modeling using AERMOD requires five years of quality-assured meteorological data that includes hourly records of the following parameters:

- Wind speed
- Wind direction
- Air temperature
- Micrometeorological Parameters (e.g., friction velocity, Monin-Obukhov length)
- Mechanical mixing height
- Convective mixing height

The first three of these parameters are directly measured by monitoring equipment located at typical surface observation stations. The friction velocity, Monin-Obukhov length, and mixing heights are derived from characteristic micrometeorological parameters and from observed and correlated values of cloud cover, solar insulation, time of day and year, and latitude of the surface observation station. Surface observation stations form a relatively dense network, are almost always found at airports, and are typically operated by the NWS. Upper air stations are fewer in number than surface observing points since the upper atmosphere is less vulnerable to local effects caused by terrain or other land influences and is therefore less variable. The NWS operates virtually all available upper air measurement stations in the United States.

The two Augusta airports (Bush and Daniel Field) are the closest meteorological stations to the Kings Mill facility, roughly 45 km northwest of the proposed site. Trinity reviewed the data quality for those two sites and Bush Field had excessive calm hours (28-40% for the 2006-2010 period) and the wind direction from Daniel Field was less than 90% complete on average over the same 2006-2010 period. As such, the Macon Airport (MCN) surface NWS observation station is proposed as a representative station for the Kings Mill site based on its proximity and similar topographic characteristics. The Macon NWS station is located approximately 130 km southwest of the Kings Mill site and the use of this station is further justified through the analysis provided below. PyraMax requests that EPD provide preprocessed meteorological data based on surface observations from Macon (station 03813) and upper air measurements from Centreville (station 3881) for the most recent years available.

Land Use Representativeness Analysis

AERMOD utilizes planetary boundary layer (PBL) turbulence calculations to characterize the stability of the atmosphere, which is affected by the prevailing meteorological conditions and the land use and cover of the surrounding area. Because site-specific parameters are utilized in the meteorological data files, EPA made the following recommendation in the March 19, 2009 *AERMOD Implementation Guide*:[19]

[19] http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf, Sections 3.1 and 3.1.1, pages 3-4.

> *When applying the AERMET meteorological processor (EPA, 2004a) to prepare the meteorological data for the AERMOD model (EPA, 2004b), the user must determine appropriate values for three surface characteristics: surface roughness length {zo}, albedo {r}, and Bowen ratio {Bo}*
>
> ...
>
> *When using National Weather Service (NWS) data for AERMOD, data representativeness can be thought of in terms of constructing realistic planetary boundary layer (PBL) similarity profiles and adequately characterizing the dispersive capacity of the atmosphere. As such, the determination of representativeness should include a comparison of the surface characteristics (i.e., zo, Bo and r) between the NWS measurement site and the source location, coupled with a determination of the importance of those differences relative to predicted concentrations.*
>
> ...
>
> *If the proposed meteorological measurement site's surface characteristics are determined to NOT be representative of the application site, it may be possible that another nearby meteorological measurement site may be representative of both meteorological parameters and surface characteristics. Failing that, it is likely that site-specific meteorological data will be required.*

The surface characteristics of interest for AERMET – surface roughness, albedo, and Bowen ratio – are based on the land use cover (e.g., urban, agriculture, wetlands, forest, water) in the area upwind of the Kings Mill site (1 km for surface roughness, 10 km for albedo and Bowen ratio). If two locations have similar land use and cover, then the locations are expected to have similar surface characteristics. Thus, a land use analysis must be performed for the area immediately surrounding the source (the Kings Mill facility) and for the area immediately surrounding the NWS site. In its March 19, 2009 *AERMOD Implementation Guide*, the EPA states:[20]

> *Based on model formulations and model sensitivities, the relationship between the surface roughness upwind of the measurement site and the measured wind speeds is generally the most important consideration.*
>
> *The dependence of meteorological measurements and plume dispersion on Bowen ratio and albedo is very different than the dependence on surface roughness. Effective values for Bowen ratio and albedo are used to estimate the strength of convective turbulence during unstable conditions by determining how much of the incoming radiation is converted to sensible heat flux. These estimates of convective turbulence are not linked as directly with tower measurements as the linkage between the measured wind speed and the estimation of mechanical turbulence intensities driven by surface roughness elements.*

---

[20] http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide_19March2009.pdf, Section 3.1.2, pages 4-5.

