APPENDIX L

Air Quality Technical Report

Will County, Illinois

Lake County, Indiana

Prepared For:

Illinois Department of Transportation

Indiana Department of Transportation

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Executive Summary

This Air Quality Technical Report supports the Illiana Corridor Tier Two Final Environmental Impact Statement (FEIS). The report evaluates the Corridor's potential air quality impacts within the Study Area. This includes an analysis of the project's impact on regional air quality levels; whether the project will cause or contribute to a new localized exceedance of carbon monoxide (CO) or particulate matter ($PM_{2.5}$) ambient air quality standards or increase the frequency or severity of any existing exceedance; the mobile source air toxic (MSAT) impacts of the project; the greenhouse gas (GHG) impacts of the project; and the construction emissions associated with the project.

According to this analysis the project is not predicted to cause or exacerbate a violation of the applicable National Ambient Air Quality Standards. It is also predicted to have no measurable effect on greenhouse gas emissions.

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1.0 Existing Conditions

"Air Pollution" is a general term that refers to one or more chemical substances that degrade the quality of the atmosphere. Individual air pollutants degrade the atmosphere by reducing visibility, damaging property, reducing the productivity or vigor of crops or natural vegetation, and/or reducing human or animal health. Air quality is a term used to describe the amount of air pollution the public is exposed to in the environment.

Air quality in the United States is governed by the Federal Clean Air Act (CAA) and is administered by the United States Environmental Protection Agency (USEPA).

1.1 US Environmental Protection Agency

The USEPA is responsible for establishing the National Ambient Air Quality Standards (NAAQS) and enforcing the CAA, and regulates emission sources, such as aircraft, ships, and certain types of locomotives, under the exclusive authority of the Federal government. The USEPA also has jurisdiction over emission sources outside state waters (e.g., beyond the outer continental shelf) and establishes various emission standards. For additional information about the USEPA, the reader can contact its general internet address found at http://www.epa.gov. Additional information on the activities of USEPA regarding Transportation and Air Quality can be found at http://www.epa.gov/otaq/index.htm.

1.2 Clean Air Act Amendments of 1990

The Clean Air Act Amendments of 1990 (CAAA) direct the USEPA to implement environmental policies and regulations that will ensure acceptable levels of air quality. Under the CAAA, a project cannot:

- Cause or contribute to any new violation of any NAAQS in any area;
- Increase the frequency or severity of any existing violation of any NAAQS in any area; or
- Delay timely attainment of any NAAQS or any required interim emission reductions or other milestones in any area.

1.3 National Ambient Air Quality Standards

As required by the CAA, NAAQS have been established for six major air pollutants. These pollutants are: carbon monoxide, nitrogen dioxide, ozone, particulate matter (PM_{10} and $PM_{2.5}$), sulfur dioxide, and lead. These standards are summarized in Table 1-1. The "primary" standards have been established to protect the public health. The "secondary" standards are intended to protect the nation's welfare and account for air pollutant effects on soil, water, visibility, materials, vegetation and other aspects of the general welfare. The states of Illinois and Indiana have adopted these standards as the state standards.

Table 1-1. National Ambient Air Quality Standards

Pollutant		Primary/ Secondary	Averaging Time	Level	Form
Carbon Monoxide		primary	8-hour	9 ppm	Not to be exceeded more than once per year
			1-hour	35 ppm	
Lead		primary and secondary	Rolling 3 month average	0.15 $\mu g/m^3$ (1)	Not to be exceeded
Nitrogen Dioxide		primary	1-hour	100 ppb	98th percentile, averaged over 3 years
		primary and secondary	Annual	53 ppb (2)	Annual Mean
Ozone		primary and secondary	8-hour	0.075 ppm (3)	Annual fourth-highest daily maximum 8-hr concentration, averaged over 3 years
Particle Pollution	$PM_{2.5}$	primary	Annual	12 $\mu g/m^3$	annual mean, averaged over 3 years
		secondary	Annual	15 $\mu g/m^3$	annual mean, averaged over 3 years
		primary and secondary	24-hour	35 $\mu g/m^3$	98th percentile, averaged over 3 years
	PM_{10}	primary and secondary	24-hour	150 $\mu g/m^3$	Not to be exceeded more than once per year on average over 3 years
Sulfur Dioxide		primary	1-hour	75 ppb (4)	99th percentile of 1-hour daily maximum concentrations, averaged over 3 years
		secondary	3-hour	0.5 ppm	Not to be exceeded more than once per year

Source: USEPA Office of Air and Radiation, http://www.epa.gov/air/criteria.html

(1) Final rule signed October 15, 2008. The 1978 lead standard (1.5 μg/m3 as a quarterly average) remains in effect until one year after an area is designated for the 2008 standard, except that in areas designated nonattainment for the 1978, the 1978 standard remains in effect until implementation plans to attain or maintain the 2008 standard are approved.

(2) The official level of the annual NO2 standard is 0.053 ppm, equal to 53 ppb, which is shown here for the purpose of clearer comparison to the 1-hour standard.

(3) Final rule signed March 12, 2008. The 1997 ozone standard (0.08 ppm, annual fourth-highest daily maximum 8-hour concentration, averaged over 3 years) and related implementation rules remain in place. In 1997, EPA revoked the 1-hour ozone standard (0.12 ppm, not to be exceeded more than once per year) in all areas, although some areas have continued obligations under that standard ("anti-backsliding"). The 1-hour ozone standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is less than or equal to 1.

(4) Final rule signed June 2, 2010. The 1971 annual and 24-hour SO2 standards were revoked in that same rulemaking. However, these standards remain in effect until one year after an area is designated for the 2010 standard, except in areas designated nonattainment for the 1971 standards, where the 1971 standards remain in effect until implementation plans to attain or maintain the 2010 standard are approved.

1.4 Ambient Air Quality Data

1.4.1 Local Meteorology

The project area is located approximately 25-40 miles south/southwest of Lake Michigan's southernmost point (near Gary, Indiana). The area stretches over 40 miles from Interstate (I) 55 in Illinois east to Interstate 65 in Indiana. This area experiences frequently changeable weather. The climate is predominantly continental, ranging from relatively warm in the summer to relatively cold in the winter. However, the continental location is partially modified by Lake Michigan and to a lesser extent by the other Great Lakes.

In late autumn and winter, air masses that are initially very cold often reach the region only after being tempered by passage over one or more of the Great Lakes. Similarly, in late spring and summer, air masses reaching the city from the north, northeast, or east are cooler because of movement over the Great Lakes. Very low winter temperatures most often occur in the air that flows southward to the west of Lake Superior before reaching the area. In summer, the higher temperatures are with south or southwest flow and are therefore not influenced by the lakes. Temperatures of 96 degrees Fahrenheit or higher occur in about half of the summers, while about half of the winters have a minimum of as low as -15 degrees Fahrenheit.

Precipitation falls mostly from air that has passed over the Gulf of Mexico. But in winter there can be snowfall, with Lake Michigan as the principal moisture source. The effect of Lake Michigan, both on winter temperatures and lake-produced snowfall, is enhanced by non-freezing of much of the lake during the winter. Summer thunderstorms are often locally heavy and variable. Longer periods of continuous precipitation are mostly in autumn, winter, and spring. About one-half of the precipitation in the winter, and about ten percent of the annual total precipitation, falls as snow. Snowfall from month to month and year to year is greatly variable. (NOAA)

1.4.2 Local Monitored Air Quality

The monitored information for three monitoring stations near the project area is presented in Table 1-2. This table presents the last three years of available monitor data (2010-2012) at each of these stations in order to illustrate the Study Area's general air quality trends. Additional air quality information for the Study Area for Illinois can be found at http://www.idot.illinois.gov/transportation-system/environment/index and for Indiana at http://www.in.gov/idem/.

Table 1-2. Summary of Air Quality Monitored Near Study Area

Air Pollutant	Standard/ Exceedance	Braidwood, Illinois Com Ed Training Center 36400 S. Essex Road			Joliet, Illinois Pershing School Midland & Campbell Streets			East Chicago, Indiana East Chicago Post Office 901 East Chicago Avenue (CO) -- Benjamin Franklin School 2400 Cardinal Drive (PM)			Gary, Indiana IITRI Bunker 201 Mississippi Street		
		2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
Carbon Monoxide (CO)	Max. 1-hour Concentration (ppm)	NM	NM	NM	NM	NM	NM	5.7	4.2	4.5	NM	NM	NM
	Max. 8-hour Concentration (ppm)	NM	NM	NM	NM	NM	NM	3.3	2.3	1.9	NM	NM	NM
	# Days>Federal 1-hour Std. of >35 ppm	NM	NM	NM	NM	NM	NM	0	0	0	NM	NM	NM
	# Days>Federal 8-hour Std. of >9 ppm	NM	NM	NM	NM	NM	NM	0	0	0	NM	NM	NM
Ozone (O_3)	Max. 1-hour Concentration (ppm)	0.08	0.106	0.08	NM	NM	NM	NM	NM	NM	0.086	0.094	0.11
	Max. 8-hour Concentration (ppm)	0.075	0.091	0.076	NM	NM	NM	NM	NM	NM	0.08	0.083	0.097
	# Days>Federal 8-hour Std. Of >0.075 ppm	0	1	1	NM	NM	NM	NM	NM	NM	1	1	4
Nitrogen Dioxide (NO_2)	Max. 1-hour Concentration (ppb)	NM	NM	NM	NM	NM	NM	NM	NM	NM	64.3	59.5	52.3
	# Days>Federal 1-hour Std. Of >100 ppb	NM	NM	NM	NM	NM	NM	NM	NM	NM	0	0	0
Sulfur Dioxide (SO_2)	Max. 1-hour Concentration (ppb)	NM	NM	NM	NM	NM	NM	NM	NM	NM	74	74.2	61.1
	# Days>Federal 1-hour Std. of >75 ppb	NM	NM	NM	NM	NM	NM	NM	NM	NM	0	0	0

Air Pollutant	Standard/ Exceedance	Braidwood, Illinois Com Ed Training Center 36400 S. Essex Road			Joliet, Illinois Pershing School Midland & Campbell Streets			East Chicago, Indiana East Chicago Post Office 901 East Chicago Avenue (CO) -- Benjamin Franklin School 2400 Cardinal Drive (PM)			Gary, Indiana IITRI Bunker 201 Mississippi Street		
		2010	2011	2012	2010	2011	2012	2010	2011	2012	2010	2011	2012
Suspended Particulates (PM_{10})	Max. 24-hour Concentration ($\mu g/m^3$)	NM	NM	NM	46	NM	NM	61	55	47	73	104	220
	#Days>Fed. 24-hour Std. of>150 $\mu g/m^3$	NM	NM	NM	0	NM	NM	0	0	0	0	0	1
Suspended Particulates ($PM_{2.5}$)	Max. 24-hour Concentration ($\mu g/m^3$)	28.7	28.8	24.5	39.8	27.9	31.8	38.2	34	35	37.8	42.4	36.5
	#Days>Fed. 24-hour Std. of>35 $\mu g/m^3$	0	0	0	0	0	0	0	0	0	0	0	0
	National Annual Average ($\mu g/m^3$)	10	10.4	9.4	11.8	10.2	11	12.5	11.3	10.7	13.7	12.4	12.6
Lead	Maximum 24-Hour Concentration ($\mu g/m^3$)	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM	NM

