# PROTOCOL

Air Quality Impact Assessment for the
Example Facility

Source ID No. 9999999

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# 1. INTRODUCTION

This protocol describes the air quality impact assessment (AQIA) that will be conducted by XYZ Consulting Company for the Example Facility located at 123 Streetname, City, Kansas as shown in Figure 1.

# 2. PROJECT DESCRIPTION

Please provide a brief description of the project here, including a description of the entire facility and individual processes, as well as modifications. Figure 2 provides 3D views of the facility. The description should also include a description of emission units.

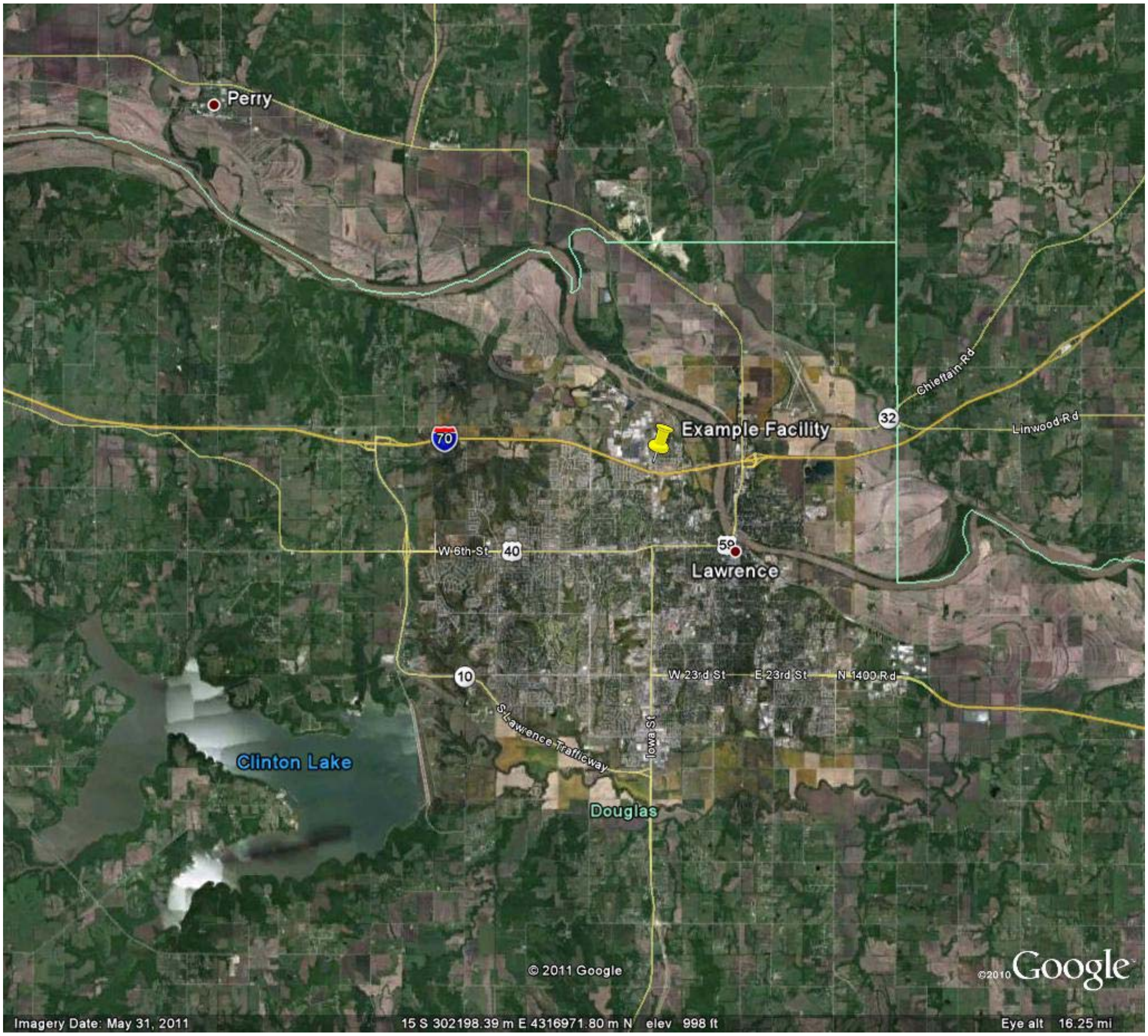
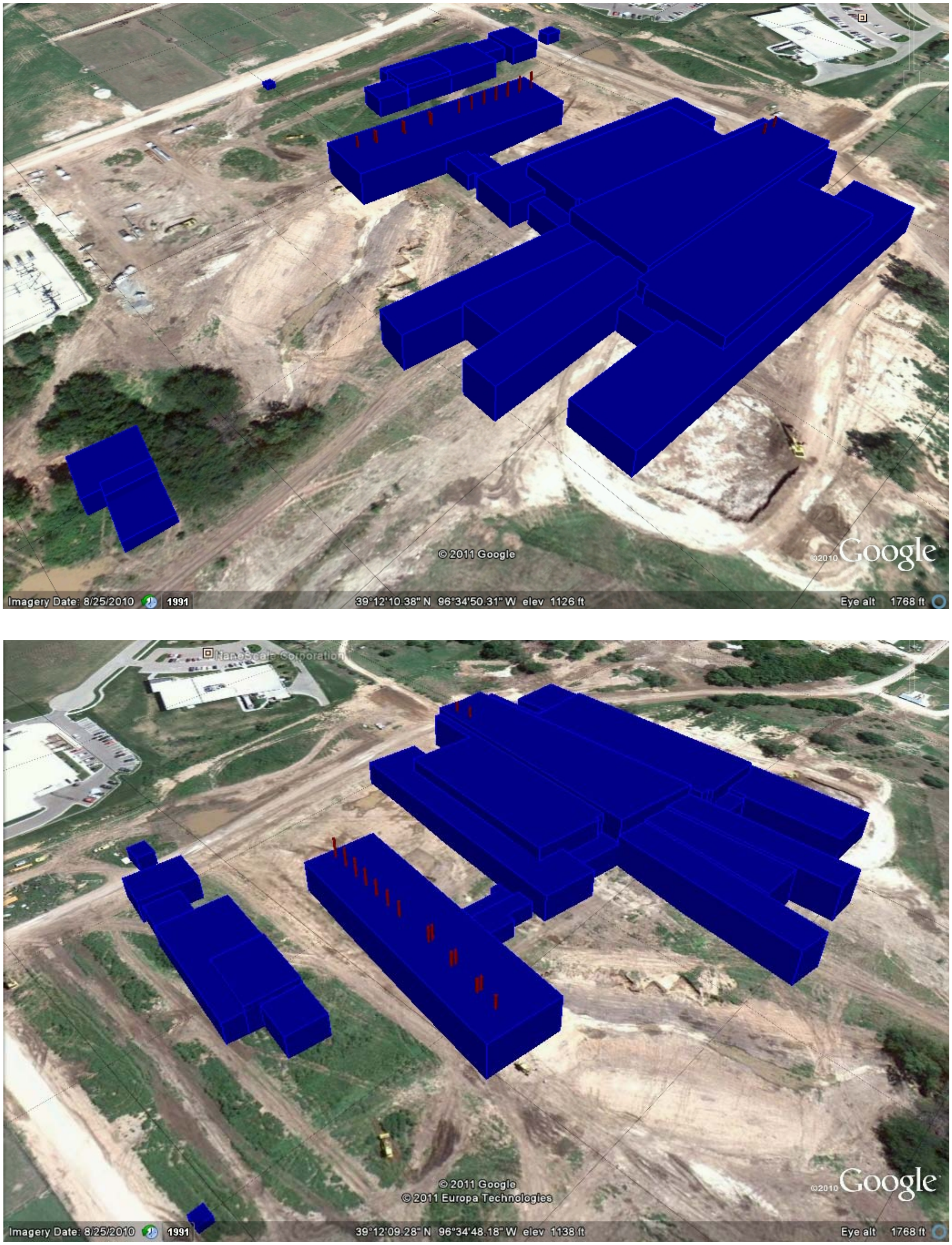