An analysis of the surface characteristics for the Kings Mill facility utilizing both pre- and post-construction land use and the nearby Macon NWS station was performed to demonstrate that the Macon NWS is representative of the Kings Mill site. In order to reflect post-construction conditions, a circular area covering 75 acres centered on the process lines was modified. The AERSURFACE input and output files along with the modified landuse file are included with this protocol. The tables and figures associated with several comparisons are included in Attachment A. These tables demonstrate that the Kings Mill facility's surface characteristics for albedo and Bowen ratio are similar to the Macon NWS station.

As shown in Attachment A, the Kings Mill facility's post-construction surface roughness parameter assignments are more similar to the Macon NWS station. The surface roughness is evaluated on a sector by sector (30°) basis and over a much smaller area than albedo and Bowen Ratio (1 km vs. 10 km); therefore, there is greater variability between the calculated surface roughness values at the two sites. Given the differing locations (airport vs. site location for pellet production facility), it is unlikely that any other NWS station within Georgia would have significantly better surface characteristics correlation; further, a more distant NWS station would likely have meteorological conditions that are more dissimilar to the Kings Mill facility than the Macon NWS station.

The Macon NWS station provides a reasonable match to the Kings Mill facility characteristics; the only area with significant difference is surface roughness, which is higher at the site than at the Macon NWS. It is worth noting that the most frequent wind directions (west, northwest and northeast) correlate well with the most similar surface roughness sectors. In addition, higher surface roughness tends to result in lower calculated concentrations, and thus using the lower surface roughness from Macon airport would likely be conservative.

Based on those results, PyraMax proposes to use the Macon NWS station for surface observational meteorological data. PyraMax will use AERMOD-ready surface and profile meteorological files provided by EPD for Macon for the modeling analyses. PyraMax will use preprocessed AERMET output files to be provided by EPD in completing the AERMOD analyses.

Building Downwash Analysis

AERMOD incorporates the Plume Rise Model Enhancements (PRIME) downwash algorithms. Direction specific building parameters required by AERMOD are calculated using the BPIP-PRIME preprocessor (version 04274).

Representation of Emission Sources

Source Types and Parameters

The AERMOD dispersion model allows for emission units to be represented as point, area, or volume sources. For point sources with unobstructed vertical releases, it is appropriate to use actual stack parameters (i.e., height, diameter, exhaust gas temperature, and gas exit velocity) in the modeling analyses.

GEP Stack Height Analysis

EPA has promulgated stack height regulations that restrict the use of stack heights in excess of "Good Engineering Practice" (GEP) in air dispersion modeling analyses. Under these regulations, that portion of a stack in excess of the GEP height is generally not creditable when modeling to determine source impacts. This essentially prevents the use of excessively tall stacks to reduce ground-level pollutant concentrations. The minimum stack height not subject to the effects of downwash, called the GEP stack height, is defined by the following formula:

$H_{GEP} = H + 1.5L$, where:

H_{GEP} = minimum GEP stack height,
H = structure height, and
L = lesser dimension of the structure (height or projected width).

This equation is limited to stacks located within 5L of a structure. Stacks located at a distance greater than 5L are not subject to the wake effects of the structure. The wind direction-specific downwash dimensions and the dominant downwash structures used in this analysis are determined using BPIP. In general, the lowest GEP stack height for any source is 65 meters by default.[21] A preliminary evaluation has indicated that none of the proposed emission units at the Kings Mill facility will exceed GEP height.

