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Illiana Corridor Air Quality Analysis Methodology

Particulate Matter ($PM_{2.5}$)

June 2013

Annual PM2.5 Hot-Spot Analysis

The PM analysis follows EPA's nine-step process, as shown in Exhibit 3-1 on page 19 of the *Transportation Conformity Guidance for Quantitative Hot-spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas* (USEPA, 2010), December 2010, found here: http://www.epa.gov/otaq/stateresources/transconf/policy/420b10040.pdf.

1. Determine Need

The Illiana Corridor traverses Will and Kankakee Counties in Illinois and Lake County in Indiana. Lake and Will Counties are currently classified as moderate non-attainment areas for the 1997 (annual) $PM_{2.5}$ standard. The Illiana Corridor is predicted to have over 10,000 ADT diesel trucks. According to Section 93.123(b)(1) of the conformity rule, which defines those projects that require a $PM_{2.5}$ or PM_{10} hot-spot analysis, this project qualifies as "(i) New highway projects that have a significant number of diesel vehicles, and expanded highway projects that have a significant increase in the number of diesel vehicles." This information was brought to the Chicago Metropolitan Agency for Planning (CMAP) on February 14, 2013 and they determined that the project would require a quantitative hot-spot analysis following EPA's "*Transportation Conformity Guidance for Quantitative Hot-spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*"(USEPA, 2010), December 2010. The Illiana project team will request a similar consultation meeting with the Northwestern Indiana Regional Planning Commission (NIRPC) to address the quantitative hot-spot analysis for the project.

2. Determine Approach, Models and Data

a. *Approach*

In consultation with the interagency working group, those locations of the project with the highest expected air quality concentrations will be analyzed. These will be the locations with the greatest increases in diesel traffic volumes, and greatest overall diesel traffic volumes. Those locations with the highest traffic volumes will most likely be where the major interchanges are with other interstates in the project area. The analysis will be performed for the either the opening or design year of the project as determined based on highest expected emissions from the project, any nearby sources, and background, for both the no-build and build scenarios. Since the project is located in an area designated as nonattainment for the annual $PM_{2.5}$ NAAQS, but attainment for the 24-hour $PM_{2.5}$ NAAQS and 24-hour PM_{10} NAAQS, the quantitative PM hot-spot analysis will be limited to comparing the project's impact to the 1997 annual $PM_{2.5}$ standard.

b. *PM Emissions*

The PM hot-spot analysis will include only directly emitted PM2.5 emissions. PM2.5 precursors are not considered in PM hot-spot analyses, since precursors take time at the regional level to form into secondary PM. Exhaust, brake wear, and tire wear emissions from on-road vehicles are included in the project's PM2.5 analysis. For this analysis, both running and crankcase running exhaust will be considered because start exhaust is unlikely to occur on the roadways included in the model domain. Re-entrained road dust will not be included because the State Implementation Plans do not identify that such emissions are a significant contributor to the PM2.5 air quality in the nonattainment area. This will be reconfirmed at the inter-agency consultation meeting. Emissions from construction-related activities will not be included because they are considered temporary as defined in 40 CFR 93.123(c)(5) (i.e., emissions that occur only during the construction phase and last five years or less at any individual site).

c. *Model*

The analysis will be performed using the current version of EPA's MOVES emissions model (MOVES2010b) and CAL3QHCR, (dated 12355).

d. *Data*

MOVES input files will be obtained from the local MPOs (CMAP and NIRPC) or other appropriate agencies. Project-specific traffic data, including hourly volume, average vehicle speeds, and facility type, will be obtained for each roadway section in the project area. Hourly vehicle volumes will be obtained for A.M. peak, midday, P.M. peak, and off-peak traffic conditions. The latest available hourly meteorological data from the National Weather Service station at local airports closest to the project area (Gary/Chicago International Airport or Chicago Midway International Airport) processed in the format required for use in CAL3QHCR, will be purchased. The meteorological data from these stations are representative of the terrain, climate and topography of the study area.

3. Estimate On-Road Vehicle Emissions

On-road vehicle emissions will be estimated using MOVES2010b. It is currently assumed that MOVES input files will be available from each of the MPOs and that unique emissions will be calculated for each MPO. MOVES input relies on link-specific data. A link file includes the vehicle volume, average speed, facility type, and grade. The PM emissions vary by time of day and time of year. Volume and speed data for each link will be obtained from the traffic analysts for A.M. peak, P.M.

peak, midday, and off-peak traffic conditions. For each intersection and analysis year, MOVES will be run 16 times (A.M. peak, P.M. peak, midday, and off-peak) using quarterly climate conditions, as developed by the MPOs. For every link, a set of four emission factors in units of grams per mile will be developed for use for each of the analysis years. Traffic projections are currently available for the time periods shown in Table 1, as are the proposed time period groupings for the analysis.

Table 1. Proposed Traffic Analysis Combinations Using Time Periods Defined in CMAP/Illiana Travel Model

Name	Description	From	To	# of Hours	Time Period
Period 1	Overnight	8:00 PM	6:00 AM	10	Off peak
Period 2	Pre- AM Shoulder	6:00 AM	7:00 AM	1	AM peak
Period 3	AM Peak	7:00 AM	9:00 AM	2	AM peak
Period 4	Post- AM Shoulder	9:00 AM	10:00 AM	1	AM peak
Period 5	Midday	10:00 AM	2:00 PM	4	Midday
Period 6	Pre- PM Shoulder	2:00 PM	4:00 PM	2	Midday
Period 7	PM Peak	4:00 PM	6:00 PM	2	PM peak
Period 8	Post- PM Shoulder	6:00 PM	8:00 PM	2	PM peak

4. Estimate Emissions from Road Dust, Construction and Additional Sources

Road dust emissions will not be included in the analysis, as described in step 2(b). Construction emissions will not be included because construction will not occur at any individual location for more than five years. No additional sources of $PM_{2.5}$ emissions will be included. It is assumed that $PM_{2.5}$ concentrations due to any other nearby emissions sources will be included in the ambient monitor values used for background concentrations. In addition, this project is not expected to result in changes to emissions from nearby sources.