Figure 1. Site location




a)

b)

Figure 2. 3D views of the facility: a) View from the SW; b) View from the NW

## 3. AIR QUALITY IMPACT ANALYSIS (AQAI) APPLICABILITY

The proposed facility is a major source as defined by K.A.R. 28-19-350, Prevention of Significant Deterioration. Therefore, the owner or operator must demonstrate that allowable emission increases from the proposed facility would not cause or contribute to air pollution in violation of:

1) any NAAQS in any air quality control region; or

2) any applicable maximum allowable increase of $PM_{10}$, $SO_2$, or $NO_2$ over the baseline concentration in any area (increment).

Emissions from the proposed project and significant emission thresholds are listed in Table 1 below. New major stationary sources with pollutant emissions exceeding significant emission rates must undergo PSD review.

Table 1. Emissions From The Proposed Project and PSD Emission Rates - Potential to Emit

| Pollutant | Project Emissions (tpy) | Significant Emission Rate (tpy) | PSD Review Required |
|---|---|---|---|
| $NO_x$ | 270.4 | 40 | Yes |
| $SO_2$ | 9.5 | 40 | No |
| PM | 26.5 | 25 | Yes |
| $PM_{10}$ | 26.5 | 15 | Yes |
| $PM_{2.5}$ | 26.5 | 10 | Yes |
| CO | 90.5 | 100 | No |
| VOC | 36.6 | 40 | No |
| Lead | 0.00 | 0.6 | No |

Based on Table 1, the following pollutants must be evaluated as part of the AQIA: nitrogen oxides ($NO_x$) as nitrogen dioxide ($NO_2$), particulate matter with an aerodynamic diameter less than or equal to ten microns ($PM_{10}$), and particulate matter with an aerodynamic diameter less than or equal to 2.5 microns ($PM_{2.5}$). Lead (Pb), VOCs, sulfur dioxide ($SO_2$) and carbon monoxide (CO) are below the significant emission rate limits and no PSD evaluation is required.