NO_2 Modeling Approach

EPA's *Guideline on Air Quality Models (Guideline)*, in 40 CFR Part 51, Appendix W, recommends a tiered approach for modeling annual average NO_2 from point sources. The *Guideline* provides that:

a) *A tiered screening approach is recommended to obtain annual average estimates of NO_2 from point sources for New Source Review analysis, including PSD... For Tier 1 ... use an appropriate Gaussian model to estimate the maximum annual average concentration and assume a total conversion of NO to NO_2. If the concentration exceeds the NAAQS and/or PSD Increments for NO_2, proceed to the 2nd level screen.*

b) *For Tier 2 (2nd level) screening analysis, multiply the Tier 1 estimate(s) by an empirically derived NO_2/NO_X value of 0.75 (annual national default).*

c) *For Tier 3 (3rd level) analyses, a detailed screening method may be selected on a case-by-case basis. For point source modeling, detailed screening techniques such as the Ozone Limiting Method may also be considered.*

---

[21] 40 CFR §51.100(ii)

PyraMax will begin by utilizing the Ambient Ratio Method (ARM), or Tier 2 approach, which has evolved from previous representations of the oxidation of nitric oxide (NO) by ambient ozone and other photochemical oxidants to form nitrogen dioxide (NO_2 – the regulated ambient pollutant). The ARM is an approach contained in Section 6.2.3 of EPA's the *Guideline.*

EPA issued a memo on March 1, 2011 providing additional clarifications regarding application of Appendix W modeling guidance for the 1-hr NO_2 NAAQS.[22] Per the memo, EPA recommends the use of 0.80 as a default ambient ratio for the 1-hour NO_2 standard under the Tier 2 approach. Based on this updated EPA guidance, PyraMax will utilize 0.80 as the ambient NO_2:NO_X ratio. Should further refinement be needed, such as the Ozone Limiting Method (OLM) or Plume Volume Molar Ratio Method (PVMRM), PyraMax will submit a separate NO_2 modeling protocol to EPD detailing the alternative approach.

Additional Impacts Modeling Methodology

The required additional impacts evaluations include a growth analysis, a soil and vegetation analysis, and a plume visibility analysis. PyraMax will use the VISCREEN model to determine the impacts on ambient visibility at any airports or state parks within the SIA to meet the requirements of the additional impacts analysis. To assess soil and vegetation impacts, the modeling results from the PSD NAAQS are assessed against the secondary NAAQS standards and EPA's soils/vegetation screening guidelines. If the screening analysis indicates that values will not exceed the SIL, then the results of the screening analysis will be compared to values from the EPA document, *A Screening Procedure for the Impacts of Air Pollution Sources on Plants, Soils, and Animals* (EPA 450/2-81-078), 1981. For those pollutants triggering NAAQS modeling requirements, the full modeled impact from the facility and inventory will be assessed against those documented values.

Toxic Air Pollutant Modeling

The evaluation of ambient impacts of toxic pollutant emissions will be submitted in accordance to the Georgia's *Guideline for Ambient Impact Assessment of Toxic Air Pollutant Emissions* (June 21, 1998), which was issued by the EPD Air Protection Branch pursuant to the provisions of GRAQC §391-3-1-.02(2)(a)3(ii).

According to the *Guideline*, dispersion modeling should be completed for potentially toxic pollutants having quantifiable emission increases. The *Guideline* infers that a pollutant is identified as a toxic pollutant if any of the following toxicity-determined values have been established for that pollutant. The *Guideline* specifies that the resources used to develop the

---

[22] U.S. EPA, Region 4, Memorandum from Mr. Tyler Fox to Regional Air Division Directors. Research Triangle Park, North Carolina. March 1, 2011.

long-term and short-term acceptable ambient concentrations (AAC) of toxic air pollutants should be referenced in the priority schedule shown following.