Source: USEPA AirData, 2013 - http://www.epa.gov/airdata/
NM = Not measured

1.5 Pollutant Description

1.5.1 Criteria Pollutants

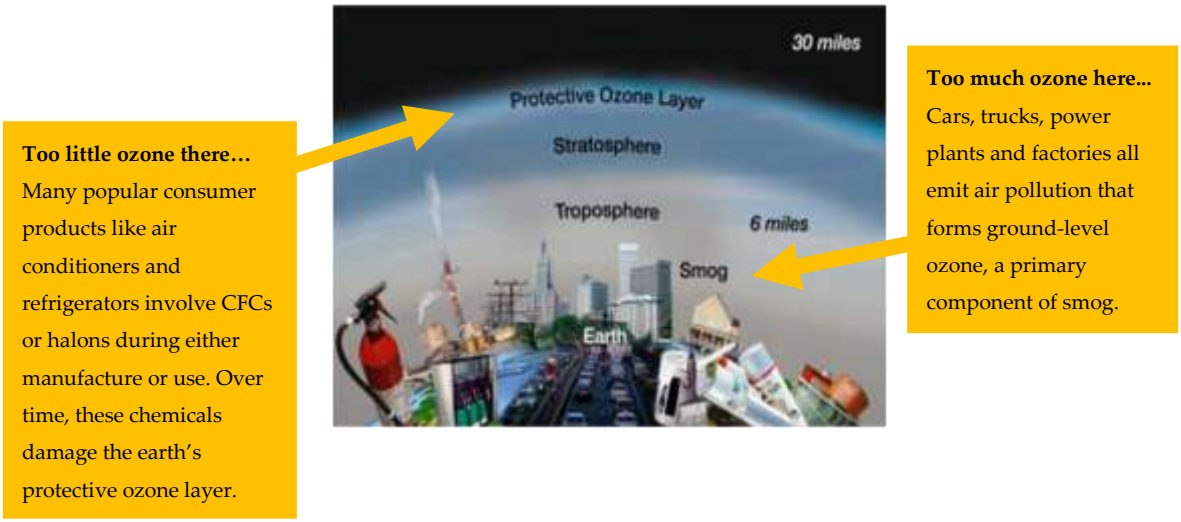
Pollutants that have established national standards are referred to as "criteria pollutants." The sources of these pollutants, their effects on human health and the nation's welfare, and their final deposition in the atmosphere vary considerably. A brief description of each pollutant is provided below.

1.5.1.1 Ozone

Ozone (O_3) is a colorless toxic gas. As shown in Figure 1-1, O_3 is found in both the Earth's upper and lower atmospheric levels. In the upper atmosphere, O_3 is a naturally occurring gas that helps to prevent the sun's harmful ultraviolet rays from reaching the Earth. In the lower layer of the atmosphere, O_3 is man-made. Although O_3 is not directly emitted, it forms in the lower atmosphere through a chemical reaction between hydrocarbons (HC), also referred to as Volatile Organic Compounds (VOC), and nitrogen oxides (NOx), which are emitted from industrial sources and from automobiles. HC are compounds comprised primarily of atoms of hydrogen and carbon.

Substantial O_3 formations generally require a stable atmosphere with strong sunlight; thus high levels of O_3 are generally a concern in the summer. O_3 is the main ingredient of smog. O_3 enters the bloodstream through the respiratory system and interferes with the transfer of oxygen, depriving sensitive tissues in the heart and brain of oxygen. O_3 also damages vegetation by inhibiting its growth. The effects of changes in VOC and NOx emissions for the proposed project are examined on a regional and statewide level.

Figure 1-1. Ozone in the Atmosphere



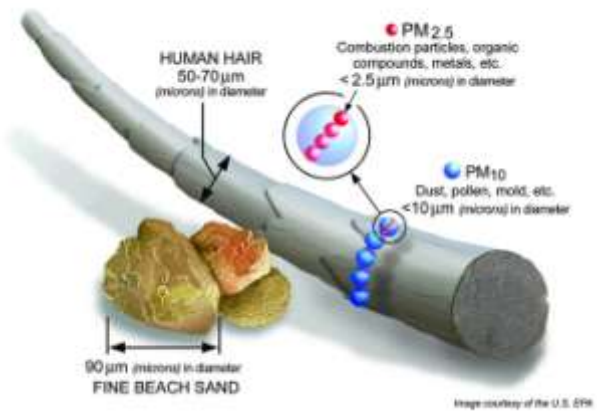
Source: USEPA - http://www.epa.gov/airquality/gooduphigh/good.html#1

1.5.1.2 Particulate Matter

Particulate pollution is composed of solid particles or liquid droplets that are small enough to remain suspended in the air. In general, particulate pollution can include dust, soot, and smoke; these can be irritating but usually are not poisonous. Particulate pollution also can include bits of solid or liquid substances that can be highly toxic. Of particular concern are those particles that are smaller than, or equal to, 10 microns (PM_{10}) or 2.5 microns ($PM_{2.5}$) in size.

PM_{10} refers to particulate matter less than 10 microns in diameter, about one-seventh the thickness of a human hair (Figure 1-2). Particulate matter pollution consists of very small liquid and solid particles floating in the air, which can include smoke, soot, dust, salts, acids, and metals. Particulate matter also forms when gases emitted from motor vehicles undergo chemical reactions in the atmosphere.

Figure 1-2. Relative Particulate Matter Size



Source: USEPA Office of Air and Radiation

Major sources of PM_{10} include motor vehicles; wood-burning stoves and fireplaces; dust from construction, landfills, and agriculture; wildfires and brush/waste burning; industrial sources; windblown dust from open lands; and atmospheric chemical and photochemical reactions. Suspended particulates produce haze and reduce visibility.

Data collected through numerous nationwide studies indicate that most of the PM_{10} comes from the following:

- Fugitive dust
- Wind erosion
- Agricultural and forestry sources

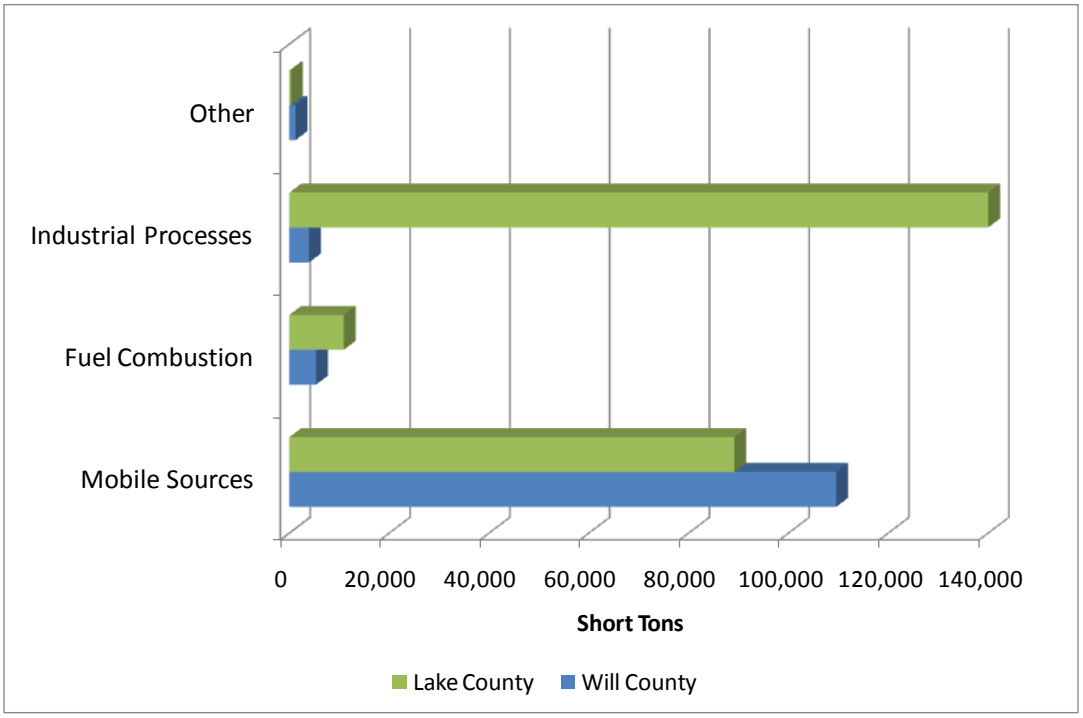
A small portion of particulate matter is the product of fuel combustion processes. In the case of $PM_{2.5}$, the combustion of fossil fuels accounts for a large portion of this pollutant. The main health effect of airborne particulate matter is on the respiratory system. $PM_{2.5}$ refers to particulates that are 2.5 microns or less in diameter, roughly 1/28th the diameter of a human hair. $PM_{2.5}$ results from fuel combustion (from motor vehicles, power generation, and industrial facilities), residential fireplaces, and wood stoves. In addition, $PM_{2.5}$ can be formed in the atmosphere from gases such as sulfur dioxide, nitrogen oxides, and volatile organic compounds. Like PM_{10}, $PM_{2.5}$ can penetrate the human respiratory system's natural defenses and damage the respiratory tract when inhaled. Whereas particles 2.5 to 10 microns in diameter tend to collect in the upper

portion of the respiratory system, particles 2.5 microns or less are so tiny that they can penetrate deeper into the lungs and damage lung tissues. The effects of PM_{10} and $PM_{2.5}$ emissions for the project are examined on a localized, or microscale, basis, a regional basis and a statewide basis.

1.5.1.3 Carbon Monoxide

Carbon monoxide (CO) is a colorless gas that interferes with the transfer of oxygen to the brain. CO is emitted almost exclusively from the incomplete combustion of fossil fuels. As shown in Figure 1-3, mobile sources (on-road motor vehicle exhaust) are the primary source of CO in Will County in Illinois. In Lake County, Indiana, mobile sources are the second-largest source of CO, after industrial processes. In cities, 85 to 95 percent of all CO emissions may come from motor vehicle exhaust. Prolonged exposure to high levels of CO can cause headaches, drowsiness, loss of equilibrium, or heart disease. CO levels are generally highest in the colder months of the year when inversion conditions (when warmer air traps colder air near the ground) are more frequent.

