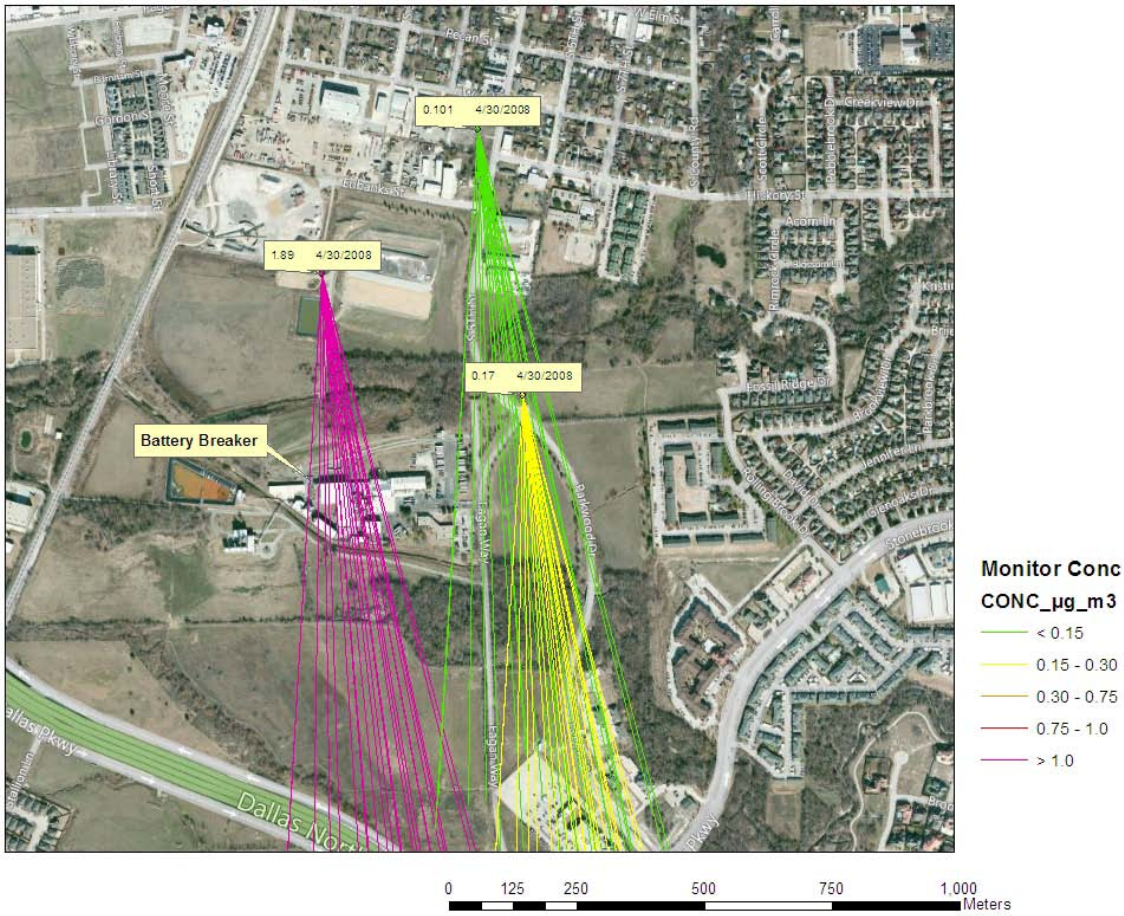

Figure D-6: Depiction of Conditions April 30, 2008. Maximum Monitored 24-Hour Concentration 1.89 µg/m³

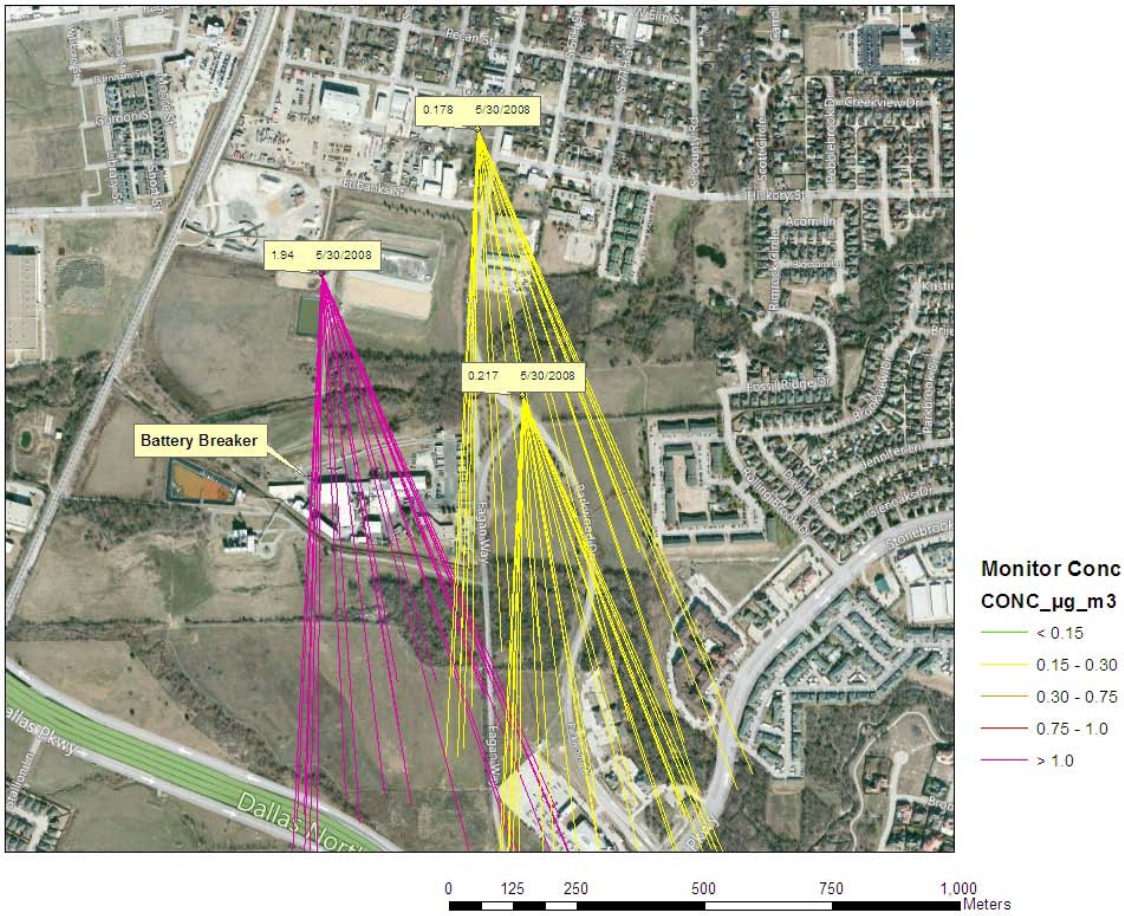

Figure D-7: Depiction of Conditions May 30, 2008. Maximum Monitored 24-Hour Concentration 1.94 µg/m³