## 4. MODEL SELECTION

AERMOD is the current model preferred by EPA for use in nearfield regulatory applications, per 40 CFR Part 51 Appendix W, Section 3.1.2, and Appendix A to Appendix W:

"AERMOD is a steady-state plume dispersion model for assessment of pollutant concentrations from a variety of sources. AERMOD simulates transport and dispersion from multiple sources based on an up-to-date characterization of the atmospheric boundary layer. AERMOD is appropriate for: point, volume, and area sources; surface, near-surface, and elevated releases; rural or urban areas; simple and complex terrain; transport distances over which steady-state assumptions are appropriate, up to 50 km; 1- hour to annual averaging times; and continuous toxic air emissions."

Based on the above, the AERMOD modeling system, Version 11103, will be used to evaluate the impacts of the following emissions that will result from the proposed Example Facility:

- 1-hour, annual $NO_2$;
- 24-hour $PM_{10}$;
- 24-hour and annual $PM_{2.5}$;

Regulatory default options in the AERMOD model will be utilized for this air quality impact analysis.

For modeling $NO_2$, the PVMRM method will be utilized. A formal request for approval will be submitted to EPA Region 7 under a separate cover letter. This method uses hourly ozone concentrations (supplied by KDHE) as well as in-stack $NO_2/NO_x$ ratios. Initially the default ratio of 0.5 will be utilized. If a more refined analysis is needed, additional data will be reviewed to determine whether a lower in-stack ratio can be justified.

## 5. MODEL INPUTS

### 5.1 SOURCE DATA

Source emission scenarios are based on the following proposed operating practices:

Boilers: All boilers will be equipped with dual fuel burners (natural gas and #2 fuel oil). For the purposes of permitting and modeling, it is assumed that the boilers are burning #2 fuel oil 8760 hours/year.

Diesel Generators: The generators will only be used for emergency power. For the purpose of permitting and modeling, 500 hours per year of operation are assumed.

Six different emission scenarios will be modeled as summarized below. Appendix A includes the emission rate calculations for each scenario.

**1-hr $NO_2$[1], 24-hr $PM_{10}$, and 24-hr $PM_{2.5}$**

- Scenario 1 ("Maximum Possible with 4 Boilers Operating at 100%"): This scenario assumes that 4 boilers will operate 8760 hours per year on fuel oil at 100% load.
- Scenario 2 ("Maximum Possible with 4 Boilers Operating - Alternate Load 1"): This scenario assumes that 4 boilers will operate 8760 hours per year on fuel oil at 75% load.
- Scenario 3 ("Maximum Possible with 4 Boilers Operating - Alternate Load 2"). This scenario assumes that 4 boilers will operate 8760 hours per year on fuel oil at 50% load.

**Annual $PM_{2.5}$ and $NO_2$**

- Scenario 4 ("Maximum Possible with 4 Boilers Operating at 100%"): This scenario assumes that 4 boilers will operate 8760 hours per year on fuel oil at 100% load and 2 generators will operate 500 hours per year at 100% load.
- Scenario 5 ("Maximum Possible with 4 Boilers Operating - Alternate Load 1"): This scenario assumes that 4 boilers will operate 8760 hours per year on fuel oil at 75% load and 2 generators will operate 500 hours per year at 75% load.
- Scenario 6 ("Maximum Possible with 4 Boilers Operating - Alternate Load 2"). This scenario assumes that 4 boilers will operate 8760 hours per year on fuel oil at 50% load, 2 generators will operate 500 hours per year at 50% load.

The source parameter inputs for each emission scenario are summarized in Table 2. Table 3 summarizes the emission rate inputs for each scenario.

[1] This is consistent with the March 1, 2011 Appendix W Modeling Guidance for the 1-hour $NO_2$ NAAQS. The guidance states that intermittent sources (i.e., the emergency generators) may be excluded in the modeling compliance with the 1-hour $NO_2$ NAAQS under certain conditions. The intermittent sources have been included for modeling annual NAAQS compliance. Emission rates were calculated using the maximum number of hours of operation on an annual basis.