Figure 1-3. Sources of CO in Lake and Will Counties (2008)



Source: USEPA, http://www.epa.gov/air/emissions/index.htm

CO concentrations can vary greatly over relatively short distances. Relatively high concentrations of CO are typically found near congested intersections, along heavily used roadways carrying slow-moving traffic, and in areas where atmospheric dispersion is inhibited by urban "street canyon" conditions. Consequently, CO concentrations must be predicted on a microscale basis.

1.5.1.4 Nitrogen Dioxide

Nitrogen dioxide (NO_2) is a brownish gas that irritates the lungs. It can cause breathing difficulties at high concentrations. As with O_3, NO_2 is not directly emitted but is formed through a reaction between nitric oxide (NO) and atmospheric oxygen. NO and NO_2 are collectively referred to as nitrogen oxides (NOx) and are major contributors to ozone formation. NO_2 also contributes to the formation of PM_{10}. At atmospheric concentrations, NO_2 is only potentially irritating. In high concentrations, the result is a brownish-red cast to the atmosphere and reduced visibility. There is some indication of a relationship between NO_2 and chronic pulmonary fibrosis. An increase in bronchitis in children (two and three years old) has also been observed at concentrations below 0.3 parts per million (ppm).

1.5.1.5 Lead

Lead (Pb) is a stable element that persists and accumulates both in the environment and in animals. Its principal effects in humans are on the blood-forming, nervous, and renal systems. Lead levels from mobile sources in the urban environment have decreased largely due to the federally-mandated switch to lead-free gasoline, and they are expected to continually decrease. An analysis of lead emissions from transportation projects is therefore not warranted.

1.5.1.6 Sulfur Dioxide

Sulfur Dioxide (SO_2) is a product of high-sulfur fuel combustion. The main sources of SO_2 are coal and oil used in power stations, industry, and domestic heating. Industrial chemical manufacturing is another source of SO_2. SO_2 is an irritant gas that attacks the throat and lungs. It can cause acute respiratory symptoms and diminished ventilator function in children. SO_2 can also yellow plant leaves and corrode iron and steel. Although diesel-fueled heavy duty vehicles emit SO_2, transportation sources are not considered by USEPA (and other regulatory agencies) to be large sources of this pollutant.

1.5.2 Mobile Source Air Toxics

In addition to the criteria pollutants for which there are NAAQS, the USEPA also regulates air toxics. Toxic air pollutants are those pollutants known or suspected to cause cancer or other serious health effects. Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries).

Controlling air toxic emissions became a national priority with the passage of the Clean Air Act Amendments (CAAA) of 1990, whereby Congress mandated that the USEPA regulate 188 air toxics, also known as hazardous air pollutants. The USEPA has assessed this expansive list in their latest rule on the Control of Hazardous Air Pollutants from Mobile Sources (Federal Register, Vol. 72, No. 37, page 8430, February 26, 2007) and identified a group of 93 compounds emitted from mobile sources that are listed in their Integrated Risk Information System (IRIS) (http://www.epa.gov/ncea/iris/index.html). In addition, USEPA identified seven compounds with large contributions from mobile sources that are among the national and regional-scale cancer risk drivers from their

1999 National Air Toxics Assessment (NATA) (http://www.epa.gov/ttn/atw/nata1999/). These are acrolein, benzene, 1,3-butadiene, diesel particulate matter plus diesel exhaust organic gases (diesel PM), formaldehyde, naphthalene, and polycyclic organic matter. While the Federal Highway Administration (FHWA) considers these the priority mobile source air toxics, the list is subject to change and may be adjusted in consideration of future USEPA rules.

The 2007 USEPA rule mentioned above requires controls that will dramatically decrease MSAT emissions through cleaner fuels and cleaner engines. According to an FHWA analysis using USEPA's MOVES2010b model, even if vehicle activity (vehicle-miles traveled [VMT]) increases by 102 percent as assumed from 2012 to 2050, a combined reduction of 83 percent in the total annual emissions for the priority MSAT is projected for the same period.

A brief description of the seven priority MSATs is given below.

Acrolein is a water-white or yellow liquid that burns easily, is readily volatilized, and has a disagreeable odor. It is present as a product of incomplete combustion in the exhausts of stationary equipment (e.g., boilers and heaters) and mobile sources. It is also a secondary pollutant, formed through the photochemical reaction of VOC and NOX in the atmosphere. Acrolein is considered to have high acute toxicity, and it causes upper respiratory tract irritation and congestion in humans. The major effects from chronic (long-term) inhalation exposure to acrolein in humans consist of general respiratory congestion and eye, nose, and throat irritation. No information is available on the reproductive, developmental, or carcinogenic effects of acrolein in humans. USEPA considers acrolein data to be inadequate for an assessment of human carcinogenic potential.

Benzene is a volatile, colorless, highly flammable liquid with a sweet odor. Most of the benzene in ambient air is from incomplete combustion of fossil fuels and evaporation from gasoline service stations. Acute inhalation exposure to benzene causes neurological symptoms, such as drowsiness, dizziness, headaches, and unconsciousness in humans. Chronic inhalation of certain levels of benzene causes disorders in the blood in humans. Benzene specifically affects bone marrow (the tissues that produce blood cells). Aplastic anemia, excessive bleeding, and damage to the immune system (by changes in blood levels of antibodies and loss of white blood cells) may develop. Available human data on the developmental effects of benzene are inconclusive due to concomitant exposure to other chemicals, inadequate sample size, and lack of quantitative exposure data. USEPA has classified benzene as a known human carcinogen by inhalation.

1,3-Butadiene is a colorless gas with a mild gasoline-like odor. Sources of 1,3-butadiene released into the air include motor vehicle exhaust, manufacturing and processing facilities, forest fires or other combustion, and cigarette smoke. Acute exposure to 1,3-butadiene by inhalation in humans results in irritation of the eyes, nasal passages, throat, and lungs. Neurological effects, such as blurred vision, fatigue, headache, and vertigo, have also been reported at very high exposure levels. One epidemiological

study reported that chronic exposure to 1,3-butadiene via inhalation resulted in an increase in cardiovascular diseases, such as rheumatic and arteriosclerotic heart diseases, while other human studies have reported effects on the blood. No information is available on reproductive or developmental effects of 1,3-butadiene in humans. USEPA has classified 1,3-butadiene as a probable human carcinogen by inhalation.

Diesel Particulate Matter (DPM)/Diesel Exhaust Organic Gases are a complex mixture of hundreds of constituents in either a gaseous or particle form. Gaseous components of diesel exhaust (DE) include CO_2, oxygen, nitrogen, water vapor, CO, nitrogen compounds, sulfur compounds, and numerous low-molecular-weight hydrocarbons. Among the gaseous hydrocarbon components of DE that are individually known to be of toxicological relevance are several carbonyls (e.g., formaldehyde, acetaldehyde, acrolein), benzene, 1,3-butadiene, and polycyclic aromatic hydrocarbons (PAHs) and nitro-PAHs. DPM is composed of a center core of elemental carbon and adsorbed organic compounds, as well as small amounts of sulfate, nitrate, metals, and other trace elements. DPM consists primarily of $PM_{2.5}$, including a subgroup with a large number of particles having a diameter <0.1 μm. Collectively, these particles have a large surface area, which makes them an excellent medium for adsorbing organics. Also, their small size makes them highly respirable and able to reach the deep lung. A number of potentially toxicologically-relevant organic compounds, including PAHs, nitro-PAHs, and oxidized PAH derivatives, are on the particles. Diesel exhaust is emitted from on-road mobile sources, such as automobiles and trucks, and from off-road mobile sources (e.g., diesel locomotives, marine vessels, and construction equipment). DPM is directly emitted from diesel-powered engines (primary particulate matter) and can be formed from the gaseous compounds emitted by diesel engines (secondary particulate matter).

Acute or short-term (e.g., episodic) exposure to DE can cause acute irritation (e.g., eye, throat, bronchial), neurophysiological symptoms (e.g., lightheadedness, nausea), and respiratory symptoms (cough, phlegm). Evidence also exists for an exacerbation of allergenic responses to known allergens and asthma-like symptoms. Information from the available human studies is inadequate for a definitive evaluation of possible non-cancer health effects from chronic exposure to DE. However, on the basis of extensive animal evidence, DE is judged to pose a chronic respiratory hazard to humans. USEPA has determined that DE is "likely to be carcinogenic to humans by inhalation" and that this hazard applies to environmental exposures.

Formaldehyde is a colorless gas with a pungent, suffocating odor at room temperature. The major emission sources of formaldehyde appear to be power plants, manufacturing facilities, incinerators, and automobile exhaust. However, most of the formaldehyde in ambient air is a result of secondary formation through photochemical reaction of VOC and NOX. The major toxic effects caused by acute formaldehyde exposure via inhalation are eye, nose, and throat irritation and effects on the nasal cavity. Other effects seen from exposure to high levels of formaldehyde in humans are coughing, wheezing, chest pains, and bronchitis. Chronic exposure to formaldehyde by inhalation in humans has been associated with respiratory symptoms and eye, nose, and throat irritation. USEPA considers formaldehyde to be a probable human carcinogen.

Naphthalene is used in the production of phthalic anhydride; it is also used in mothballs. Acute (short-term) exposure of humans to naphthalene by inhalation, ingestion, and dermal contact is associated with hemolytic anemia, damage to the liver, and neurological damage. Cataracts have also been reported in workers acutely exposed to naphthalene by inhalation and ingestion. Chronic (long-term) exposure of workers and rodents to naphthalene has been reported to cause cataracts and damage to the retina. Hemolytic anemia has been reported in infants born to mothers who "sniffed" and ingested naphthalene (as mothballs) during pregnancy. Available data are inadequate to establish a causal relationship between exposure to naphthalene and cancer in humans. USEPA has classified naphthalene as a Group C, possible human carcinogen.

The term **Polycyclic Organic Matter (POM)** defines a broad class of compounds that includes the polycyclic aromatic hydrocarbon compounds (PAH), of which benzo[a]pyrene is a member. POM compounds are formed primarily from combustion and are present in the atmosphere in particulate form. Sources of air emissions are diverse and include cigarette smoke, vehicle exhaust, home heating, laying tar, and grilling meat. Cancer is the major concern from exposure to POM. Epidemiologic studies have reported an increase in lung cancer in humans exposed to coke oven emissions, roofing tar emissions, and cigarette smoke; all of these mixtures contain POM compounds. Animal studies have reported respiratory tract tumors from inhalation exposure to benzo[a]pyrene and forestomach tumors, leukemia, and lung tumors from oral exposure to benzo[a]pyrene. USEPA has classified seven PAHs (benzo[a]pyrene, benz[a]anthracene, chrysene, benzo[b]fluoranthene, benzo[k]fluoranthene, dibenz[a,h]anthracene, and indeno[1,2,3-cd]pyrene) as Group B2, probable human carcinogens.