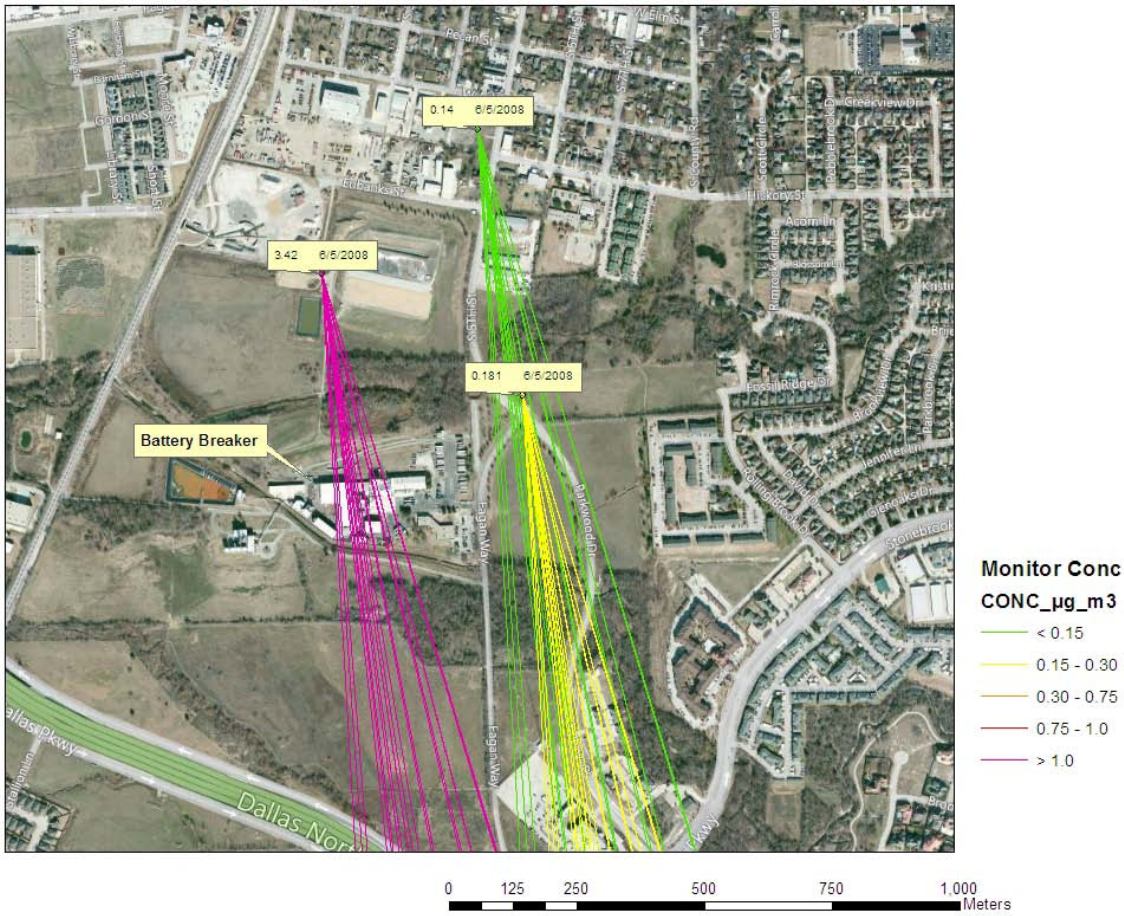

Figure D-8: Depiction of Conditions June 5, 2008. Maximum Monitored 24-Hour Concentration 3.24 µg/m³

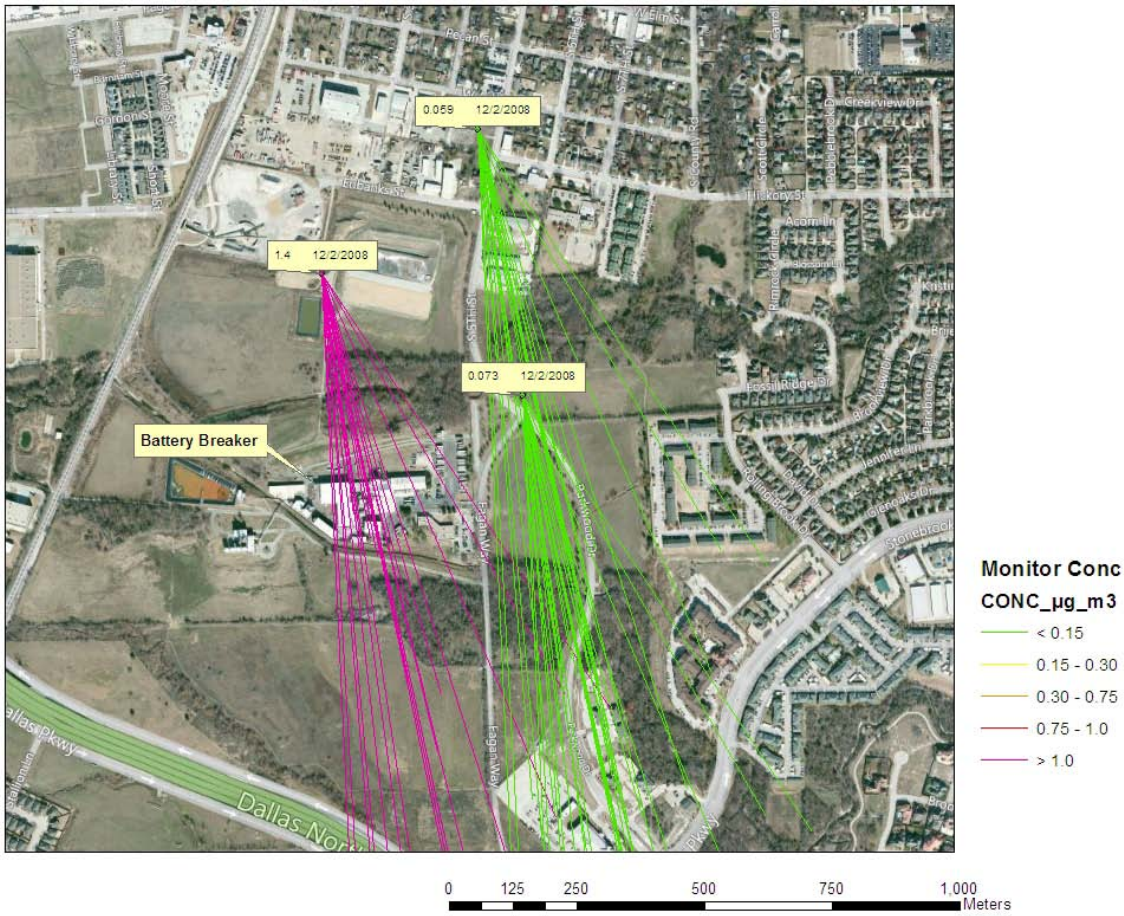

Figure D-9: Depiction of Conditions December 2, 2008. Maximum Monitored 24-Hour Concentration 1.40 µg/m³

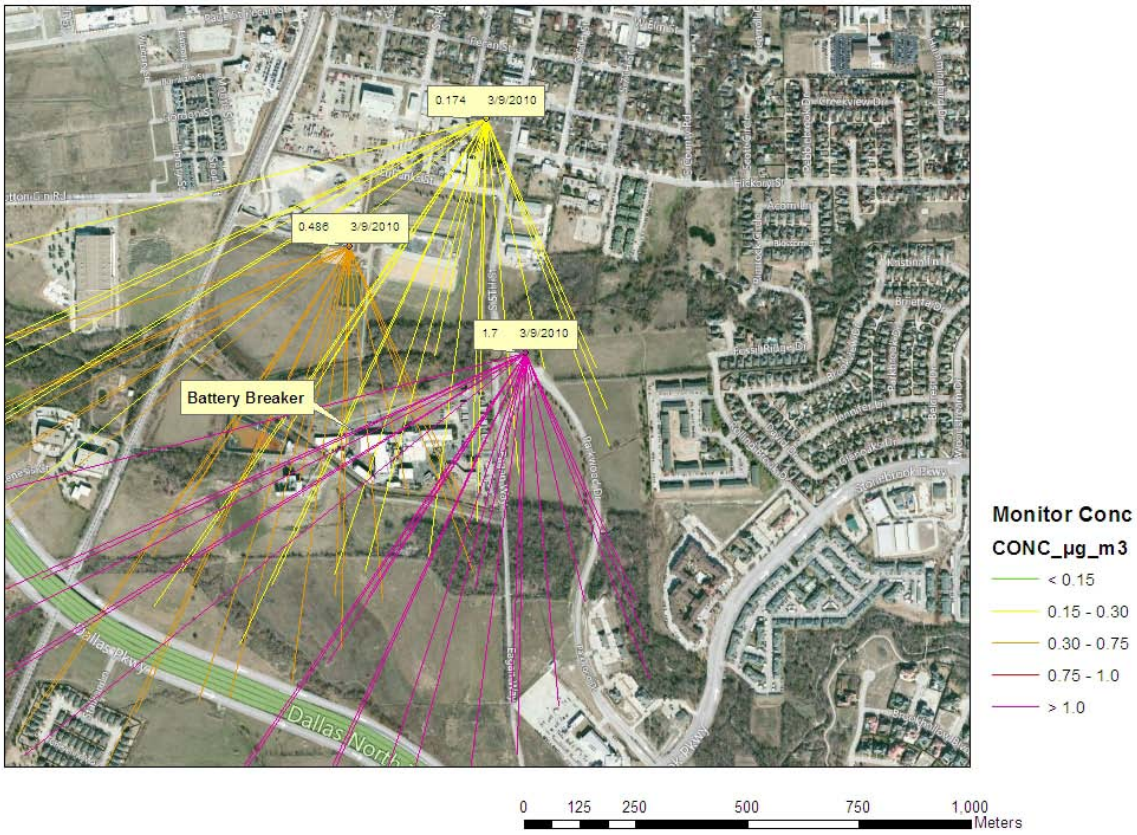

Figure D-10: Depiction of Conditions March 9, 2010. Maximum Monitored 24-Hour Concentration 1.70 µg/m³

Conclusions Based On Data Analysis

From the graphics depicting the spatial analysis of the data, it is apparent that when a large percentage of the hourly wind directions during a sampling period are from the Exide site process area towards a monitor, the monitored concentration is elevated. Since the dominant wind directions are from the south to southeast, there are many days when winds continuously blow from the Exide site process area towards the Eubanks monitor. As a result, the Eubanks monitor typically records the highest concentrations. During the same sampling periods, the Ash Street and Parkwood Street monitors typically record concentrations much lower than the Eubanks monitor. Since one monitor is impacted much higher than the other two monitors, it is concluded that the dominant source of emissions is relatively close to the monitor and that this dominant source is the process area. A distant source would tend to be well dispersed and impact all monitors in a similar way. When the Ash Street and Parkwood Street monitors are not downwind of the Exide site process area, which is frequent due to the prevailing wind directions, these monitors are impacted mostly by distant background sources not located at the Exide site.