| Table 2a: Source Parameters - Scenarios 1 and 4 (4 Boilers and 2 Generators Operating at 100%) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Source Description | ID | Stack X Coordinate (m) | Stack Y Coordinate (m) | Base Elevation (m) | Source Height Above Base (m) | Exit Tempera-ture (K) | Exit Diameter (m) | Exit Velocity (m/s) |
| Boiler | | | | | | | | |
| Boiler 1 | BLR-1 | 708971.2 | 4342110.3 | 345.80 | 21.34 | 420.8 | 0.76 | 8.86 |
| Boiler 2 | BLR-2 | 708964.2 | 4342111.0 | 345.80 | 21.34 | 420.8 | 0.76 | 8.86 |
| Boiler 3 | BLR-3 | 708957.5 | 4342111.8 | 345.80 | 21.34 | 420.8 | 0.76 | 8.86 |
| Boiler 4 | BLR-4 | 708950.9 | 4342112.7 | 345.80 | 21.34 | 420.8 | 0.76 | 8.86 |
| Generators (not run for Scenario 1) | | | | | | | | |
| Generator 1 | DG-1 | 708880.4 | 4342121.6 | 345.80 | 21.34 | 639.7 | 0.46 | 37.37 |
| Generator 2 | DG-2 | 708888.7 | 4342120.9 | 345.80 | 21.34 | 639.7 | 0.46 | 37.37 |

| Table 2b: Source Parameters - Scenarios 2 and 5 (4 Boilers and 2 Generators - Alternate Load 1) | | | | | | | | |
|---|---|---|---|---|---|---|---|---|
| Source Description | ID | Stack X Coordinate (m) | Stack Y Coordinate (m) | Base Elevation (m) | Source Height Above Base (m) | Exit Tempera-ture (K) | Exit Diameter (m) | Exit Velocity (m/s) |
| Boiler | | | | | | | | |
| Boiler 1 | BLR-1 | 708971.2 | 4342110.3 | 345.80 | 21.34 | 417.0 | 0.76 | 7.90 |
| Boiler 2 | BLR-2 | 708964.2 | 4342111.0 | 345.80 | 21.34 | 417.0 | 0.76 | 7.90 |
| Boiler 3 | BLR-3 | 708957.5 | 4342111.8 | 345.80 | 21.34 | 417.0 | 0.76 | 7.90 |
| Boiler 4 | BLR-4 | 708950.9 | 4342112.7 | 345.80 | 21.34 | 417.0 | 0.76 | 7.90 |
| Generators (not run for Scenario 2) | | | | | | | | |
| Generator 1 | DG-1 | 708880.4 | 4342121.6 | 345.80 | 21.34 | 629.9 | 0.46 | 35.10 |
| Generator 2 | DG-2 | 708888.7 | 4342120.9 | 345.80 | 21.34 | 629.9 | 0.46 | 35.10 |

| Table 2c: Source Parameters - Scenarios 3 and 6 (4 Boilers and 2 Generators - Alternate Load 2”) | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| Source | | Stack X Coordinate | Stack Y Coordinate | Base Elevation | Source Height Above Base | Exit Tempera-ture | Exit Diameter | Exit Velocity |
| Description | ID | (m) | (m) | (m) | (m) | (K) | (m) | (m/s) |
| Boiler | | | | | | | | |
| Boiler 1 | BLR-1 | 708971.2 | 4342110.3 | 345.80 | 21.34 | 407.6 | 0.76 | 5.15 |
| Boiler 2 | BLR-2 | 708964.2 | 4342111.0 | 345.80 | 21.34 | 407.6 | 0.76 | 5.15 |
| Boiler 3 | BLR-3 | 708957.5 | 4342111.8 | 345.80 | 21.34 | 407.6 | 0.76 | 5.15 |
| Boiler 4 | BLR-4 | 708950.9 | 4342112.7 | 345.80 | 21.34 | 407.6 | 0.76 | 5.15 |
| Generators (not run for Scenario 3) | | | | | | | | |
| Generator 1 | DG-1 | 708880.4 | 4342121.6 | 345.80 | 21.34 | 614.8 | 0.46 | 26.94 |
| Generator 2 | DG-2 | 708888.7 | 4342120.9 | 345.80 | 21.34 | 614.8 | 0.46 | 26.94 |

| Table 3: Source Emission Rates | | | |
|---|---|---|---|
| Source | | NOx | $PM_{10}$ and $PM_{2.5}$ |
| Scenario | ID | (g/s) | (g/s) |
| 1-hr $NO_2$ | | | |
| 1 | BLR 1-4 | 1.64 | 0.27 |
| 2 | BLR 1-4 | 1.45 | 0.23 |
| 3 | BLR 1-4 | 0.96 | 0.16 |
| Annual $NO_2$ and $PM_{2.5}$ | | | |
| 4 | BLR 1-4 | 1.64 | 0.27 |
| | DG 1-2 | 0.60 | 0.01 |
| 5 | BLR 1-4 | 1.45 | 0.23 |
| | DG 1-2 | 0.53 | 0.01 |
| 6 | BLR 1-4 | 0.96 | 0.16 |
| | DG 1-2 | 0.35 | 0.00 |