1.5.3 Climate Change and Greenhouse Gases

Climate change is an important national and global concern. While the earth has gone through many natural changes in climate in its history, there is general agreement that the earth's climate is currently changing at an accelerated rate and will continue to do so for the foreseeable future. Anthropogenic (human-caused) greenhouse gas (GHG) emissions contribute to this rapid change. Carbon dioxide (CO_2) makes up the largest component of these GHG emissions. Other prominent transportation greenhouse gases include methane (CH_4) and nitrous oxide (N_2O).

Many GHGs occur naturally. Water vapor is the most abundant GHG and makes up approximately two thirds of the natural greenhouse effect. However, the burning of fossil fuels and other human activities are adding to the concentration of GHGs in the atmosphere. Many GHGs remain in the atmosphere for time periods ranging from decades to centuries. GHGs trap heat in the earth's atmosphere. Because atmospheric concentration of GHGs continues to climb, our planet will continue to experience climate-related phenomena. For example, warmer global temperatures can cause changes in precipitation and sea levels.

To date, no national standards have been established regarding GHGs, nor has USEPA established criteria or thresholds for ambient GHG emissions pursuant to its authority to establish motor vehicle emission standards for CO_2 under the CAA. However, there is a considerable body of scientific literature addressing the sources of GHG emissions and their adverse effects on climate, including reports from the Intergovernmental Panel on Climate Change, the US National Academy of Sciences, and USEPA and other federal agencies. The GHGs are different from other air pollutants evaluated in federal environmental reviews because their impacts are not localized or regional due to their rapid dispersion into the global atmosphere, which is characteristic of these gases. The affected environment for CO_2 and other GHG emissions is the entire planet. In addition, from a quantitative perspective, global climate change is the cumulative result of numerous and varied emissions sources (in terms of both absolute numbers and types), each of which makes a relatively small addition to global atmospheric GHG concentrations. In contrast to broad scale actions such as actions involving an entire industry sector or very large geographic areas, it is difficult to isolate and understand the GHG emissions impacts for a particular transportation project. Furthermore, presently there is no scientific methodology for attributing specific climatological changes to a particular transportation project's emissions.

1.6 Attainment Status

Section 107 of the 1977 Clean Air Act Amendment requires that the USEPA publish a list of all geographic areas in compliance with the NAAQS, plus those not attaining the NAAQS. Areas not in NAAQS compliance are deemed non-attainment areas. Areas that have insufficient data to make a determination are deemed unclassified, and are treated as being attainment areas until proven otherwise. Maintenance areas are areas that were previously designated as nonattainment for a particular pollutant, but have since demonstrated compliance with the NAAQS for that pollutant. An area's designation is based on the data collected by the state monitoring network on a pollutant-by-pollutant basis.

The Illiana Corridor is located in Will County in Illinois and Lake County in Indiana. Table 1-3 shows the attainment status for those portions of the counties in which the project is located. As shown in the table, the USEPA has classified Will and Lake counties as nonattainment areas for O_3. For the 1997 annual $PM_{2.5}$ NAAQS, Will County is classified as a nonattainment area and Lake County is classified as a maintenance area.

Table 1-3. Project Area Attainment Status

Pollutant	Will County Illinois	Lake County Indiana
Ozone (O_3)	Nonattainment	Nonattainment
Nitrogen Dioxide (NO_2)	Attainment	Attainment
Carbon Monoxide (CO)	Attainment	Attainment
Particulate Matter (PM_{10})	Attainment	Attainment
1997 Particulate Matter ($PM_{2.5}$) Annual/2006 24-Hour	Nonattainment/ Attainment	Maintenance/ Attainment
Lead (Pb)	Attainment	Attainment

Source: USEPA, 2013

1.7 Transportation Conformity Rule, State Implementation Plan and Transportation Improvement Program Status

Under the Clean Air Act Amendments of 1990, the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA), and the Transportation Equity Act for the 21st Century (TEA-21), proposed transportation projects must be derived from a long-range transportation plan (LRP) or regional transportation plan (RTP) that conforms with the state air quality plans as outlined in the state implementation plan (SIP). The SIP sets forth the state's strategies for achieving air quality standards. USEPA's Transportation Conformity Rule requires federal agencies to conduct a conformity determination for a proposed transportation plan, program, or project in a nonattainment or maintenance area before it can be approved, accepted, funded, or adopted. A conformity determination is a formal regulatory process by which the agency evaluates, analyzes, and determines whether the proposed federal action would comply with the air quality standards under the CAA. Specifically, transportation plans, programs, or projects may not cause or contribute to new violations of air quality standards, exacerbate existing violations, or interfere with timely attainment or required interim emissions reductions towards attainment.

The conformity rule also establishes the process by which the FHWA, the Federal Transit Administration (FTA), and local metropolitan planning organizations (MPOs) determine conformance of transportation plans and transportation improvement programs (TIPs), and federally-funded highway and transit projects. As part of this process, local MPOs are required under regulations promulgated in the CAA of 1990 to determine conformance of metropolitan transportation plans (MTPs) and TIPs before they are adopted, approved, or accepted. TIPs are a subset of staged, multi-year, inter-modal programs of transportation projects covering metropolitan planning areas

that are consistent with MTPs. The TIPs include a list of roadway and transit projects selected as priorities for funding by cities, county road commissions, and transit agencies. Projects to be completed in the near term are usually included in the region's TIP.

The Statewide Transportation Improvement Program (STIP) includes projects for the entire state. The purpose of the air quality analysis is to develop transportation plans that conform to state or federal air quality implementation plans. FHWA and FTA must make conformity determinations on federally-funded projects before they are adopted, accepted, approved, or funded.

The jurisdiction of two MPOs encompass the Corridor: the Chicago MPO Policy Committee (Chicago MPO) and the Northwestern Indiana Regional Planning Commission (NIRPC). Within the Chicago MPO planning area, the responsibilities of the MPO are carried out by the MPO Policy Committee with staff support from the Chicago Metropolitan Agency for Planning (CMAP).

- In Illinois, on October 17, 2013, the Chicago MPO approved amendments to GO TO 2040 and the FY2010-2015 TIP to include the proposed Illiana Corridor as a fiscally constrained major capital project and the associated conformity analysis.[1] The Illiana Corridor is identified in the TIP and in GO TO 2040 as project number 12-02-9024. On October 24, 2013, FHWA and FTA approved amendments to the IDOT STIP amendment that included the CMAP TIP amendment and found that the conformity analysis performed by CMAP met the applicable criteria of 40 CFR 51 and 93 (the federal transportation conformity rules) and that these amendments conform to the SIP.

  CMAP has also completed a conformity analysis as part of the GO TO 2040 Plan Update and the FY2014-2019 TIP that included the Illiana Corridor Preferred Alternative in Illinois.[2] The public comment period for the Plan and TIP amendments and the associated conformity analysis closed on August 1, 2014. This conformity analysis, along with the GO TO 2040 Plan Update and FY2014-2019 TIP will be considered by the Chicago MPO for adoption in October 2014. FHWA and FTA will subsequently review the documents and associated analyses in relation to determining conformity.

- In Indiana, on December 12, 2013, the Full Commission of NIRPC approved amending the 2040 Comprehensive Regional Plan and the FY2014-2017 TIP to include the proposed Illiana Corridor as a fiscally constrained major capital project

[1] See CMAP Staff Memorandum to MPO Policy Committee, Semi-annual GO TO 2040/TIP Conformity analysis & TIP Amendments, October 9, 2013.
[2] See CMAP Staff Memorandum to Transportation Committee, Semi-annual GO TO 2040/TIP Conformity analysis & TIP Amendments, May 30, 2014.

and the associated conformity analysis.[3] The Illiana Corridor is part of Amendment #4 to the TIP. FHWA and FTA approved the INDOT STIP amendment that included the NIRPC TIP amendment on January 31, 2014 and found that the conformity analysis performed by NIRPC met the applicable criteria of 40 CFR 51 and 93 and that the amendments conform to the SIP.

NIRPC has also completed a conformity analysis as part of an amendment to their 2040 Comprehensive Regional Plan and the FY2014-2017 TIP that included the Illiana Corridor Preferred Alternative in Indiana and the I-65 Added Travel Lane project from US 231 to SR 2.[4] This conformity analysis, along with the amendment of the 2040 Plan and FY2014-2017 TIP was approved by the Full Commission of NIRPC at the April 17, 2014 meeting. The I-65 Added Travel Lane project from US 231 to SR 2 is part of Amendment #11 to the TIP. FHWA and FTA found the NIRPC Plan and TIP amendments to conform as required by the conformity rule on May 5, 2014.

[3] See NIRPC, Air Quality Conformity Determination Between The 2040 Comprehensive Regional Plan, as amended, The Fiscal Year 2014 to 2017 Transportation Improvement Program, as amended, and The Indiana State Implementation Plan for Air Quality, October 1, 2013.

[4] See NIRPC, Air Quality Conformity Determination Between The 2040 Comprehensive Regional Plan, as amended, The Fiscal Year 2014 to 2017 Transportation Improvement Program, as amended, and The Indiana State Implementation Plan for Air Quality, February 19, 2014.

2.0 Environmental Consequences

2.1 Sources of Emissions

Pollutants that can be traced principally to motor vehicles are relevant to the evaluation of the project's impacts. These pollutants include CO, HC, NO_x, O_3, PM_{10}, $PM_{2.5}$, and MSAT. Transportation sources account for a small percentage of regional emissions of SO_x and Pb; thus, a detailed analysis of these pollutants is not required.

HC (VOC) and NO_x emissions from automotive sources are a concern primarily because they are precursors in the formation of ozone and particulate matter. Ozone is formed through a series of reactions that occur in the atmosphere in the presence of sunlight. Since the reactions are slow and occur as the pollutants are diffusing downwind, elevated ozone levels often are found many miles from the sources of the precursor pollutants. Therefore, the effects of HC and NO_x emissions generally are examined on a regional or "mesoscale" basis.

PM_{10} and $PM_{2.5}$ impacts are both regional and local. A large portion of particulate matter, especially PM_{10}, comes from disturbed vacant land, construction activity, and paved road dust. $PM_{2.5}$ also comes from these sources. Motor vehicle exhaust, particularly from diesel vehicles, is also a source of PM_{10} and $PM_{2.5}$. PM_{10}, and especially $PM_{2.5}$, can also be created by secondary formation from precursor elements such as sulfur dioxide (SO_2), nitrogen oxides (NO_X), volatile organic compounds (VOCs) and ammonia (NH_3). Secondary formation occurs because of chemical reaction in the atmosphere generally downwind some distance from the original emission source. Thus it is appropriate to predict concentrations of PM_{10} and $PM_{2.5}$ on both a regional and a localized basis.