When the winds are persistent from directions other than from the Exide site process area towards a monitor, the lead concentrations recorded are low. Persistent wind directions from the Exide site landfill to the Eubanks monitor did not produce elevated lead concentrations. Given the close proximity of the landfill to the monitor, it is concluded that the landfill, during

the analysis period between 2006 and 2010, did not significantly contribute to high monitored lead concentrations.

MODELING ANALYSIS

Model and Model Programs

The dispersion modeling analysis was performed using the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) modeling system. There are two input data processors that are regulatory components of the AERMOD modeling system: AERMET, a meteorological data preprocessor that incorporates air dispersion based on planetary boundary layer turbulence structure and scaling concepts, and AERMAP, a terrain data preprocessor that incorporates complex terrain using United States Geological Survey (USGS) Digital Elevation Data. The Building Profile Input Program for Plume Rise Model Enhancements (BPIPPRM), a multi-building dimensions program incorporating the good engineering practice (GEP) technical procedures for Plume Rise Model Enhancements (PRIME) applications was also used.

The selections made for model programs, model settings, meteorological data, and downwash data for this analysis are summarized below.

- AERMOD (Version 09292) was used with default regulatory settings. Since the current version of AERMOD is not capable of calculating rolling three-month average concentrations, the EPA post-processor LeadPost was used. The input values to LeadPost are monthly average values at each receptor in the POSTFILE output format from AERMOD.

- AERMET (Version B10300) was used to process meteorological data for the period 2006 through 2010.

- Downwash parameters were generated using BPIPPRM (Version 04274). Building and point source locations were derived from global positioning system (GPS) measurements by TCEQ regional staff and validated by TCEQ Air Permits staff using aerial photography.

- Terrain elevations within the modeling domain were determined using AERMAP (Version 11103). The input data used for this analysis were USGS seamless data covering the following digital elevation models (DEMs): Little Elm, Frisco, Lewisville East, and Hebron data sets.

Meteorology

SURFACE CHARACTERISTICS

In order to generate meteorological input data for use with AERMOD, surface characteristics (noontime albedo, Bowen ratio, and surface roughness length) of the modeling domain must be obtained for input for AERMET. Values for Bowen ratio and surface roughness length for the modeling domain were calculated using the methodology proposed by the Alaska Department of Environmental Conservation (ADEC) described in *ADEC Guidance re AERMET Geometric Means, How to Calculate the Geometric Mean Bowen Ratio and the Inverse-Distance Weighted Geometric Mean Surface Roughness Length in Alaska*[1], with input of land cover data from the USGS National Land Cover Database (NLCD) 2001. The ADEC guidance provided an equivalent calculation method to the surface characteristic pre-processor program

AERSURFACE (Version 08009), which requires the input of land cover data from the USGS NLCD 1992. The ADEC guidance is for use with land cover data other than the 1992 NLCD.

The 2001 NLCD was used rather than the 1992 NLCD due to the rapid growth of the Frisco area. From United States Census Bureau data, the 1990 population of Frisco was less than 10,000, the 2000 population was over 30,000, and the 2010 population was over 116, 000. For this reason, the 1992 NLCD was deemed not representative of current land cover characteristics. The 2006 NLCD is the most recent available dataset, so it was used for this modeling analysis.

Using the 1992 NLCD classifications obtained from the AERSURFACE User's Guide[2], land cover data from 2001 were reclassified to reasonably equivalent 1992 NLCD classifications using documentation from the NLCD 1992/2001 Retrofit Land Cover Change Product[3].

Representative noontime albedo, Bowen ratio, and surface roughness length values were calculated using the reclassified 2001 NLCD with the ADEC guidance. The noontime albedo and average Bowen ratio values were calculated using the reclassified 2001 NLCD for all land classifications within a 10 kilometer (km) square, as specified by the AERSURFACE User's Guide, surrounding the Exide site. The surface roughness length value was calculated using the reclassified 2001 NLCD for all land classifications within a 1 km radius of the Exide site centroid, as specified by the AERSURFACE User's Guide. The noontime albedo calculated was 0.174, Bowen ratio was 0.76, and surface roughness length was 0.234 meters.

RAW DATA INPUT

Meteorological raw input data were used with generalized surface characteristics of the application site and processed with AERMET (Version B10300). This version of AERMET integrates one-minute Automated Surface Observing System (ASOS) wind data with Integrated Surface Hourly Data (ISHD) using the EPA's AERMINUTE (Version B10300) program. ISHD and one-minute ASOS wind data were obtained from the National Climactic Data Center (NCDC). The upper air data was obtained from the National Oceanic Atmospheric Administration Earth System Research Laboratory.

Meteorological data from 2006 through 2010 from the Dallas-Fort Worth surface station (Station # 03927) and the Fort Worth upper air station (Station # 03990) were used in these analyses. Missing data from the Dallas-Fort Worth surface station were replaced with available 2006 through 2010 data from the McKinney Airport surface station (Station # 53914). The McKinney Airport was selected because it is the nearest National Weather Service (NWS) station to the lead nonattainment area. The McKinney Airport ISHD and one-minute ASOS wind data were processed in conjunction with Fort Worth upper air data using AERMET. Any hours that contained missing data in the Dallas-Fort Worth input file were replaced with the corresponding hourly data in the McKinney Airport input file when available. Table D-3: *Missing and Calm Hours in Meteorological Data* lists the number of hours with missing and filled data. A "calm" is defined as a reported wind speed less than three knots.

Table D-3: Missing and Calm Hours in Meteorological Data

Year	Total Hours	Missing Hours Before Fill	Missing Hours After Fill	Calm Hours Before Fill	Calm Hours After Fill
2006	8760	202	166	28	29

Year	Total Hours	Missing Hours Before Fill	Missing Hours After Fill	Calm Hours Before Fill	Calm Hours After Fill
2007	8760	314	294	37	39
2008	8784	211	183	117	119
2009	8760	95	83	19	20
2010	8760	62	42	63	63

METEOROLOGY SENSITIVITY ANALYSIS

A sensitivity analysis was performed using the base case emissions with unfilled and filled meteorological input data. The rolling 3-month average lead concentrations were compared receptor by receptor. At the location of the highest predicted concentration, the difference in concentration was 0.07%. For all receptors within 1 km of the Exide site, the difference was less than 2% except for five receptors. At those five receptors, the difference was less than 2.5%. Due to the small number of missing hours of data, small number of hours with calms compared to the total number of hours , the highest predicted concentration being at or near the site property line, and the rolling three-month averaging time for predicted concentrations, additional filling of meteorological data would not significantly impact the modeling results.

Receptor Grid

The receptor grid used in the modeling analyses consisted of receptors with 100 meter spacing and extended approximately 3 km from the Exide site property line in all directions. Discrete receptors were used for the locations of the existing ambient air monitoring stations.

Source and Building Configuration

Sources 18, 21, 22, 23, 37, 38, 39, 45, and 48, authorized by Exide Permit 1147A, are stacks that were characterized as point sources in the model. Refer to Table D-4: Exide *Source Description List* for a list of emission points referenced in this SIP revision. The actual height and diameter for each source was modeled. The stack exit temperature and velocity for each source was based on stack test data provided by Exide for each stack. The emission rates modeled were the highest hourly emission rate from the most recent stack test. Stack test-based exit temperatures, velocities, and emission rates were used for the base case analysis because they are representative of actual routine operations.

Emissions from sources 10, 35, 36, 41, 42, 43, 44, 52, and 53, also authorized by Exide Permit 1147A, are all fugitive in nature and were characterized as area sources. Fugitive emissions sources are those emissions that are not emitted to the atmosphere through a vent, stack, or discrete emission point. The dimensions of the sources are representative of the areas where the emissions are generated. The height of release for Exide sources 10, 35, 36, 44, and 52 was based on the height where the emissions escape a structure. The release height for sources Exide 41, 42, and 43 (vehicle traffic) was set to 1 meter, which is a reasonable height for road generated emissions. The release height of source 53 was the height of the conveyance system to the blast furnace.