Notes:

Operating hours per year for generators: 500

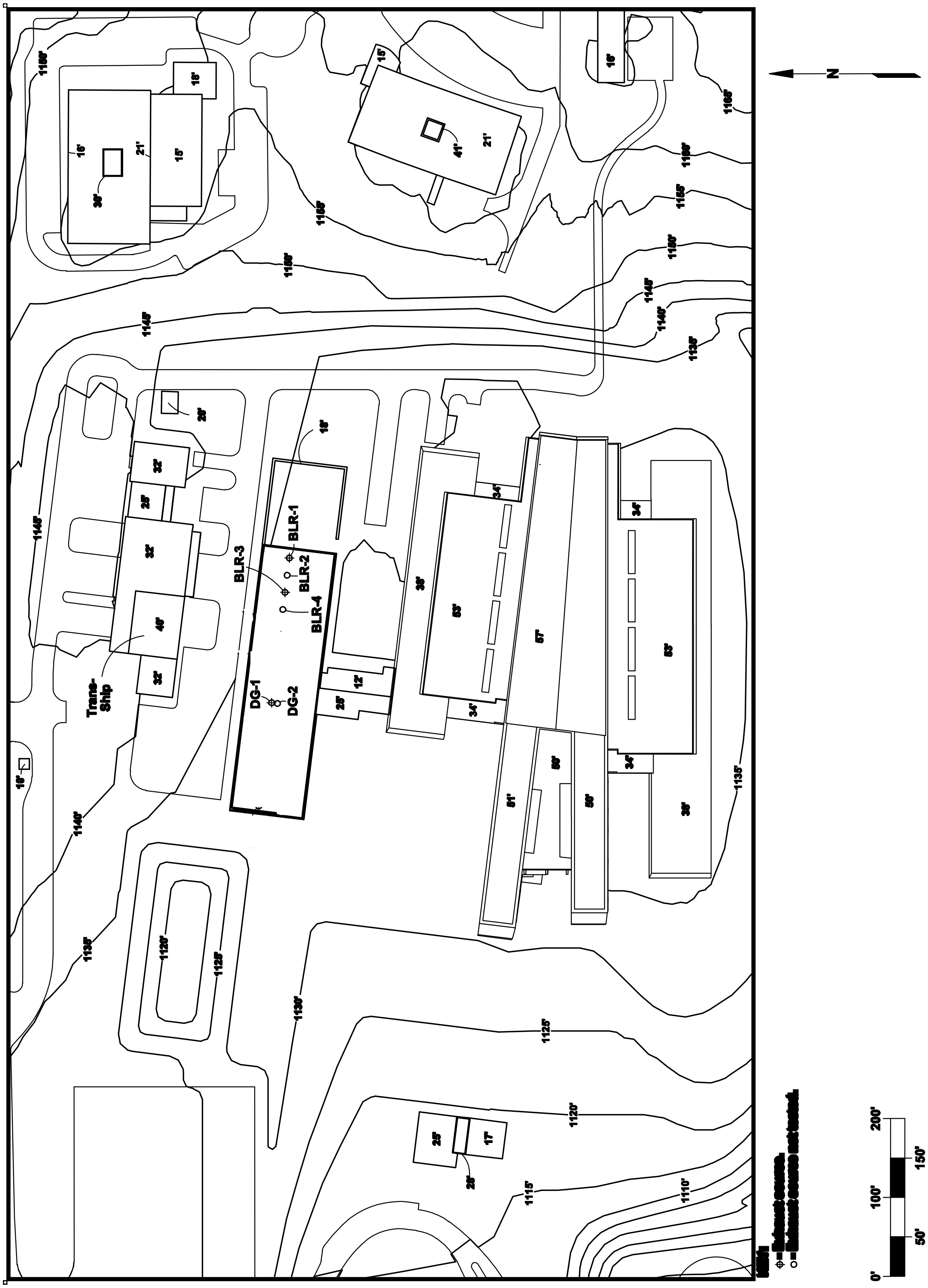



Figure 3. Site plan showing the source locations and surrounding buildings

## 5.2 URBAN OR RURAL

The USGS National Land Cover Data for 2006 (NLCD2006) for the site (see Figure 4) was reviewed to determine if a rural or urban site classification is to be used for the modeling. Figure 4 indicates the site location and a circle with a 3 km radius around the project site. In accordance with Appendix W of 40 CFR Part 51, an urban dispersion classification is to be used if land use types I1 (heavy industrial), I2 (light-moderate industrial), C1 (commercial), R2 (compact residential) and R3 (compact residential) account for 50% or more of the area within the 3 km radius around the site. The land use classifications I1, I2, C1, R2 and R3 correspond to the NLCD 2006 land cover classes 23 (developed, medium intensity) and 24 (developed, high intensity) indicated in medium and dark red in Figure 4. Land cover classes 23 and 24 account for less than 50% of the area within the 3 km radius around the site. Therefore it was concluded that the area is "rural" for air modeling purposes. A population of 50,000, which is the approximate population for City, Kansas, will be used for the urban option.