- EPA Integrated Risk Information System (IRIS) reference concentration (RfC) or unit risk;
- Occupational Safety and Health Administration (OSHA) Permissible Exposure Limits (PEL);
- American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV);
- National Institute for Occupational Safety and Health (NIOSH) Recommended Exposure Limits (REL); and
- Lethal Dose – 50% (LD50) Standards.

PyraMax will detail the methodology for identifying TAP in the analysis included as part of the application submittal.

A preliminary assessment of the air toxic impacts from the kilns, spray dryers, cage mills, and boilers will be conducted using the SCREEN3 model. If preliminary screening results show that refined modeling is required, either the AERMOD or ISCST3 (version 02035) models will be used to complete the air dispersion analysis.

If AERMOD will be used, all applicable elements of the modeling methodology outlined for the PSD air dispersion modeling analysis will be utilized as developed for that analysis, including the effects of building downwash. If ISCST3 will be used, the refined modeling procedures outlined in the *Guideline* will be utilized. Meteorological data for use with the ISCST3 model for Macon/Centreville (1974-1978), as available on the Georgia EPD website, will be used unless otherwise specified.[23]

---

[23] http://www.georgiaair.org/airpermit/html/sspp/modeling.htm

SUMMARY AND APPROVAL OF MODELING PROTOCOL

PyraMax is supplying this written preliminary protocol so that EPD can formally comment on and approve the methodologies to be used for this analysis. PyraMax requests a written response to this protocol at your earliest convenience.

If you have any questions about the material presented in this letter, require additional information, or would like to talk about any of the proposed methods, please do not hesitate to call me at 919-462-9693.

Sincerely,

TRINITY CONSULTANTS

Jonathan Hill
Senior Consultant

Attachment

cc: Ms. Susan Jenkins (Georgia EPD)
Mr. Don Anschutz (PyraMax Ceramics, LLC)
Mr. Michael Burgess (PyraMax Ceramics, LLC)
Mr. Tom Muscenti (Trinity Consultants)
Mr. Justin Fickas (Trinity Consultants)

Attachment A

Land Use Representativeness Comparison Information

To define the land use characteristics and micrometeorological parameters in the areas of interest, Trinity Consultants (Trinity) utilized the EPA program AERSURFACE (version 08009) to analyze a digital mapping of land use and cover; specifically the 30-meter resolution USGS digital National Land Cover Data (NLCD) from 1992, as is recommended for usage with AERSURFACE.[1]

AERSURFACE resolves predominant land cover types into a grid comprising 30 meter-by-30 meter cells extending out to a specified distance from the center of the Kings Mill or NWS site; the recommended distance is 1 km for surface roughness and 10 km for albedo and Bowen ratio. The data, which contain the land use category code and coordinates for each cell, are used by AERSURFACE to calculate the wind sectors and determine the weighted percentage of each land use type contained within each of the twelve 30-degree sectors; note that albedo and Bowen ratio are constant for each of the sectors, varying only seasonally. The weighted percentages of each land use type are then utilized to calculate the weighted average surface parameters (Bowen ratio, albedo, and surface roughness) for each of the sectors.

Figures A-1a and A-1b illustrate the land use and cover for the Kings Mill site based on the grid cell assignments contained in the AERSURFACE roughness domain output file. Figure A-1a shows pre-construction land use and Figure A-1b depicts post-construction landuse. The circle in the figures denotes a 1 km radius around the center of the Kings Mill site; individual sectors are also shown in black. A similar figure for the Macon NWS station was created by Trinity using the AERSURFACE grid cell assignments (from AERSURFACE runs prepared using the NWS coordinates provided by EPD) and is included as Figure A-2.[2]

---

[1] http://seamless.usgs.gov/website/seamless/viewer.htm

[2] http://mi3.ncdc.noaa.gov/mi3qry/login.cfm

FIGURE A-1A. LAND USE CATEGORIES FOR THE 1-KM AREA SURROUNDING THE KINGS MILL FACILITY (PRE-CONSTRUCTION)