In order to simplify the modeling analysis, Exide sources 10 and 35 were combined. The modeling analysis used for the lead nonattainment area designation (designation modeling) shows that source 10 has a higher contribution than source 35 at the location of the maximum predicted concentration. The combined emissions from both sources were represented as coming from only source 10. Sources 41, 42, and 43 were also combined. The designation modeling shows that source 41 has a higher contribution than sources 42 or 43 at the location of the maximum predicted concentration. The combined emissions from all three sources were represented as coming from only source 41. A modeling analysis is considered more conservative when all emissions are assumed to come from one source with the highest predicted concentration rather than apportioned to multiple sources.

Sources 11, 12, 13, 14, 15, 16, 17, 24, 25, and 26, authorized by Exide Permit 3048A, are stacks that were characterized as point sources. The actual height and diameter for each source was modeled. The stack exit temperature and velocity for each source was based on stack test data for each stack. The emission rates modeled were the highest hourly emission from the most recent stack test. The rationale for using the stack test results for stack exit temperatures, velocities, and emission rates was the same as for sources authorized by Exide Permit 1147A.

Emissions from sources 27 and 28, also authorized by Exide Permit 3048A, are all fugitive in nature and were characterized as area sources. The dimensions of the sources are representative of the areas where the emissions are generated. The height of release for sources 27 and 28 was based on the height where the emissions escape a structure.

Table D-4: Exide Source Description List

Emission Point Number	Source Name
10	Furnace Fugitives
11	Oxide Reactor No. 3 Baghouse Stack
12	Oxide Reactor No. 2 Baghouse Stack
13	Oxide Reactor No. 1 Baghouse Stack
14	Oxide Hygiene Baghouse Stack (MELTPOT1, MELTPOT2, MELTPOT3)
15	North Hammerhill Baghouse Stack
16	Oxide Reactor No. 4 Baghouse Stack
17	South Hammerhill Baghouse Stack
18	Hard Lead Ventilation Baghouse Stack
21	Soft Lead Ventilation Baghouse Stack

Emission Point Number	Source Name
22	Specialty Alloy Baghouse Stack
23	Refining Building Vacuum Stack
24	Oxide Reactor No. 5 Baghouse Stack
25	Oxide Reactor No. 6 Baghouse Stack
27	West Truck Loading Fugitives
28	East Truck Loading Fugitives
35	Furnace Fugitives
36	Refining/Casting
37	Reverberatory/Blast Furnaces Fugitives Baghouse Stack
38	Reverberatory/Blast Furnaces Metallurgical Scrubber Stack
39	Slag Fixation Baghouse Stack
41	Vehicle Traffic
42	Vehicle Traffic
43	Vehicle Traffic
44	Raw Material Storage
45	Raw Material Storage/Shredder Baghouse Stack
48	Battery Breaker Scrubber Stack
52	Slag Handling
53	Material Handling
999	Battery Breaker Operation

In comparing monitoring data to modeling results considering only the sources authorized by Exide Permits 1147A and 3048A, there was a disparity between some actual and predicted concentrations. The actual concentrations were significantly higher than those predicted given

certain meteorological conditions. The commission concluded that a source or sources were not accounted for in the modeling. Based on the review and analysis of actual and predicted 24-hour concentrations, there appeared to be an unaccounted source to the south-southeast (SSE) of the Frisco Eubanks monitor (Air Quality System Identification [AQS ID] 480850009). When winds were blowing from the SSE, the Frisco Eubanks monitor tended to record concentrations significantly higher (one order of magnitude higher) than the other two existing monitors which are located northeast and southeast of the Frisco Eubanks monitor. In addition, higher wind speeds from the SSE tended to result in higher monitored concentrations.

Exide management informed TCEQ staff that the unaccounted source could be the fugitive emissions from the battery breaking operation. The fugitive emissions from the battery breaking operations for the lead battery recycling industry were previously believed to be negligible due to the large amount of liquid in the batteries suppressing particulate emissions. However, ambient air monitoring conducted at the Exide Technologies site in Vernon, California, showed that emissions from the battery breaker operation provided to the TCEQ by Exide were a large contributor to monitored concentrations.

Monitoring data from Exide's Frisco, Texas and Vernon, California sites was used to develop an emission rate from the battery breaker operation for the base case. Data from three monitored samples for each site were considered. The data consisted of the 24-hour average monitored concentration of lead and 1-hour average wind speeds. All six sample days experienced winds predominantly blowing from the battery breaker operation to the monitor. Winds during all six sample days were high enough that atmospheric stability was assumed to be neutral.

The SCREEN3 (version 96043) dispersion screening model was used to estimate the emission rate necessary to result in the monitored concentration given the distance from the operation to the monitor, wind speed, and neutral stability for that day. The source was represented as an area source the size of the battery breaker operation for the appropriate site. The emission rates in pounds per hour (lb/hr) were converted to an emissions flux in pounds per hour per square meter (lb/hr•m^2). The six data points were plotted as emission flux (lb/hr × m^2) versus wind speed in miles per hour (mph). A power series correlation was performed on the six data points. The resulting equation to estimate emissions was emission flux = 2.0 × 10-6 × (wind speed)$^{1.9822}$. The correlation coefficient (R^2) value for the correlation was 0.9807 which suggests a strong correlation. An R^2 value of 1 would denote a perfect correlation. Figure D-11: *Chart Depicting Emission Flux Estimate of Batter Breaker Fugitive Source* depicts the charted data.

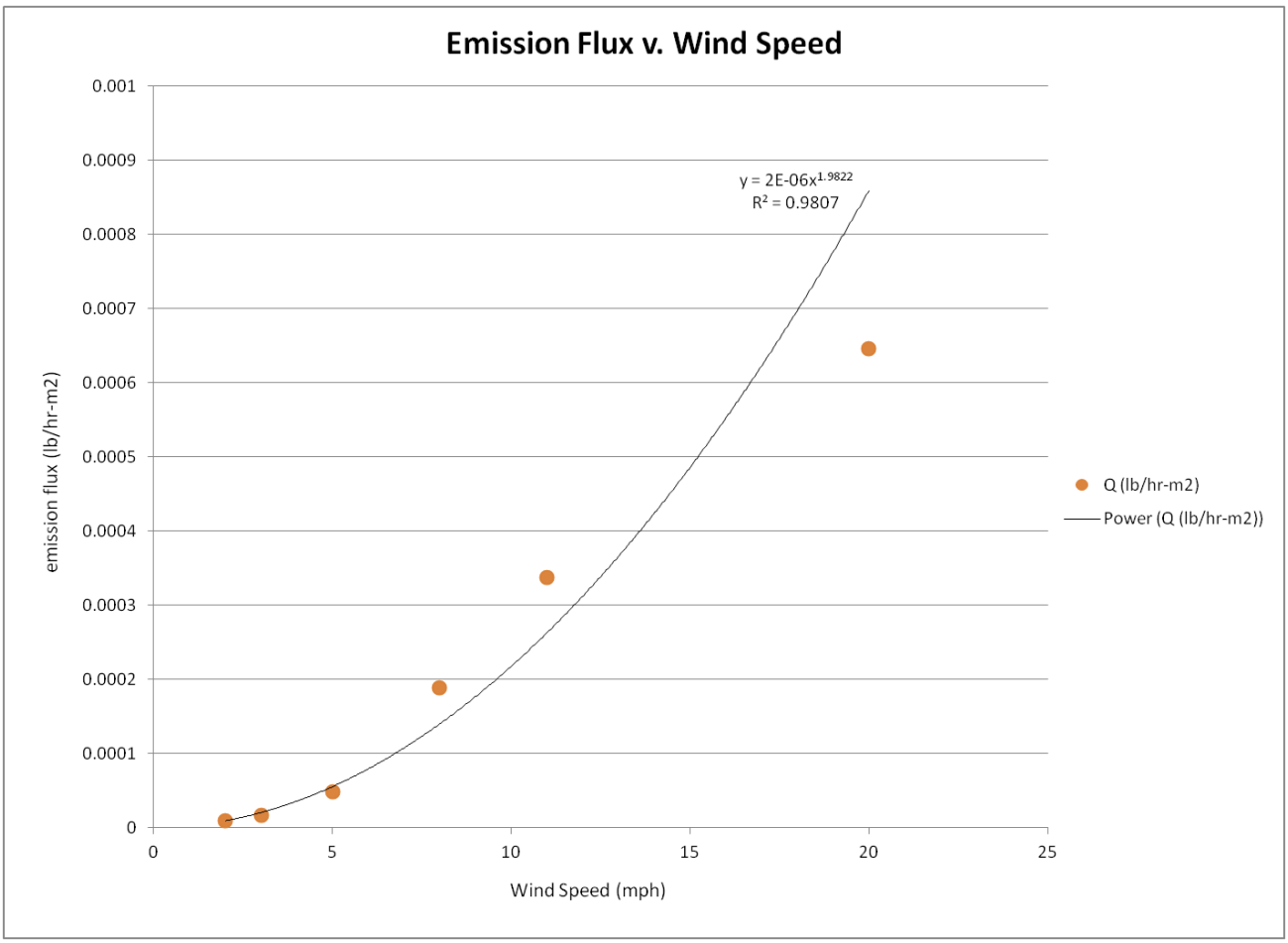

Figure D-11: Chart Depicting Emission Flux Estimate of Batter Breaker Fugitive Source

The base case modeling was performed again considering the estimated emissions from the battery breaker operation. The source (999) was represented as an area source with dimensions representative of the operation. Since the emissions from this source were assumed to be wind generated, wind category scalars were used in the modeling to account for this behavior. The scalar values were determined from the equation emission flux = 2.0 × 10-6 × (wind speed)$^{1.9822}$. The scalar values for each upper bound wind speed in meters per second (m/sec) were 1.00 for 1.54 m/sec, 4.03 for 3.09 m/sec, 11.14 for 5.14 m/sec, 28.56 for 8.24 m/sec, and 49.18 for 10 m/sec.