5. Select an Air Quality Model, Data Inputs and Receptors

a. *Model*

The USEPA's CAL3QHCR air dispersion model will be used to estimate concentrations of $PM_{2.5}$ due to project operation. The model uses traffic data, emission factor data, and meteorological data to estimate ground-level concentrations of $PM_{2.5}$ at a series of receptors. For each modeled scenario, the model setup will include a series of links, or roadway segments, in the vicinity of the free flow segment, interchange or intersection being modeled.

b. *Data Inputs*

Link-specific inputs include length, mixing zone width, hourly volume, and emission factor. A conservative link height of 0 feet will be assumed for all links for simplicity (to be confirmed at inter-agency meeting). CAL3QHCR requires the vehicle volume and emission factor for each hour of the day; the PM hot-spot guidance suggests 3-hour A.M. and P.M. peak periods along with midday and off-peak time periods. Meteorological input files will be processed using surface data and upper air data from local airports. As recommended in EPA's "Guideline on Air Quality Models" (Appendix W to 40 CFR Part 51), five consecutive years of the most recent and readily available meteorological data will be used for the dispersion modeling analysis. For each scenario, CAL3QHCR will be run separately for each of the five years of meteorological data. CAL3QHCR does not distinguish between emissions changes due to seasonal differences; therefore, each season will be run separately, for a total of 20 model runs per scenario.

c. *Receptors*

Receptors will be placed in order to estimate the highest concentrations of $PM_{2.5}$ to determine any possible violations of the NAAQS. A receptor grid will be placed over the microscale study area with the smallest receptor spacing within the area. Highest concentrations are expected to occur at the intersections of the highest-volume roadways. Identical receptor grids will be used for No-Build and Build Alternatives in order to directly compare project effects. The grid will be centered over each modeled interchange, and gridded receptors that fall within five meters of any project feature or other locations where public would normally be present for a limited timed will be removed, according to the PM guidance. Receptor placement will be discussed at the inter-agency meeting.

6. Determine Background Concentrations From Nearby and Other Sources

If available, future background data will be obtained from SIP modeling data, or from national rulemakings. If this information is not available, data from $PM_{2.5}$ monitors in the project vicinity will be evaluated for the most representative (background values. Once selected and confirmed through interagency consultation, the background value(s) will be added to the CAL3QHCR modeled design values for comparison to the NAAQS. The background values will likely be conservative, because it is expected that ambient $PM_{2.5}$ concentrations will be lower in future years as a result of State Implementation Plans and the general trend in declining vehicle emissions due to technological advances. It is assumed that emissions from other nearby sources are already included in the ambient monitoring data.

7. **Calculate Design Values and Determine Conformity**

The model results (Step 5) will be added to the background concentration(s) (Step 6) for both the build and no-build scenarios in order to calculate the design values. The annual $PM_{2.5}$ design value is currently defined as the average of three consecutive years' annual averages, each estimated using equally-weighted quarterly averages. The NAAQS is met when the three-year average concentration is less than or equal to the 1997 annual $PM_{2.5}$ NAAQS. CAL3QHCR output provides the maximum quarterly average $PM_{2.5}$ concentration at each receptor. For the receptor with the maximum modeled concentration in each scenario, the following steps will be used to determine the design value, as outlined in the guidance:

i. For each year of meteorological data, determine the average concentration in each quarter.
ii. Within each year of meteorological data, add the average concentrations of all four quarters and divide by four to calculate the average annual modeled concentration for each year of meteorological data.
iii. Sum the modeled average annual concentrations from each year of meteorological data, and divide by the number of years of meteorological data used.
iv. Add the average annual background concentration to the average annual modeled concentration to determine the total average annual concentration.

If the design value in the build scenario is less than or equal to the relevant PM NAAQS at appropriate receptors, then the project meets conformity requirements. In the case where the design value is greater than the NAAQS in the build scenario, a project could still meet conformity requirements if the design values in the build scenario are less than or equal to the design values in the no-build scenario at appropriate receptors.

8. **Consider Mitigation or Control Measures**

If the project does not meet conformity requirements, mitigation or control measures to reduce emissions in the project area may be considered. If such measures are considered, additional modeling will need to be completed and new design values calculated to ensure that conformity requirements are met. Mitigation measures, which must include written commitments for implementation (40 CFR 93.125), include the following:

i. Retrofitting, replacing vehicles/engines, and using cleaner fuels;[1]
ii. Reducing idling;[2]
iii. Redesigning the transportation project itself;
iv. Controlling fugitive dust; and
v. Controlling other sources of emissions.

9. Document the PM Hot-Spot Analysis

The PM hotspot analysis and results will be documented in an Air Quality Technical Report. Due to the large volume of input and output files created for this analysis, they will be available electronically upon request.

[1,2] It should be noted that IDOT currently has a special provision for retrofitting diesel construction equipment, and clean fuels and idling restrictions are found in the Department's supplemental specifications and recurring special provisions.