CO impacts are generally localized. Even under the worst meteorological conditions and most congested traffic conditions, high concentrations are limited to a relatively short distance (300 to 600 feet) of heavily traveled roadways. Vehicle emissions are the major sources of CO. The Illiana Corridor could change traffic patterns within the project study corridor. Consequently, it is appropriate to predict concentrations of CO on both a regional and a localized or "microscale" basis.

MSAT impacts are both regional and local. Through the issuance of USEPA's Final Rule (FR) regarding emission control of Hazardous Air Pollutants from Mobile Sources [66 FR 17229], it was determined that many existing and newly promulgated mobile source emission control programs would result in a reduction of MSATs. The USEPA examined the impacts of existing and newly promulgated mobile source control programs, including its reformulated gasoline program, its national low emission vehicle standards, its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements, and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel requirements. Future emissions likely would be lower than present levels as a result of the USEPA's national control programs that are projected to

reduce MSAT emission by 83 percent from 2010 to 2050, even if VMT increases by 102 percent.

2.2 Emission Burden Analysis

A regional, or mesoscale, analysis of a project determines a project's overall impact on regional air quality levels. A regional analysis was performed for the Illiana Corridor using the latest version of USEPA's MOVES emissions program, MOVES2010b. MOVES2010b incorporates project-generated VMT as well as specific MOVES input factors, such as inspection and maintenance programs, fleet mix, and speed profiles, for the traffic network being analyzed. MOVES input factors were obtained from the appropriate MPOs for the project area – the Chicago MPO for Will County, Illinois, and from NIRPC for Lake County, Indiana.

The emission burden analysis of a project determines the annual "pollutant burden" levels for each of the project alternatives, as well as the No-Action Alternative, in order to provide a basis of comparison for regional emissions of each of the criteria pollutants under the different project alternatives. The 2040 VMT and emission burdens (in metric tons) for each of the project alternatives, as well as the No-Action Alternative, are presented in Table 2-1.

As shown in the table, the build alternatives are predicted to increase regional pollutant burdens of HC, NOx and CO by approximately 0.4 to 3.3 percent in 2040, as compared to the No-Action Alternative. The build alternatives are predicted to decrease regional pollutant burdens of particulate matter (PM_{10} and $PM_{2.5}$) by approximately 0.3 to 1.9 percent in 2040, as compared to the No-Action Alternative.

The Illiana Corridor is currently included in the TIPs for the Chicago MPO and NIRPC.

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2.3 MSAT Analysis

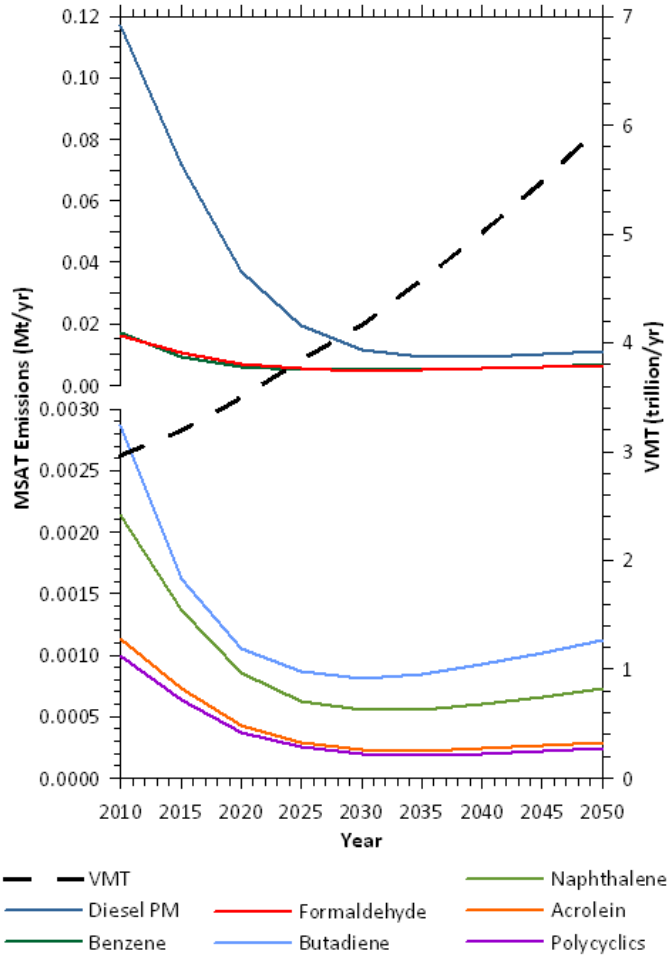
The USEPA is the lead federal agency for administering the CAA and has certain responsibilities regarding the health effects of MSATs. The USEPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources (66 Federal Register 17229, March 29, 2001). This rule was issued under the authority in Section 202 of the CAA. In its rule, USEPA examined the impacts of existing and newly promulgated mobile source control programs including: its reformulated gasoline program; its national low emission vehicle standards; its Tier 2 motor vehicle emissions standards and gasoline sulfur control requirements; and its proposed heavy duty engine and vehicle standards and on-highway diesel fuel requirements. Future emissions likely would be lower than present levels as result of the USEPA's national control programs that are projected to reduce MSAT emission by 83 percent from 2010 to 2050, even if VMT increases by 102 percent (see Figure 2-1).

Table 2-1. 2040 Regional Emission Burden Assessment (Metric Tons)

Pollutant/Parameter		No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
Annual Project Study Corridor VMT	Illinois	4,392,944,996	4,472,441,817	4,472,441,817	4,472,441,817
	Indiana	2,084,002,632	2,138,049,573	2,138,049,573	2,138,049,573
	Total	*6,476,947,627*	*6,610,491,390*	*6,610,491,390*	*6,610,491,390*
	% Change from No-Action	—	2.1%	2.1%	2.1%
Hydrocarbons (HC)	Illinois	1,046	1,045	1,045	1,045
	Indiana	443	452	452	452
	Total	*1,489*	*1,497*	*1,497*	*1,497*
	% Change from No-Action	—	0.5%	0.5%	0.5%
Nitrogen Oxides (NOx)	Illinois	2,676	2,732	2,732	2,732
	Indiana	989	1,055	1,055	1,055
	Total	*3,665*	*3,787*	*3,787*	*3,787*
	% Change from No-Action	—	3.3%	3.3%	3.3%
Carbon Monoxide (CO)	Illinois	16,616	16,638	16,638	16,638
	Indiana	8,243	8,315	8,315	8,315
	Total	*24,859*	*24,952*	*24,952*	*24,952*
	% Change from No-Action	—	0.4%	0.4%	0.4%
Particulate Matter (PM_{10})	Illinois	148	143	143	143
	Indiana	80	81	81	81
	Total	*228*	*224*	*224*	*224*
	% Change from No-Action	—	-1.9%	-1.9%	-1.9%
Particulate Matter ($PM_{2.5}$)	Illinois	80	79	79	79
	Indiana	41	41	41	41
	Total	*121*	*121*	*121*	*121*
	% Change from No-Action	—	-0.3%	-0.3%	-0.3%

Source: Parsons Brinckerhoff, 2013

Figure 2-1. National MSAT Emission Trends 2010–2050 for Vehicles Operating on Roadways Using USEPA's MOVES 2010b Model



Note: Trends for specific locations may be different, depending on locally derived information representing vehicle-miles travelled, vehicle speeds, vehicle mix, fuels, emission control programs, meteorology, and other factors

Source: FHWA's *Interim Guidance Update on Air Toxic Analysis in NEPA Documents* (FHWA, 2012) - USEPA MOVES2010b model runs conducted during May - June 2012 by FHWA.

On February 9, 2007 and under authority of CAA Section 202(l), USEPA signed a Final Rule, Control of Hazardous Air Pollutants from Mobile Sources, which sets standards to control MSATs from motor vehicles. Under this rule, USEPA is setting standards on fuel composition, vehicle exhaust emissions, and evaporative losses from portable containers. The new standards are estimated to reduce total emissions of MSATs by 330,000 tons in 2030, including 61,000 tons of benzene. Concurrently, total emissions of VOC will be reduced by over 1.1 million tons in 2030 as a result of adopting these standards.

On February 3, 2006, the FHWA released *Interim Guidance on Air Toxic Analysis in NEPA Documents* (FHWA 2006a). This guidance was superseded on December 6, 2012 by FHWA's *Interim Guidance Update on Air Toxic Analysis in NEPA* (FHWA 2012). The purpose of FHWA's guidance is to advise on when and how to analyze MSATs in the National Environmental Policy Act (NEPA) environmental review process for highways. This guidance is considered interim since MSAT science is still evolving. As the science progresses, FHWA will update the guidance.

A quantitative analysis provides a basis for identifying and comparing the potential differences among MSAT emissions, if any, between the various alternatives. The quantitative assessment presented is derived in part from a study conducted by the FHWA entitled *A Methodology for Evaluating Mobile Source Air Toxic Emissions Among Transportation Project Alternatives* (FHWA 2006b). The FHWA's Interim Guidance groups projects into the following tier categories:

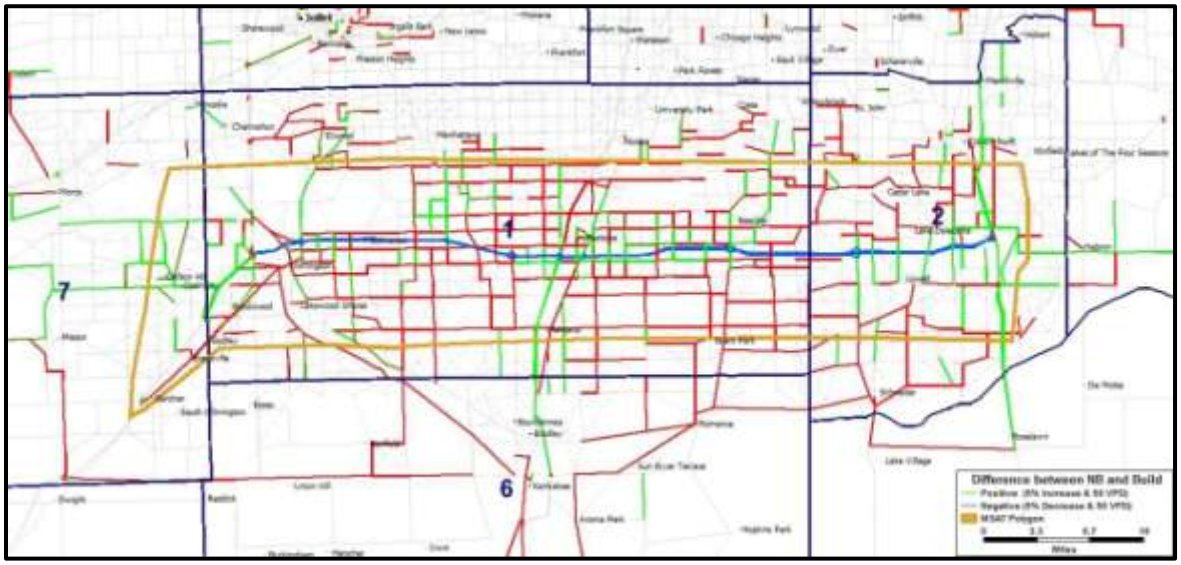
- No analysis for projects without potential for meaningful MSAT effects;
- Qualitative analysis for projects with low potential MSAT effects; and
- Quantitative analysis to differentiate alternatives for projects with higher potential MSAT effects.