Table D-5: *Base Case Point Source Parameters* contains input parameters for all point sources modeled for the base case. Table A-6: *Base Case Area Source Parameters* contains input parameters for all area sources modeled for the base case. The total annual lead emissions represented is 4.39 tpy, based on a representative worst case 24-hour period. The modeling assumes that emission rates are continuous 24 hours a day, 365 days a year. Because Exide's process rate varies from day to day, the continuous emissions assumption predicts a higher ambient concentration than would be expected in reality.

Table D-5: Base Case Point Source Parameters

Source ID	Easting (meters)	Northing (meters)	Elevation (meters)	Height (meters)	Temp (Kelvin)	Velocity (meters per second)	Diameter (meters)	Emission Rate (pound per hour)
11	702713	3668797	194.89	16.76	369	12.04	0.3048	0.0069
12	702713	3668794	194.87	16.76	369	8.50	0.3048	0.0134
13	702713	3668792	194.85	15.85	391	13.17	0.3048	0.0015
14	702721	3668793	194.95	16.76	328	27.96	0.5334	0.0061
15	702725	3668808	195.17	16.76	350	14.17	0.3810	0.0031
16	702718	3668803	195	17.37	369	13.47	0.2530	0.0030
17	702729	3668780	194.88	16.76	355	14.02	0.3810	0.0058
18	702628	3668768	193.7	30.63	313	4.98	1.6154	0.0400
21	702627	3668739	193.59	31.24	311	18.08	1.5210	0.0600
22	702686	3668804	194.63	22.86	304	15.05	0.8108	0.0200
23	702637	3668765	193.77	7.70	351	14.19	0.1778	0.0004
24	702722	3668783	194.85	16.46	369	11.49	0.3810	0.0010
25	702722	3668778	194.8	16.46	358	9.45	0.3810	0.0015
26	702736	3668783	194.97	9.14	355	11.58	0.1524	0.0015
37	702683	3668810	194.63	22.86	309	19.15	1.6764	0.0500

Source ID	Easting (meters)	Northing (meters)	Elevation (meters)	Height (meters)	Temp (Kelvin)	Velocity (meters per second)	Diameter (meters)	Emission Rate (pound per hour)
38	702620	3668772	193.65	50.29	315	15.94	1.3716	0.0952
39	702546	3668731	193.17	19.10	0*	45.00	0.4877	0.0530
45	702623	3668714	193.5	32.16	303	12.92	1.8044	0.0700
48	702585	3668771	193.38	15.77	0*	12.28	1.0097	0.0025

*Denotes ambient temperature

Table D-6: Base Case Area Source Parameters

Source ID	Easting (meters)	Northing (meters)	Elevation (meters)	Height (meters)	East - West Length (meters)	North - South Length (meters)	Rotation Angle	Emission Rate (pounds per hour)
10	702643	3668771	193.87	4.57	28.956	24.384	-2	0.0800
27	702734	3668768	194.80	4.57	0.914	0.914	0	0.0010
28	702756	3668782	195.40	4.57	0.914	0.914	0	0.0010
35	702654	3668740	193.79	4.57	22.860	30.480	-2	0.0000
36	702646	3668755	193.80	4.57	32.004	15.240	-2	0.0100
41	702518	3668769	193.03	1.00	94.488	21.336	40	0.0388
42	702625	3668693	193.42	0.30	80.772	44.196	-2	0.0000
43	702703	3668745	194.26	0.30	62.484	39.624	-2	0.0000

Source ID	Easting (meters)	Northing (meters)	Elevation (meters)	Height (meters)	East - West Length (meters)	North - South Length (meters)	Rotation Angle	Emission Rate (pounds per hour)
44	702591	3668760	193.42	3.99	24.384	41.148	-2	0.0300
52	702632	3668766	193.72	4.57	21.336	16.764	-2	0.0100
53	702616	3668762	193.58	1.83	16.764	19.812	-2	0.1300
999	702555	3668760	193.21	1.00	40	40	-2	0.0380

A graphical representation depicting source locations and building configuration is below.

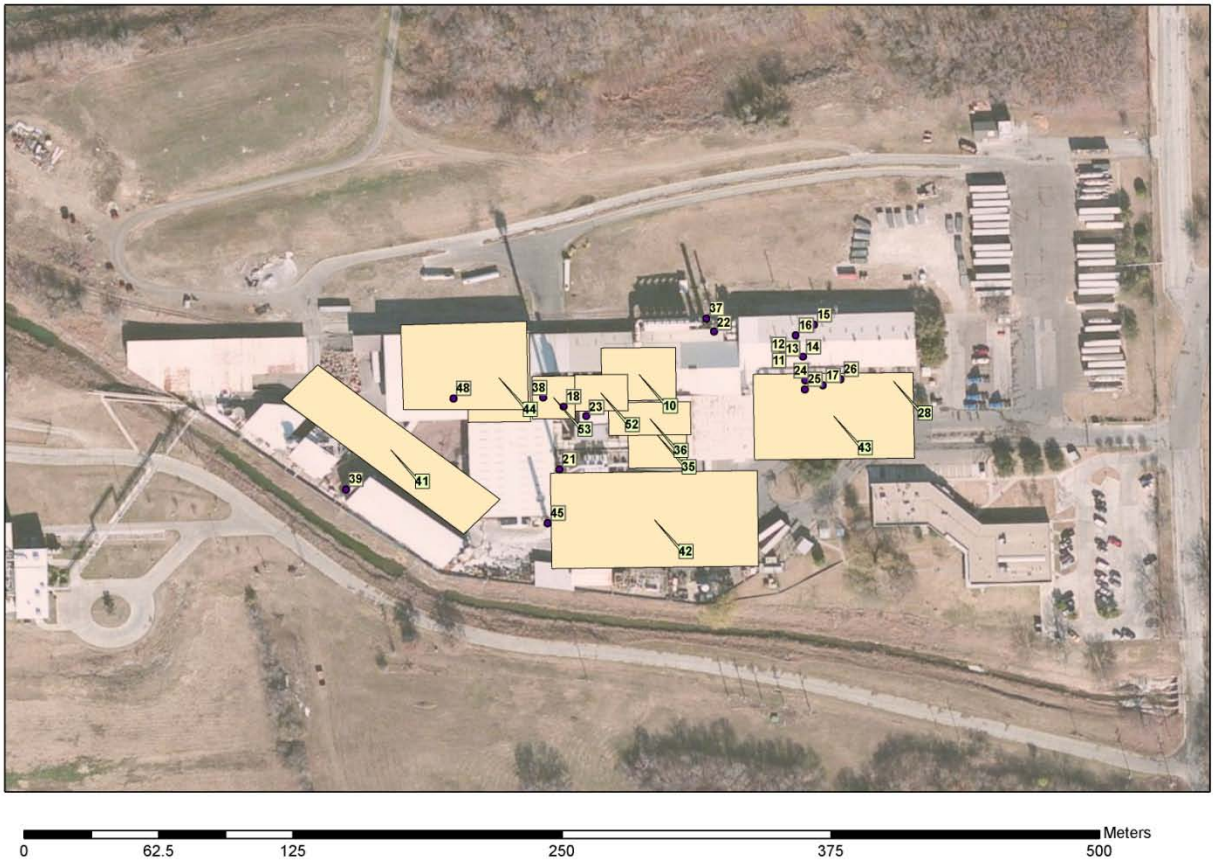

Figure D-12: Graphical Representation of Current Emission Source Locations and Building Configuration

Base Case Modeling Results

Table D-5: *Base Case Source Contribution at Location of Maximum Predicted Concentration* lists the contributions of each source at the location of the maximum rolling three-month predicted concentration in microgram per cubic meter (µg/m^3). These results suggest which sources require controls and to what extent in order for the Exide Frisco Site to operate in compliance with the 2008 lead NAAQS. The sources with the highest contributions are 10, 41, 44, 53, and 999. The contribution of these five sources at the location of the maximum predicted concentration is 1.2922 µg/m^3. The contribution from all other sources is 0.1493 µg/m^3.