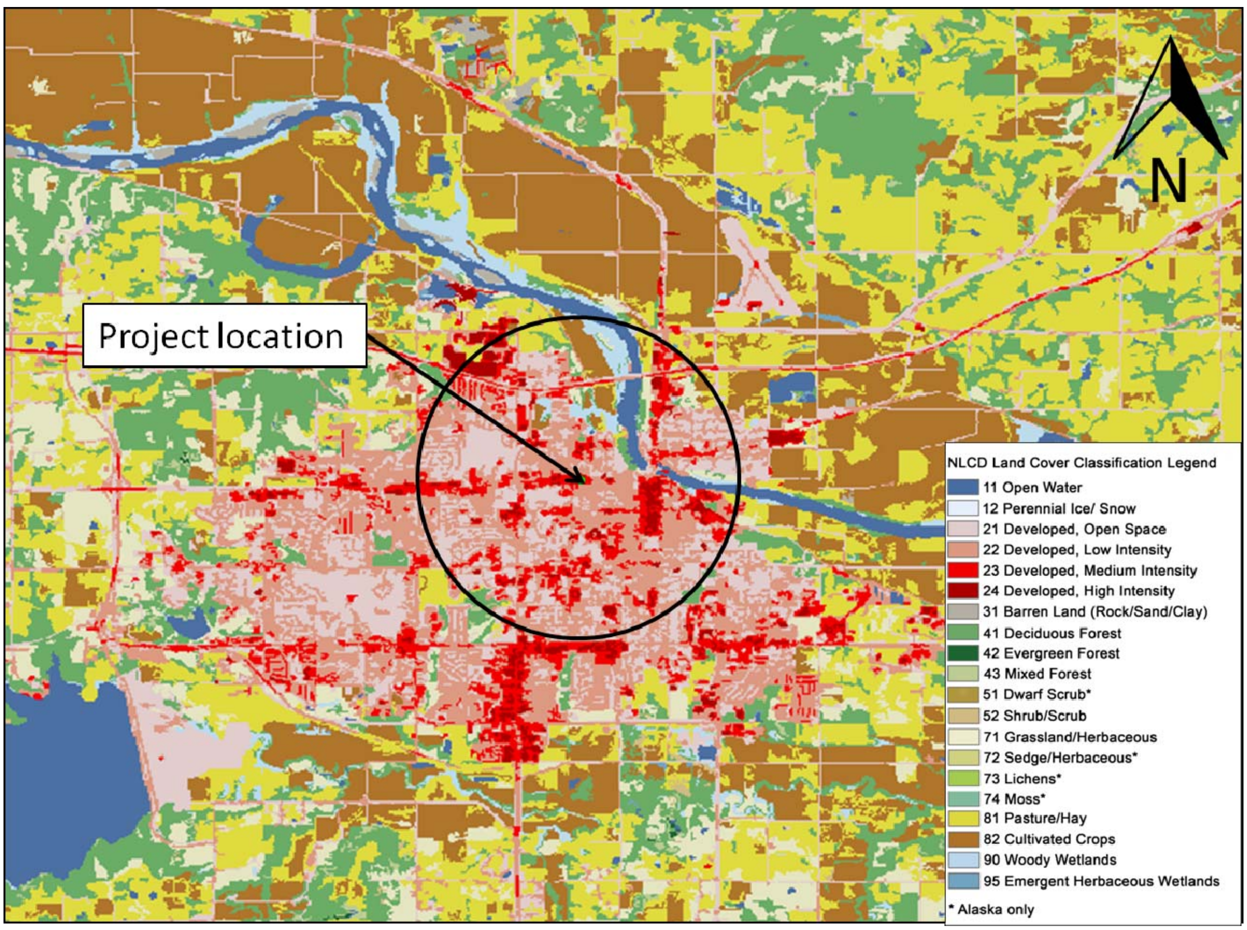



Figure 4. 2006 USGS National Land Cover map for City, KS

### 5.3 TERRAIN

The proposed project will be modeled using the Elevated Terrain Mode. Elevations for the project will be obtained using U.S. Geological Survey (USGS) NED files with a 30 m resolution for a 50 km radius around the facility. The AERMAP processor will be used to process the NED files and generate source, building, and receptor heights and hill height scales as applicable.

### 5.4 METEOROLOGICAL DATA

KDHE will provide five years of meteorological (met) data for AERMOD model input as summarized in Table 4.

AERMET, the meteorological data pre-processor for the AERMOD modeling system, will be used to extract and process the surface and upper air data in order to calculate the boundary layer parameters that are ultimately necessary for the calculation of pollutant concentrations within the atmosphere.