Based on FHWA's recommended tiering approach, the Illiana Corridor falls within Tier 3 (for projects with a high potential for MSAT effects) for which FHWA recommends quantitative analysis to differentiate alternatives. In accordance with FHWA's recommendation, USEPA's MOVES2010b was used to calculate annual MSAT pollutant burdens for the No-Action and build alternatives.

The MSAT Study Area was refined to focus only on the portion of the Study Area substantially impacted by the project. Comparisons between the No-Action and build alternatives were therefore made for links where daily traffic volumes differed between the two alternatives by five percent or more and the change was more than 50 vehicles per day. The Study Area was refined by conducting a comparison between the No-Action and build alternatives for all links in the regional model. Links where daily traffic volumes differed between the No-Action and build alternatives by five percent or more and had an increase or decrease in absolute volume of 50 or more vehicles per day (vpd) were flagged. Using this data, in combination with professional judgment and local knowledge, a roadway network within a defined boundary, representing the a

subset of the Study Area, as shown in Figure 2-2 was developed. All roadways within this boundary were analyzed.

Figure 2-2. Roadway Network Used to Calculate Total MSAT Emissions



The refined Study Area allows for capture of the scatter of +/- 5 percent links within the area where local knowledge also indicates traffic volume changes (albeit in many cases quite small) would likely result from the project. There are numerous links where the regional model predicts increases or decreases of more than five percent (and more than 50 vehicles per day) that are not included in the refined Study Area. As noted above, the limits of the affected network reflect local knowledge and professional judgment of how far the project effects would extend in a practical setting, as well as an understanding of travel demand modeling and the sensitivity of such models to changes in network coding. Likewise several links included in the affected network do not experience a change in volume between the No-Action and build alternatives, but a continuous network of links is desirable for encapsulating the full extent of the MSAT burden in the vicinity of the project.

By conducting this Study Area screening analysis, the affected network was sized to include the project itself, nearby roadways that show meaningful changes in traffic, potential diversion routes, and the roadways in between that create a continuous network. The same affected network is used to compute the emission burdens under all tested scenarios, including the No-Action Alternative. This allows for a "like-to-like" comparison of the total VMT and resulting pollutant emission burdens.

The results of this analysis for the year 2040 are shown in Table 2-2. All future calculated MSAT emission burdens are predicted to decrease as compared to the existing scenario, even with a large increase in VMT. The build alternatives are predicted to demonstrate an increase in MSAT burdens as compared to the No-Action Alternative.

Table 2-2. 2040 Predicted MSAT Emission Burdens (metric tons/year)

Pollutant*/Parameter		Existing	No-Action Alternative	Alternative 1	Alternative 2	Alternative 3
MSAT Study Area VMT	Illinois	7.47E+08	1.80E+09	1.91E+09	1.91E+09	1.91E+09
	Indiana	3.55E+08	6.47E+08	7.03E+08	7.03E+08	7.03E+08
	Total	*1.10E+09*	*2.44E+09*	*2.62E+09*	*2.62E+09*	*2.62E+09*
Acrolein	Illinois	0.32	0.10	0.10	0.10	0.10
	Indiana	0.17	0.04	0.04	0.04	0.04
	Total	*0.49*	*0.13*	*0.15*	*0.15*	*0.15*
Benzene	Illinois	2.54	1.80	1.86	1.86	1.86
	Indiana	1.39	0.64	0.69	0.69	0.69
	Total	*3.94*	*2.43*	*2.55*	*2.55*	*2.55*
1,3 Butadiene	Illinois	0.49	0.32	0.33	0.33	0.33
	Indiana	0.27	0.11	0.12	0.12	0.12
	Total	*0.76*	*0.43*	*0.45*	*0.45*	*0.45*
Diesel PM	Illinois	38.28	4.69	5.43	5.43	5.43
	Indiana	21.32	2.10	2.55	2.55	2.55
	Total	*59.60*	*6.78*	*7.98*	*7.98*	*7.98*
Formaldehyde	Illinois	4.32	2.18	2.33	2.33	2.33
	Indiana	2.37	0.84	0.97	0.97	0.97
	Total	*6.70*	*3.02*	*3.31*	*3.31*	*3.31*
Naphthalene	Illinois	0.52	0.22	0.23	0.23	0.23
	Indiana	0.29	0.08	0.09	0.09	0.09
	Total	0.80	0.30	0.33	0.33	0.33

*POM emissions are not calculated by MOVES, but the trend would be similar to that for naphthalene.

In summary, it is projected that there would be changes in MSAT emissions in the immediate area of the project under the build alternatives, regardless of which one is chosen, relative to the No-Action Alternative, as a result of the VMT changes associated with the project. The MSAT levels could be higher in some locations than others, such as adjacent to the Illiana Corridor main line, but current tools and science are not adequate to quantify them. Regardless, on a regional basis, USEPA's vehicle and fuel regulations, coupled with fleet turnover, will over time cause substantial reductions that, in almost all cases, will cause region-wide MSAT levels to be substantially lower than today.

One of the concerns raised with regard to MSATs over the last several years concerns the contribution of vehicles in the near-road environment to MSAT concentrations. Several studies have shown that the concentrations of some emissions return to background concentrations within 1,000 feet of the roadway (Hagler et al. 2009; Beckerman et al 2008; Zhu et al. 2002). Some residences are located within 1,000 feet of the proposed project.

This document has provided a quantitative analysis of MSAT emissions relative to the proposed project and has acknowledged that the alternatives could increase exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain. Available technical tools do not enable prediction of the project-specific health impacts of the emission changes associated with the alternatives. Because of these limitations, the following discussion is included in accordance with the President's Council on Environmental Quality (CEQ) regulations (40 CFR, Section 1502.22[b]) regarding incomplete or unavailable information.

2.3.1 Information that is Unavailable or Incomplete

In FHWA's view, information is incomplete or unavailable to credibly predict the project-specific health impacts due to changes in MSAT emissions associated with a proposed set of highway alternatives. The outcome of such an assessment, adverse or not, would be influenced more by the uncertainty introduced into the process through assumption and speculation rather than any genuine insight into the actual health impacts directly attributable to MSAT exposure associated with a proposed action.

The USEPA is responsible for protecting the public health and welfare from any known or anticipated effect of an air pollutant. They are the lead authority for administering the CAA and its amendments and have specific statutory obligations with respect to hazardous air pollutants and MSAT. The USEPA is in the continual process of assessing human health effects, exposures, and risks posed by air pollutants. They maintain the Integrated Risk Information System (IRIS), which is "a compilation of electronic reports on specific substances found in the environment and their potential to cause human health effects" (USEPA, http://www.epa.gov/iris/). Each report contains assessments of non-cancerous and cancerous effects for individual compounds and quantitative estimates of risk levels from lifetime oral and inhalation exposures, with uncertainty spanning perhaps an order of magnitude.

Other organizations are also active in the research and analyses of the human health effects of MSAT, including the Health Effects Institute (HEI). Two HEI studies are summarized in Appendix D of FHWA's *Interim Guidance Update on Mobile Source Air Toxic Analysis in NEPA Documents*. Among the adverse health effects linked to MSAT compounds at high exposures are: cancer in humans in occupational settings; cancer in animals; and irritation to the respiratory tract, including the exacerbation of asthma. Less obvious is the adverse human health effects of MSAT compounds at current environmental concentrations (HEI, http://pubs.healtheffects.org/view.php?id=282) or in the future as vehicle emissions substantially decrease (HEI, http://pubs.healtheffects.org/view.php?id=306).

The methodologies for forecasting health impacts include emissions modeling; dispersion modeling; exposure modeling; and then final determination of health impacts - each step in the process building on the model predictions obtained in the previous step. All are encumbered by technical shortcomings or uncertain science that prevents a more complete differentiation of the MSAT health impacts among a set of project alternatives. These difficulties are magnified for lifetime (i.e., 70 year) assessments,

particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over that time frame, since such information is unavailable.

It is particularly difficult to reliably forecast 70-year lifetime MSAT concentrations and exposure near roadways; to determine the portion of time that people are actually exposed at a specific location; and to establish the extent attributable to a proposed action, especially given that some of the information needed is unavailable.

There are considerable uncertainties associated with the existing estimates of toxicity of the various MSAT, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population, a concern expressed by HEI (http://pubs.healtheffects.org/view.php?id=282). As a result, there is no national consensus on air dose-response values assumed to protect the public health and welfare for MSAT compounds, and in particular for diesel PM. The USEPA (http://www.epa.gov/risk/basicinformation.htm#g) and the HEI (*http://pubs.healtheffects.org/getfile.php?u=395*) have not established a basis for quantitative risk assessment of diesel PM in ambient settings.

There is also the lack of a national consensus on an acceptable level of risk. The current context is the process used by the USEPA as provided by the CAA to determine whether more stringent controls are required in order to provide an ample margin of safety to protect public health or to prevent an adverse environmental effect for industrial sources subject to the maximum achievable control technology standards, such as benzene emissions from refineries. The decision framework is a two-step process. The first step requires USEPA to determine an "acceptable" level of risk due to emissions from a source, which is generally no greater than approximately 100 in a million. Additional factors are considered in the second step, the goal of which is to maximize the number of people with risks less than 1 in a million due to emissions from a source. The results of this statutory two-step process do not guarantee that cancer risks from exposure to air toxics are less than 1 in a million; in some cases, the residual risk determination could result in maximum individual cancer risks that are as high as approximately 100 in a million. In a June 2008 decision, the US Court of Appeals for the District of Columbia Circuit upheld USEPA's approach to addressing risk in its two step decision framework. Information is incomplete or unavailable to establish that even the largest of highway projects would result in levels of risk greater than deemed acceptable.