The post-processor LeadPost reports results were rounded to three decimal places. In order to display the rolling three-month concentrations to five decimal places, output files from

AERMOD using the MAXIFILE option for monthly averages with a reporting threshold of 0.00001 µg/m³ were generated. The three-month rolling averages to five decimal places were calculated from the monthly averages reported by the MAXIFILE output.

Table D-7: Base Case Source Contribution at Location of Maximum Predicted Concentration

Source ID	Source Contribution (µg/m³)	Source Contribution Percent of Maximum
10	0.19758	13.71%
11	0.00375	0.26%
12	0.00789	0.55%
13	0.00084	0.06%
14	0.00219	0.15%
15	0.00141	0.10%
16	0.00157	0.11%
17	0.00274	0.19%
18	0.00878	0.61%
21	0.00794	0.55%
22	0.00616	0.43%
23	0.00039	0.03%
24	0.00052	0.04%
25	0.00081	0.06%
26	0.00126	0.09%
27	0.00178	0.12%
28	0.00163	0.11%
36	0.02303	1.60%
37	0.00781	0.54%
38	0.00517	0.36%
39	0.02714	1.88%

Source ID	Source Contribution (µg/m³)	Source Contribution Percent of Maximum
41	0.08894	6.17%
44	0.07487	5.19%
45	0.01068	0.74%
48	0.00165	0.11%
52	0.02412	1.67%
53	0.32835	22.78%
999	0.60249	41.80%
ALL	1.44149	100.00%

Model Evaluation

In order to determine if the source representations used for the current situation are appropriate, modeling results were compared to monitored values. Modeling results and monitoring data for 24-hour, monthly, and rolling 3-month averages were compared. The 24-hour averages were only compared using 2008 data for select sampling periods when monitored concentrations were high. Monthly and rolling 3-month averages were compared for the period 2006-2010.

The comparison of modeled to monitored 24-hour concentrations was performed qualitatively for all monitors. The qualitative analysis consisted of observing if the dispersion pattern predicted by the modeling was consistent with the monitored values. A qualitative comparison of modeled and monitored concentrations was performed for data from the Eubanks monitor during select sampling periods when monitored concentrations were high. Table D-8 depicts the comparison of modeled and monitored concentrations at the Eubanks monitor.

Table D-8: Comparison of Modeled and Monitored Concentrations at the Eubanks Monitor

Date	Modeled Concentration (µg/m³)	Monitored Concentration (µg/m³)
April 24, 2008	1.99	1.22
April 30, 2008	1.90	1.89
May 30, 2008	2.32	1.94

Date	Modeled Concentration (µg/m^3)	Monitored Concentration (µg/m^3)
June 5, 2008	3.77	3.42
December 2, 2008	2.22	1.40

Figures D-13 through D-17 depict a quantitative analysis of modeling results and monitored concentrations. The predicted concentrations at the receptors are represented with the same color scheme as monitored concentrations. The purpose of the qualitative analysis is to determine if the dispersion pattern predicted by the modeled representations essentially agree with monitored concentrations.

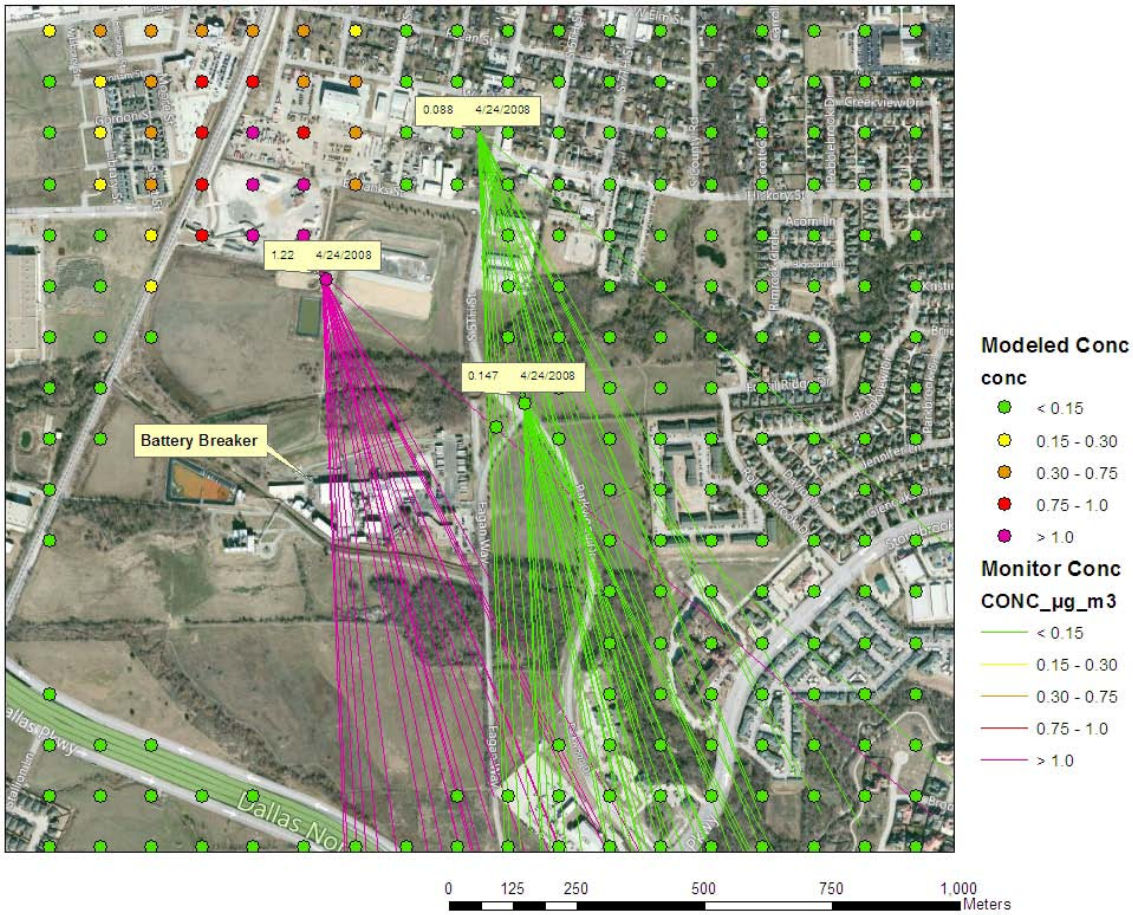

Figure D-13: Modeling Results Comparison with Monitored Concentrations April 24, 2008