The surface characteristics for use with the AERMET program will be determined using AERSURFACE. The Albedo and Bowen ratio will be evaluated for a 10 kilometer radius around the airport anemometer location as well as the site location. The surface roughness will be evaluated for a 1 kilometer radius around the airport anemometer location and the site location.

**Table 4. Meteorological Data Stations for AERMOD Input**

| Type | Station Name | WBAN # | Latitude/ Longitude | Elevation (m) | Years of Data | Comments |
|---|---|---|---|---|---|---|
| Surface Air Station | City Municipal Airport | 55555 | 39.13334/ -96.68333 | 333 | 2006-2010 | Will be provided by KDHE |
| Upper Air Station | Topeka (TOP) | 13996 | 39.06667/ -96.63333 | 268 | 2006-2010 | Will be provided by KDHE |

### 5.5 BUILDING DOWNWASH

Good Engineering Practice (GEP) stack height for stacks constructed after January 12, 1979 is defined as the greater of

- 65 meters, measured from the base of the stack and

- Stack height calculated from the following formula:

  $H_g = H + 1.5L$

Where

$H_g$ = GEP stack height, measured from the ground level elevation at the base of the stack;

H = height of any nearby structures, measured from the ground level at the base of the stack; and

L = lesser dimension of the height or projected width of any nearby structures.

The proposed boiler and generator stack heights will be less than 25 m above local grade. The calculated GEP stack height is 40.38 m. The release heights of all emissions sources are below the GEP stack height. Building downwash will be included using the Building Profile Input Program (BPIP) and plume rise model enhancements (PRIME) in AERMOD. Building dimensions that will be input into BPIP are shown in Figure 3.

### 5.6 RECEPTORS

AERMOD estimates ambient concentrations using a network of points, called receptors, throughout the region of interest. The model uses emissions and weather information to estimate ambient pollutant concentrations at each receptor location. Model receptors will be placed at locations that reflect the public's exposure to the pollutant. Receptors will be placed at 50 meter spacing along the proposed facility's property boundary. The remaining receptors for significant impact modeling for the proposed facility will consist of a multi-tiered grid as shown in Table 5.

**Table 5. Receptor Spacing for Significant Impact Modeling for the Proposed Facility**

| Receptor Grid Type | Distance From Project Center (m) | Receptor Spacing (m) |
|---|---|---|
| Extra Fine | Fenceline to 1000 | 50 |
| Fine | 1,000+ to 2,000 | 100 |
| Medium | 2,000+ to 10,000 | 250 |
| Coarse | 10,000+ to 50,000 | 500 |

Receptors will be placed following the spacing in the table above up to 10 kilometers. If significant concentrations of criteria pollutants extend beyond the 10 kilometer initial grid, the grid will be expanded outwards up to 50 kilometers.

Screening modeling resulting in a significant impact for any receptors at or beyond the facility fenceline requires a full impact analysis. The screening model area of impact (AOI) will be determined by first finding the distance to the farthest receptor showing a concentration greater than the significant impact level (SIL). This distance is then added to 50 kilometers and the area within this radius from the center of the facility is considered to be the AOI. The methodology for determining receptor grids for the full impact analysis is described below.

## 6. SIGNIFICANCE DETERMINATION

Since the Example facility proposes to emit $NO_x$, $PM_{10}$, and $PM_{2.5}$ above the PSD significant emission rate thresholds, an ambient air quality impact analysis is required. In order to determine if a full impact modeling analysis and/or ambient air monitoring is necessary, a preliminary modeling analysis will first be conducted. The preliminary analysis will include only the proposed sources to determine if significant modeled impacts will take place. For each pollutant where AERMOD predicts the first highest concentration to be below the SIL threshold, no further analysis is necessary for that pollutant. The SILs and pre-application monitoring thresholds for applicable pollutants are shown in Table 6. After the preliminary modeling is completed, the table will be filled in to determine if additional modeling and/or monitoring is required.

**Table 6. Significance Determination Table**

| Pollutant | Averaging Period | Maximum Predicted Concentration (μg/m$^3$) | Modeling Significant Impact Level (SIL) (μg/m$^3$) | Exceeds SIL? | Pre-application Monitoring Threshold Concentration (μg/m$^3$) | Exceeds Monitoring Threshold? |
|---|---|---|---|---|---|---|
| $NO_2$ | Annual | | 1 | | 14 | |
| | 1-hour | | 10[1] | | NA | |
| $PM_{10}$ | 24-hour | | 5 | | 10 | |
| $PM_{2.5}$ | Annual | | 0.3 | | NA | |
| | 24-hour | | 1.2 | | 4 | |

[1] This KDHE-established interim SIL is valid until the EPA promulgated SILs are effective and adopted in Kansas air quality regulations.