Because of the limitations in the methodologies for forecasting health impacts described, any predicted difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with predicting the impacts. Consequently, the results of such assessments would not be useful to decision makers, who would need to weigh this information against project benefits, such as reducing traffic congestion, accident rates, and fatalities plus improved access for emergency response, that are better suited for quantitative analysis.

2.4 Microscale CO Analysis

Microscale CO air quality modeling was performed using guidance from each of the states as following, as described below.

2.4.1 Illinois Methodology

For analysis sites[5] in Illinois, IDOT's intersection screening model "Illinois Carbon Monoxide Screen for Intersection Modeling" (COSIM) pre-screening worksheets were filled out for each site. These worksheets, which also contained the peak hourly approach volume as well as the closest receptor distance to any one edge of the intersection roadway, were provided to IDOT. This information was processed by IDOT staff, and the results of the analysis were provided to Parsons Brinckerhoff.

2.4.2 Indiana Methodology

For analysis sites in Indiana, and following INDOT's *Procedural Manual for Preparing Environmental Documents,* the most recent version of the USEPA mobile source emission factor model (MOVES2010b, EPA 2012) and the CAL3QHC (Version 2.0) air quality dispersion model (USEPA 1995b) were used to estimate existing, future No-Action and future Build CO levels at selected locations in the project area.

Mobile source models are the basic analytical tools used to estimate CO concentrations expected under given traffic, roadway geometry, and meteorological conditions. The mathematical expressions and formulations that comprise the various models attempt to describe an extremely complex physical phenomenon as closely as possible. The dispersion modeling program used in this project for estimating pollutant concentrations near roadway intersections is the CAL3QHC (Version 2.0) dispersion model developed by USEPA and first released in 1992.

CAL3QHC is a Gaussian model recommended in the USEPA's Guidelines for Modeling Carbon Monoxide from Roadway Intersections (USEPA 1992). Gaussian models assume that the dispersion of pollutants downwind of a pollution source follow a normal distribution from the center of the pollution source.

Different emission rates occur when vehicles are stopped (i.e., idling), accelerating, decelerating, and moving at different average speeds. CAL3QHC simplifies these different emission rates into two components:

- Emissions when vehicles are stopped (i.e., idling) during the red phase of a signalized intersection
- Emissions when vehicles are in motion during the green phase of a signalized intersection

[5] The process for selecting appropriate analysis sites is described in Section 2.4.3 below.

The CAL3QHC (Version 2.0) air quality dispersion model has undergone extensive testing by USEPA and has been found to provide reliable estimates of inert (i.e., nonreactive) pollutant concentrations resulting from motor vehicle emissions. A complete description of the model is provided in the User's Guide to CAL3QHC (Version 2.0): A Modeling Methodology for Predicting Pollutant Concentrations near Roadway Intersections (Revised) (USEPA 1995b).

The transport and concentration of pollutants emitted from motor vehicles are influenced by three principal meteorological factors: wind direction, wind speed, and the atmosphere's profile. The values for these parameters were chosen to maximize pollutant concentrations at each prediction site. That is, to establish a conservative, reasonable worst-case scenario. The values used for these parameters are:

- **Wind Direction**. Maximum CO concentrations normally are found when the wind is assumed to blow parallel to a roadway adjacent to the receptor location. At complex intersections, it is difficult to predict which wind angle will result in maximum concentrations. Therefore, the approximate wind angle that would result in maximum pollutant concentrations at each receptor location was used in the analysis. All wind angles from 0 to 360 degrees (in 5-degree increments) were considered.
- **Wind Speed**. The CO concentrations are greatest at low wind speeds. A conservative wind speed of one meter per second (2.2 miles per hour) was used to predict CO concentrations during peak traffic periods.
- **Profile of the Atmosphere**. A "mixing" height (the height in the atmosphere to which pollutants rise) of 1,000 meters, and neutral atmospheric stability (stability class D) conditions were used in estimating microscale CO concentrations.

The CO levels estimated by the model are the maximum concentrations which could be expected to occur at each air quality receptor site analyzed, given the assumed simultaneous occurrence of a number of worst-case conditions: peak-hour traffic conditions, conservative vehicular operating conditions, low wind speed, low atmospheric temperature, neutral atmospheric conditions, and maximizing wind direction.

Microscale modeling is used to predict CO concentrations resulting from emissions due to motor vehicles using roadways immediately adjacent to the locations at which predictions are being made. A CO background level must be added to this value to account for CO entering the area from other sources upwind of the receptors. Background levels for this analysis were obtained from the East Chicago, Indiana monitoring site, which is the closest CO monitoring location to the project area. The background values used for the 1-hour and 8-hour CO levels, 5.6 ppm and 2.4 ppm, respectively, are the maximum of the 2nd highest levels from the past three years of data (2010-2012) at this location. These values were conservatively used as the background for all CO modeling analyses. Future CO background levels are anticipated to be lower than existing levels due to mandated emission source reductions.

Traffic data for the air quality analysis were derived from traffic counts and other information developed as part of an overall traffic analysis for the project. Output from the "Synchro8" signal timing traffic model was used to obtain signal timing parameters.

The percentages of each type of vehicle, for the existing and future year conditions, were obtained from traffic information developed for this project.

Emission factors were developed using the latest version of USEPA's Motor Vehicle Emission Simulator (MOVES), MOVES2010b. MOVES2010b is the USEPA's state-of-the-art tool for estimating emissions from highway vehicles. The model is based on analyses of millions of emission test results and considerable advances in the Agency's understanding of vehicle emissions. Compared to previous tools, MOVES2010b incorporates the latest emissions data, more sophisticated calculation algorithms, increased user flexibility, new software design, and substantial new capabilities. Detailed MOVES2010b information can be found in Appendix B.

2.4.3 Screening Evaluation

Following USEPA guidance,[6] an analysis of CO levels was conducted for representative intersections to evaluate the air quality impacts at intersections most affected by the build alternatives. First, 2040 traffic projections for the intersections in the project area were examined for the No-Action and build alternatives. There were 54 intersections that were identified in the project area as the most congested and most affected by the build alternatives (Table 2-3), as compared to the No-Action Alternative. Next, these 54 intersections were screened based primarily on projected Level of Service (LOS) at the intersections. The LOS describes the quality of traffic operating conditions, ranging from A to F, and it is measured as the duration of delay that a driver experiences at a given intersection. LOS A represents free-flow movement of traffic and minimal delays to motorists. LOS F generally indicates severely congested conditions with excessive delays to motorists. Intermediate grades of B, C, D, and E reflect incremental increases in congestion.

Intersections were flagged based on this screening evaluation if (1) the level of service (LOS) decreases below D in one of the build scenarios compared to the no-build scenario, or (2) if the delay and/or volume increase from the no-build scenario to build scenarios along with a LOS below D. Based on the screening evaluation, 15 of the 54 intersections were found to meet these criteria and were flagged for further review. In accordance with EPA guidance, intersections were then selected for further analysis whose conditions are suspected to be the most conducive to high concentration impacts. Eight of the 15 intersections that were flagged were chosen for detailed analysis. These eight intersections include those with the highest delay in the AM and PM peak periods, as well as the intersection with the highest volume in the AM peak period. A ninth

[6] US Environmental Protection Agency (USEPA). 1992. "Guideline for Modeling Carbon Monoxide from Roadway Intersections." EPA-454/R-92-005. November 1992.

Table 2-3. Illiana Corridor Intersection Screening

#	Intersection	2040 No Build						2040 Build					
		AM			PM			AM			PM		
		LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume
1	Arsenal Rd at I-55 SB Ramps	A	9.0	3,085	B	15.8	3,251	B	13.2	3,294	B	12.7	3,174
2	Arsenal Rd at I-55 NB On-Off/SB Off Ramps	A	3.3	2,290	A	1.5	2,201	A	2.7	2,316	A	3.4	2,668
3	Lorenzo Rd at I-55 SB Ramps	F	>> 150.0	1,901	F	>> 150.0	1,876	F	68.1	1,662	F	130.2	1,524
4	Lorenzo Rd at I-55 NB Ramps	A	7.7	197	A	7.9	217	A	8.1	217	A	7.9	217
5	IL-129/Murphy Rd at W Frontage Rd	A	2.9	1,328	A	3.1	1,377	A	3.8	1,601	A	6.4	1,684
6	IL-129 at Stripmine Rd	B	10.7	2,000	B	11.1	2,223	C	22.2	2,323	B	19.2	2,411
7	IL-129 at I-55/Illiana SB/WB Ramps							B	19.3	2,479	B	16.5	2,733
8	IL-129 at I-55/Illiana NB/EB Ramps							A	7.7	3,155	A	5.6	3,109
9	Coal City Rd at I-55 SB Ramps	B	11.6	1,106	B	17.1	1,268	B	11.6	1,138	B	13.1	1,372
10	Coal City Rd at I-55 NB Ramps	A	2.5	1,332	A	2.1	1,320	A	2.9	1,301	A	2.0	1,305
11	Riley Rd at Arsenal Rd	A	1.8	449	A	1.4	706	A	4.6	455	A	5.0	518
12	Riley Rd at Peotone Rd	A	0.7	1,215	A	2.3	1,254	A	5.3	1,158	C	24.1	1,244
13	Riley Rd at Illiana EB Ramps							B	11.0	917	A	8.0	702
14	Riley Rd at Illiana WB Ramps							A	6.0	1,017	A	6.4	885

#	Intersection	2040 No Build						2040 Build					
		AM			PM			AM			PM		
		LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume
15	IL-53 and Illiana WB Ramps							B	13.6	2,964	B	13.7	3,005
16	IL-53 and Illiana EB Ramps							B	17.2	2,682	A	9.6	2,613
17	IL-53 at Arsenal Rd	F	50.1	2,383	F	>> 150.0	2,409	E	39.3	2,819	F	54.0	2,954
18	IL-53 at Wilmington-Peotone Rd	E	62.0	2,846	E	58.9	2,846	D	40.1	2,735	D	43.5	2,735
19	Old Chicago Rd at Arsenal Rd	C	23.2	1,119	C	23.9	1,119	A	9.2	444	A	8.4	408
20	Old Chicago Rd at Peotone Rd	F	-	1,912	F	-	2,107	F	91.2	1,040	E	44.6	1,033
21	Wilton Center at Arsenal Rd - north of interchange	F	>> 150.0	1,304	F	>> 150.0	1,258	F	-	1,455	F	58.5	1,438
22	Wilton Center at Wilmington-Peotone Rd - south of interchange	B	10.8	996	A	9.8	1,001	B	14.5	792	C	16.8	797
23	Wilton Center (Cedar) Rd at Illiana WB Ramps							C	21.7	1,498	B	13.0	1,509
24	Wilton Center (Cedar) Rd at Illiana EB Ramps							B	18.6	1,152	B	15.1	1,190
25	US 45 at Wilmington-Peotone Rd - north of interchange	F	>> 150.0	1,629	F	>> 150.0	1,629	F	81.2	1,336	F	64.0	1,256
26	US 45 at Kennedy Rd- south of interchange	D	26.7	637	A	3.6	637	A	5.9	501	A	5.0	524
27	US 45 and Illiana WB Ramps							A	7.9	1,388	A	7.6	1,235
28	US 45 and Illiana EB Ramps							B	15.9	1,391	B	11.7	1,197