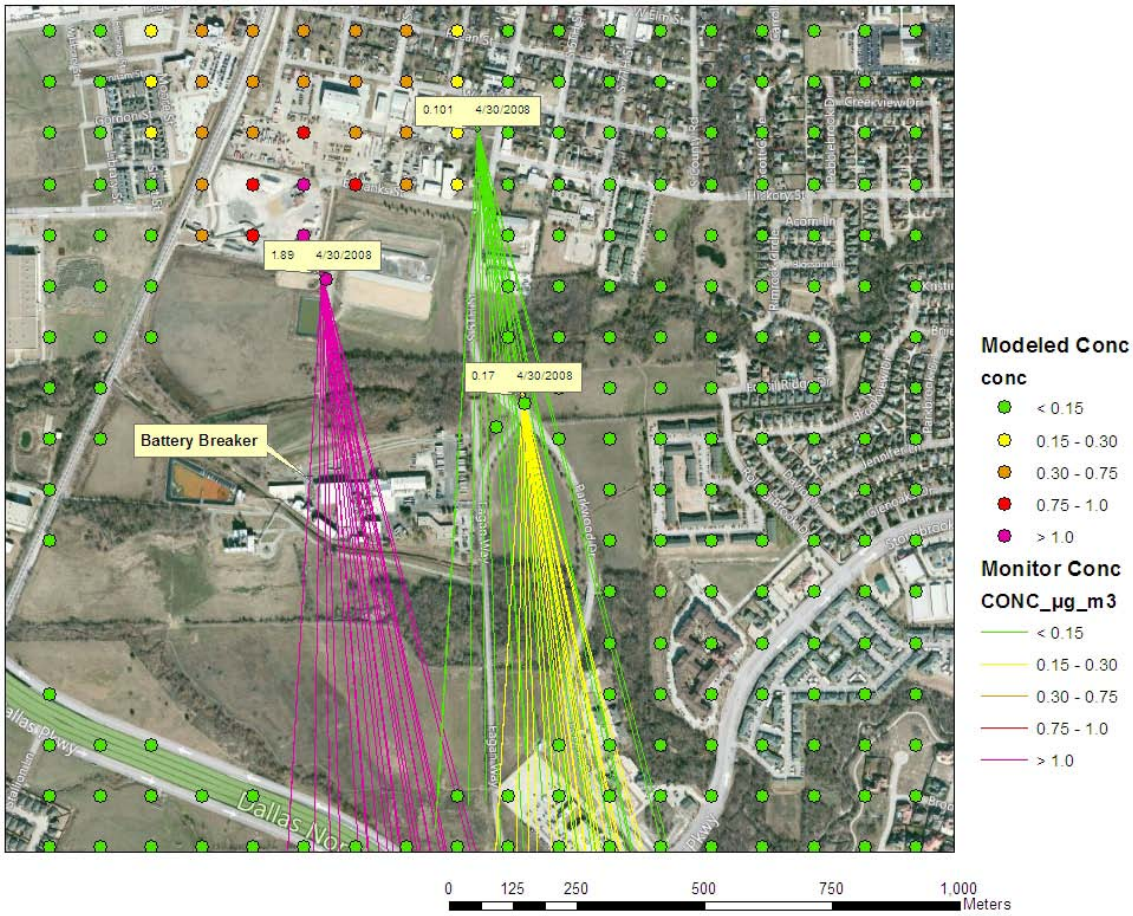

Figure D-14: Modeling Results Comparison with Monitored Concentrations April 30, 2008

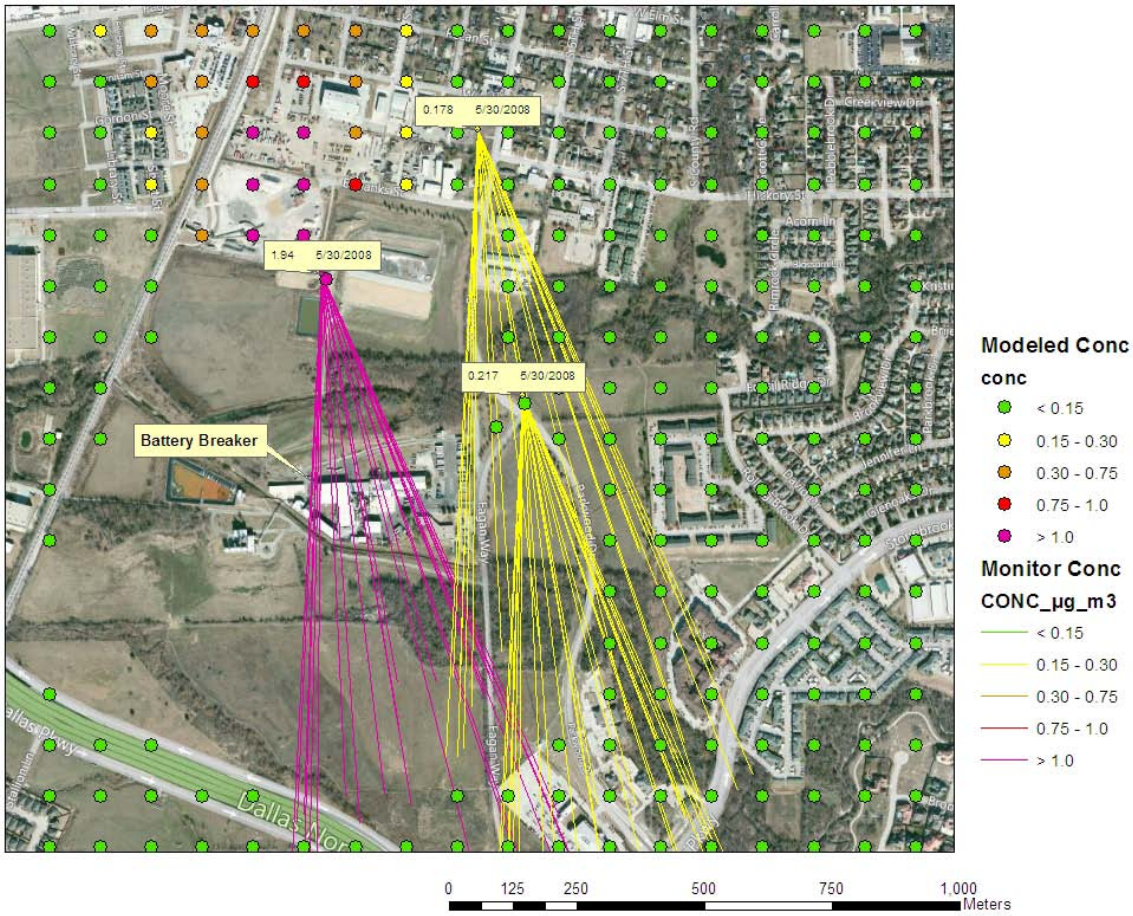

Figure D-15: Modeling Results Comparison with Monitored Concentrations May 30, 2008

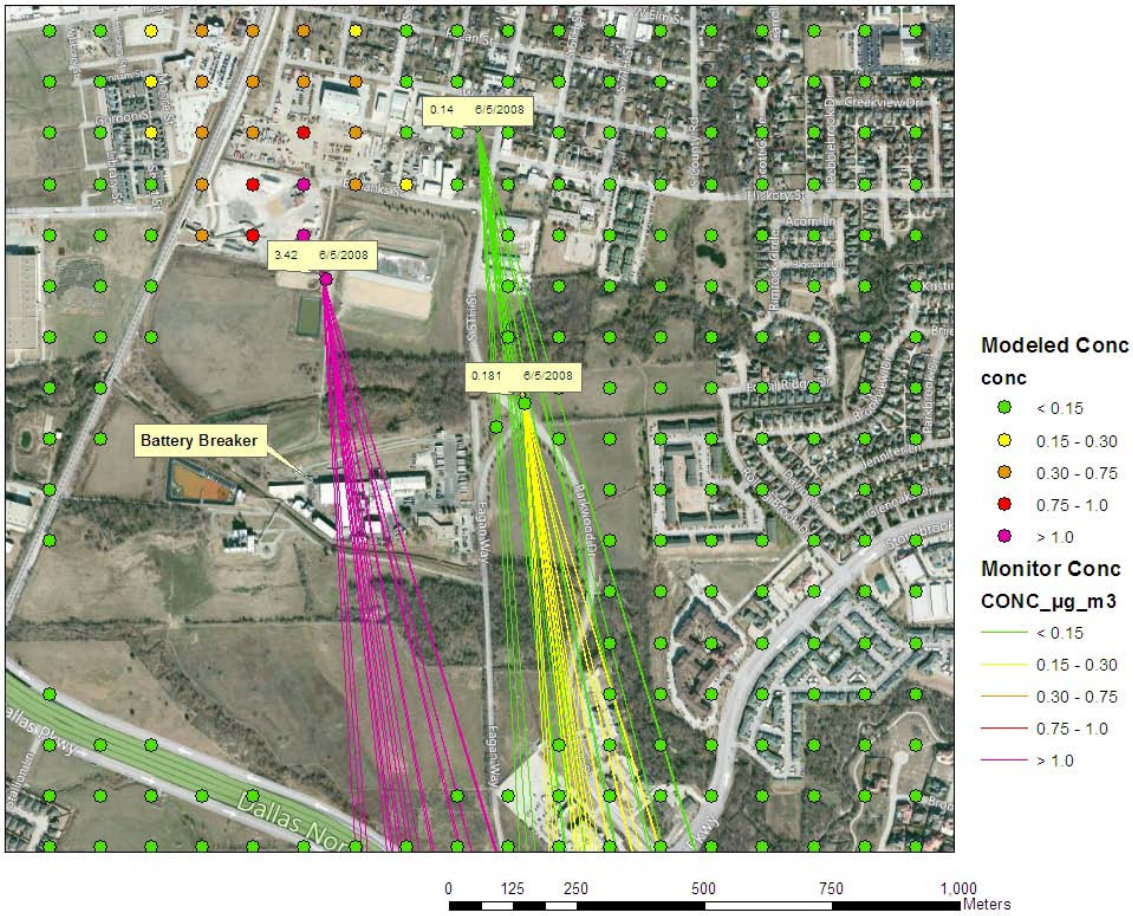

Figure D-16: Modeling Results Comparison with Monitored Concentrations June 5, 2008