## 7. REFINED MODELING

Refined modeling will be conducted to demonstrate compliance with the NAAQS for each pollutant and averaging period for which the SIL was exceeded. Evaluation of compliance with the NAAQS requires that the refined modeling accounts for the combined impact of the proposed project, nearby sources, and background concentrations. KDHE will supply emission sources within the following distances from the facility for the full impact analysis as shown in Table 7.

| **Table 7. Radius of Impact for SIL** | |
|---|---|
| **Pollutant** | **Radius of Impact + 50 km** |
| $NO_2$ | TBD[1] |
| $PM_{10}$ | TBD |
| $PM_{2.5}$ | TBD |

The cumulative modeling analysis includes the facility's total emissions along with emissions from the radius of impact plus 50 kilometers of the source, and combines impacts with representative ambient monitored background concentrations to estimate if a NAAQS or PSD increment will be violated. A receptor grid should extend to 50 kilometers from the source.

KDHE will provide the nearby source inventories using information available through the KDHE emission inventory database and the facility files. The background concentrations will also be obtained from KDHE.

Table 8 will summarize the results from the refined analysis and will include the total concentration compared to the NAAQS for each pollutant for which a refined analysis was conducted.

[1] For 1-hour $NO_2$, KDHE will supply nearby sources on a case by case basis, accounting for terrain influences on the location and gradients of maximum 1-hour concentrations. These considerations suggest that the emphasis on determining which nearby sources to include in the modeling analysis should focus on the area within a smaller radius from the project location in most cases. This approach is consistent with EPA guidance.

| Table 8. NAAQS Compliance Demonstration | | | | | | |
|---|---|---|---|---|---|---|
| Pollutant | Averaging Period | Maximum Predicted Concentration (µg/m$^3$) | Background Concentration (µg/m$^3$) | Total Concentration (µg/m$^3$) | NAAQS (µg/m$^3$) | % of NAAQS |
| $NO_2$ | Annual | | | | 100 | |
| | 1-hour | | | | 188[2] | |
| $PM_{10}$ | 24-hour | | | | 150[3] | |
| $PM_{2.5}$ | Annual | | | | 15[4] | |
| | 24-hour | | | | 35[5] | |

Model runs will also be conducted to demonstrate that the allowable increments will not be exceeded for each pollutant and averaging period. The contributions from the proposed project will be modeled, as well as total increment consumed by all sources that received a permit after the minor source baseline date. The results will be summarized in Tables 9 and 10. KDHE will provide the sources to include in the increment consumption modeling.

| Table 9. PSD Increment Consumption | | | | |
|---|---|---|---|---|
| Pollutant | Averaging Period | Modeled Concentration (µg/m$^3$) | Class II Increment (µg/m$^3$) | % of Increment |
| $NO_2$ | Annual | | 25 | |
| $PM_{10}$ | Annual | | 17 | |
| | 24-hour | | 30 | |
| $PM_{2.5}$ | Annual | | 4 | |
| | 24-hour | | 9 | |

[2] The 3-year average of the 98th percentile (8$^{th}$ highest) of the daily maximum 1-hour average may not exceed 100 ppb (188.7 µg/m$^3$).

[3] Not to be exceeded more than once per year on average over 3 years.

[4] Based on the annual distribution of daily maximum 1-hour values, averaged over 5 consecutive years.

[5] Based on the annual distribution of daily maximum 1-hour values, averaged over 5 consecutive years.

| Table 10. All Sources Cumulative Increment Consumption | | | | |
|---|---|---|---|---|
| Pollutant | Averaging Period | Modeled Concentration (μg/m$^3$) | Class II Increment (μg/m$^3$) | % of Increment |
| $NO_2$ | Annual | | 25 | |
| $PM_{10}$ | Annual | | 17 | |
| | 24-hour | | 30 | |
| $PM_{2.5}$ | Annual | | 4 | |
| | 24-hour | | 9 | |

## 8. ADDITIONAL IMPACT AIR QUALITY ANALYSIS

### 8.1 VISIBLITY IMPACTS

The PSD regulations require the applicant to provide an analysis of impairment to visibility that will occur as a result of the source and growth associated with the source [40 CFR 52.21(o)(1)]. There are no Federal Class I areas located within 100 km of the proposed facility. Hence, a visibility impact assessment on the Example Nearby State Park will be made using VISCREEN.

### 8.2 IMPACT ON SOIL AND VEGETATION

An impact analysis on soil, vegetation & animals will be conducted according to the guideline in “A Screening Procedure for Impacts of Air Pollution Sources on Plants, Soils and Animal, EPA 450/2-81-078".”

### 8.3 GROWTH IMPACTS

The final report will include a statement regarding any deterioration of air quality due to secondary emissions from associated industry, local rush hour traffic from employees, future phase of the project, etc. Also, a statement will be made about availability of future growth and the increment consumed by this project.

# APPENDIX A

[attach emission calculations here]