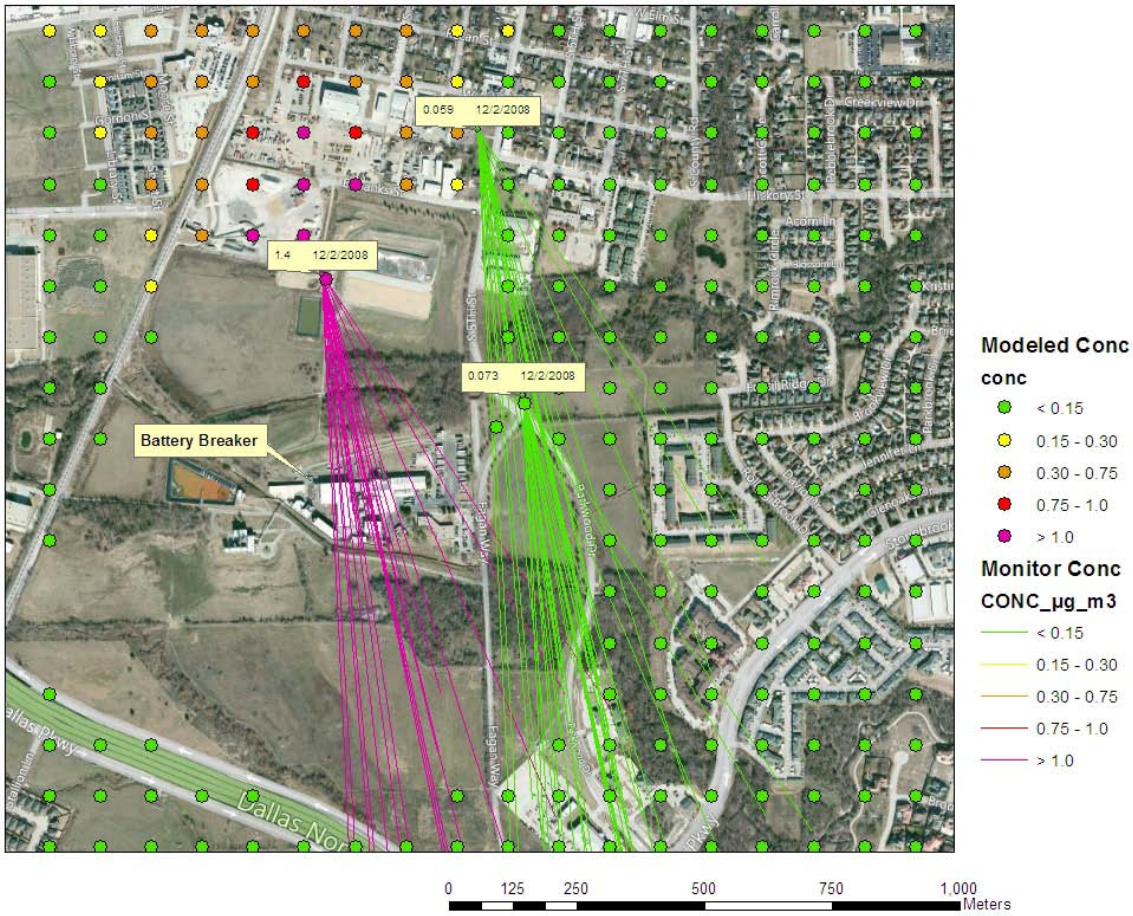

Figure D-17: Modeling Results Comparison with Monitored Concentrations December 2, 2008

Monitored and modeled monthly and rolling 3-month average concentrations at the Eubanks monitor were compared for the period 2006-2010. Figure D-18: *Comparison of Monthly Average Monitored and Modeled Concentrations at the Eubanks Monitor for 2006-2010* depicts the comparison. There are disparities in the comparison. The emission rates modeled were assumed to be constant and do not represent the variable nature of the emissions due to process variations. Even so, in general, the modeling results vary temporally in a similar way as the monitored concentrations at the Eubanks monitor.

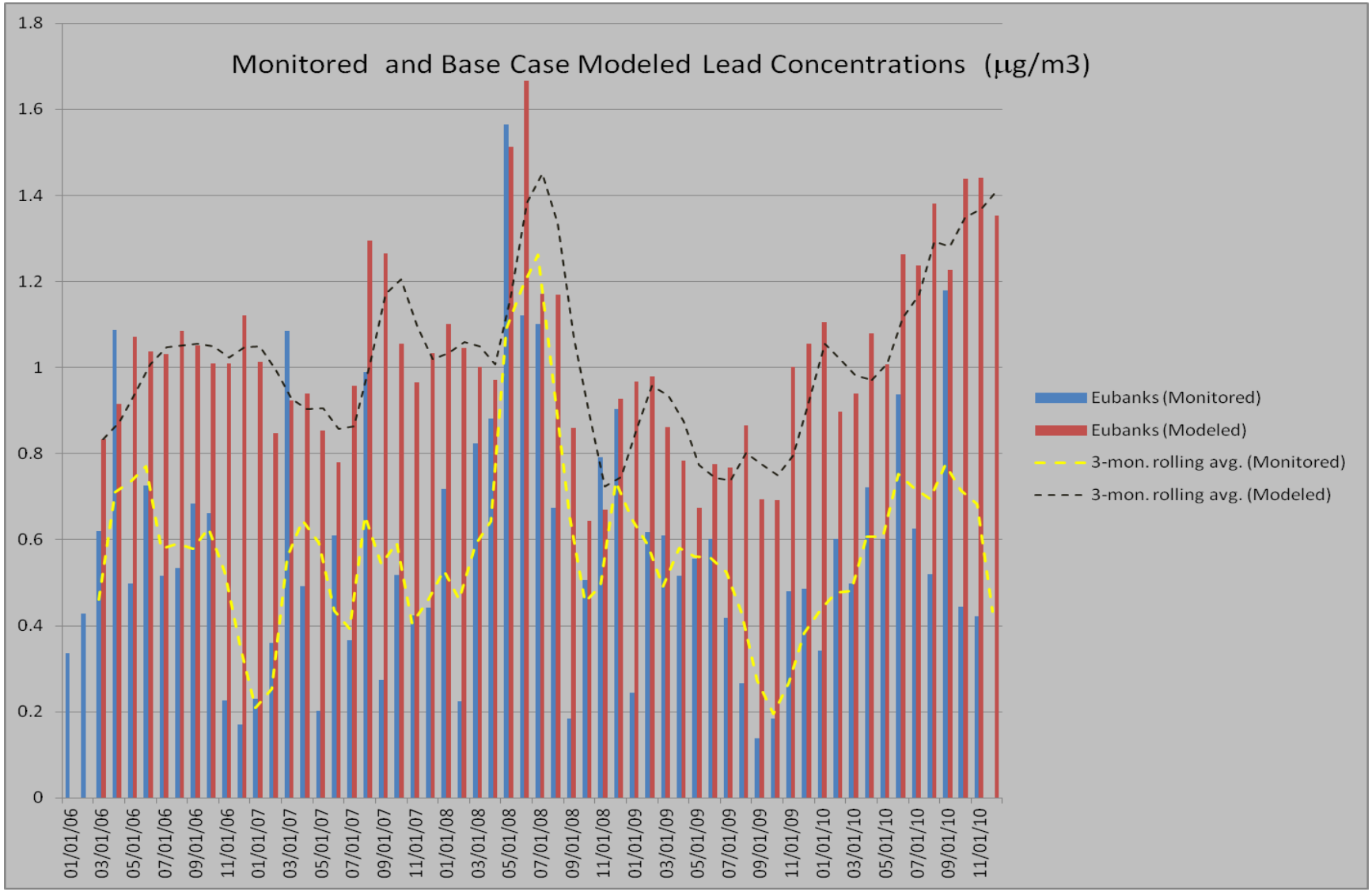

Figure D-18: Comparison of Monthly Average Monitored and Modeled Concentrations at the Eubanks Monitor for 2006-2010

Conclusions Based on Modeling Analysis

The modeling results appear to substantially agree with monitored concentrations when an additional fugitive source is located in the western portion of the Exide site process area. The model results substantially agree with monitored values for the 24-hour, monthly, and rolling 3-month averaging times. Though it is not conclusive that the source represented in the modeling exactly describes the actual emissions, the approximate location and character (varying with wind speed) of the emission source appear to be correct. What can be concluded is there are more actual fugitive emissions from the process area than have been previously represented. The inclusion of these additional emissions in the attainment demonstration modeling provided acceptable model performance and helps ensure that all significant emission sources are considered when determining modeled concentrations.

When considering the impact of each source on the maximum predicted rolling 3-month concentration, the point source emissions make up a small portion, approximately 10 percent, of the total impact. Control of point source emissions will have little impact on the maximum predicted and actual concentrations of lead. Significant control of all fugitive emissions will have a very large impact on reducing predicted and actual concentrations of lead.