#	Intersection	2040 No Build						2040 Build					
		AM			PM			AM			PM		
		LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume
29	County Hwy 9 at I-57 SB Ramps	B	12.7	1,261	B	12.2	1,236	B	18.9	1,211	B	15.8	1,335
30	County Hwy 9 at I-57 NB Ramps	F	137.4	1,346	F	51.3	1,273	A	7.8	1,166	A	5.8	1,165
31	I-57 at Wilmington-Peotone Rd NB Ramps	F	>> 150.0	1,611	F	>> 150.0	1,468	E	38.7	1,688	F	>> 150.0	1,993
32	I-57 at Wilmington-Peotone Rd SB Ramps	D	29.0	1,660	F	145.8	1,888	F	>> 150.0	1,727	F	>> 150.0	1,299
33	Wilmington-Peotone Rd at Rathje Rd - east of interchange	B	16.5	1,790	D	39.3	1,889	B	12.5	1,554	B	14.7	1,713
34	Wilmington-Peotone Rd at 88th Ave - west of interchange	F	-	2,704	F	-	2,996	F	-	2,610	F	-	2,854
35	IL-50 at Tucker Rd - north of interchange	F	>> 150.0	3,008	F	>> 150.0	3,008	F	>> 150.0	3,505	F	>> 150.0	3,505
36	IL-50 at Kennedy Rd - south of interchange	C	17.0	1,852	C	21.0	1,883	D	32.1	1883	E	47.6	1,886
37	IL-50 and Illiana WB Ramps							B	19.7	2,509	B	13.8	2,425
38	IL-50 and Illiana EB Ramps							A	8.4	930	A	9.3	1,059
39	IL-1 at 311th St / Corning Rd	F	-	1,358	F	133.5	1,347	F	-	2,019	F	-	2,051
40	IL-1 at Kentucky Rd	C	15.1	1,140	E	38.6	1,160	A	4.5	1,235	A	6.3	1,261
41	IL-1 and Illiana WB Ramps							B	10.7	2,036	A	8.9	2,065
42	IL-1 and Illiana EB Ramps							C	20.8	1,541	C	20.5	1,619

#	Intersection	2040 No Build						2040 Build					
		AM			PM			AM			PM		
		LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume	LOS	Delay	Volume
43	US 41 at 157th Ave - north of interchange	F	-	1,894	F	-	1,875	F	-	1,906	F	-	1,903
44	US 41 at SR 2 - south of interchange	B	17.9	2,218	C	22.8	2,339	C	20.8	2,369	C	24.0	1,865
45	US 41 and Illiana WB Ramps							A	4.1	1,593	A	5.4	1,733
46	US 41 and Illiana EB Ramps							A	5.0	1,652	A	5.0	1,778
47	SR 55 at 153rd Ave - north of interchange	F	-	1,605	F	-	1,689	F	-	1,853	F	-	1,865
48	SR 55 at 163rd Ave - south of interchange	A	3.1	1,132	A	4.3	1,132	B	10.3	1,466	C	21.1	1,581
49	SR 55 and Illiana WB Ramps							B	14.8	1,922	A	7.5	1,733
50	SR 55 and Illiana EB Ramps							C	26.7	1,982	A	8.6	1,713
51	SR 2 at I-65 SB Ramps	B	14.4	1,993	B	13.7	2,130	A	9.0	1,807	B	10.2	2,038
52	SR 2 at I-65 NB Ramps	B	14.3	1,832	B	10.4	1,846	B	10.9	2,066	B	10.2	2,065
53	US 231 at I-65 SB Ramps	B	11.3	1,965	B	11.4	2,095	A	7.9	1,928	B	13.0	2,046
54	US 231 at I-65 NB Ramps	A	6.1	1,412	A	5.8	1,404	A	7.4	1,410	A	7.1	1,415

Source: Parsons Brinckerhoff, 2013

Shaded cells = intersection does not exist in the No-Action Alternative

intersection was chosen because it demonstrates the highest volume in the PM peak period. The nine intersections selected also show proximity to sensitive receptors and even geographical representation across the project area. Seven of these intersections are in Illinois; two are in Indiana. The intersections chosen for analyses were:

Illinois

- #12 – Riley Road at Peotone Road
- #17 – IL-53 at Arsenal Road
- #21 – Wilton Center at Arsenal Road
- #31 – I-57 at Wilmington-Peotone NB Ramps
- #32 – I-57 at Wilmington-Peotone SB Ramps
- #34 – Wilmington-Peotone Road at 88th Avenue
- #39 – IL-1 at 311th Street

Indiana

- #43 – US 41 at 157th Avenue
- #47 – SR 55 at 153rd Avenue

2.4.4 Illinois Analysis

COSIM pre-screen worksheets were submitted to IDOT for the seven selected intersections in Illinois. In accordance with the Illinois COSIM Carbon Monoxide Screen for Intersection Modeling Air Quality Manual Version 4.0, the Illinois portion of this project is exempt from a project-level carbon monoxide analysis because the highest design-year approach volume on the busiest leg of each of the seven intersections analyzed is less than 5,000 vehicles per hour. Refer to Appendix A for the pre-screen modeling results for each of the seven intersections analyzed in Illinois.

2.4.5 Indiana Analysis

Maximum one-hour and eight-hour CO levels were predicted for the existing (2010), opening (2018) and design year (2040) at the two intersections selected for analysis in Indiana. Maximum one-hour CO concentrations are shown in Table 2-4. Maximum eight-hour CO concentrations are shown in Table 2-5. The CO levels estimated by the model are the maximum concentrations that could be expected to occur at each air quality receptor site analyzed. This assumes simultaneous occurrence of a number of worst case conditions: peak hour traffic conditions, conservative vehicular operating conditions, low wind speed, low atmospheric temperature, neutral atmospheric conditions, and maximizing wind direction.

Table 2-4. Predicted Worst-Case One-Hour CO Concentrations (ppm)

Intersection	2010		2018				2040			
	Existing		No Build		Build*		No Build		Build*	
	AM	PM	AM	PM	AM	PM	AM	PM	AM	PM
US 41 at 157th Avenue	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.9	5.8	5.8
IN 55 at 153rd Avenue	5.8	5.9	5.8	5.8	5.9	5.9	5.9	5.9	6.0	5.9

Notes: Concentrations = modeled results + 1-hour CO background.
1-hour CO background = 5.6 ppm; 1-hour CO standard = 35 ppm.
*The build alternative results represent all three build alternatives.
Abbreviations: AM = morning; PM = evening; ppm = parts per million.

Table 2-5. Predicted Worst-Case Eight-Hour CO Concentrations (ppm)

Intersection	2010	2018*		2040*	
	Existing	No Build	Build	No Build	Build
US 41 at 157th Avenue	2.6	2.6	2.6	2.6	2.5
IN 55 at 153rd Avenue	2.6	2.5	2.6	2.6	2.7

Notes: Concentrations = (modeled results x persistence factor [0.7]) + 8-hour CO background.
8-hour CO background = 2.4 ppm; 8-hour CO standard = 9 ppm.
*The build alternative results represent all three build alternatives , as traffic is not expected to differ for the three build alternatives based on the alignment differences in the three build alternatives.
Abbreviations: ppm = parts per million.

Based on the 1-hour values presented in Table 2-4, the build alternatives are predicted to slightly increase CO levels (less than 2%) at one location and slightly decrease CO levels at one location in 2040, when compared to the No-Action Alternative. The alternatives are not predicted to cause or exacerbate a violation of the NAAQS for CO, as all levels are below the 1-hour NAAQS of 35 ppm.

Based on the eight-hour values presented in Table 2-5, the build alternatives are predicted to slightly increase CO levels at one location and slightly decrease CO levels at one location in 2040, when compared to the No-Build Scenario. The alternatives are not predicted to cause or exacerbate a violation of the NAAQS for CO, as all levels are below the 8-hour NAAQS of 9 ppm. The CAL3QHC Version 2 input and output data for each site is contained in Appendix C.

In summary, a microscale CO analysis was conducted to determine if any of the alternatives have the potential to cause or exacerbate a violation of the applicable CO standards. The result of this analysis, which was conducted following USEPA's *Guideline for Modeling Carbon Monoxide from Roadway Intersections* (USEPA 1992a), is that the alternatives are not predicted to cause or exacerbate a violation of the NAAQS for CO.

2.5 Microscale $PM_{2.5}$ Analysis

The PM analysis follows USEPA's nine-step process, as shown in Figure 2-3, which is detailed in USEPA's the *Transportation Conformity Guidance for Quantitative Hot-Spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*, November 2013 (http://www.epa.gov/otaq/stateresources/transconf/policy/420b13053-sec.pdf. The hot-spot analysis compares the air quality concentrations with the proposed project (the build scenario) to the 1997 annual PM2.5 NAAQS (15 $\mu g/m^3$). These air quality concentrations are determined by calculating a future design value, which is a statistic that describes future air quality concentrations in the project area that can be compared to a particular NAAQS. This report serves as documentation of the PM hot-spot analysis and includes a description of all steps.

2.5.1 Determination of Need

The Illiana Corridor traverses Will County in Illinois and Lake County in Indiana. Will County is currently classified as a moderate non-attainment area and Lake County is classified as a maintenance area for the 1997 (annual) $PM_{2.5}$ standard. Section 93.123(b)(1) of the conformity rule, defines those projects that require a $PM_{2.5}$ or PM_{10} hot-spot analysis as including "(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." As shown in Table 2-6 and Table 2-7, the Illiana Corridor is predicted to have between 6,100 to 8,100 Average Annual Daily Traffic (AADT) diesel trucks in 2040 and between 3,450 and 5,340 AADT diesel trucks in 2018. This information was brought to the interagency group on February 14, 2013 and they determined that the project would complete a quantitative hot-spot analysis following USEPA's "*Transportation Conformity Guidance for Quantitative Hot-Spot Analysis in $PM_{2.5}$ and PM_{10} Nonattainment and Maintenance Areas*", November 2013.

Figure 2-3. Overview of PM Quantitative Hot-Spot Analysis

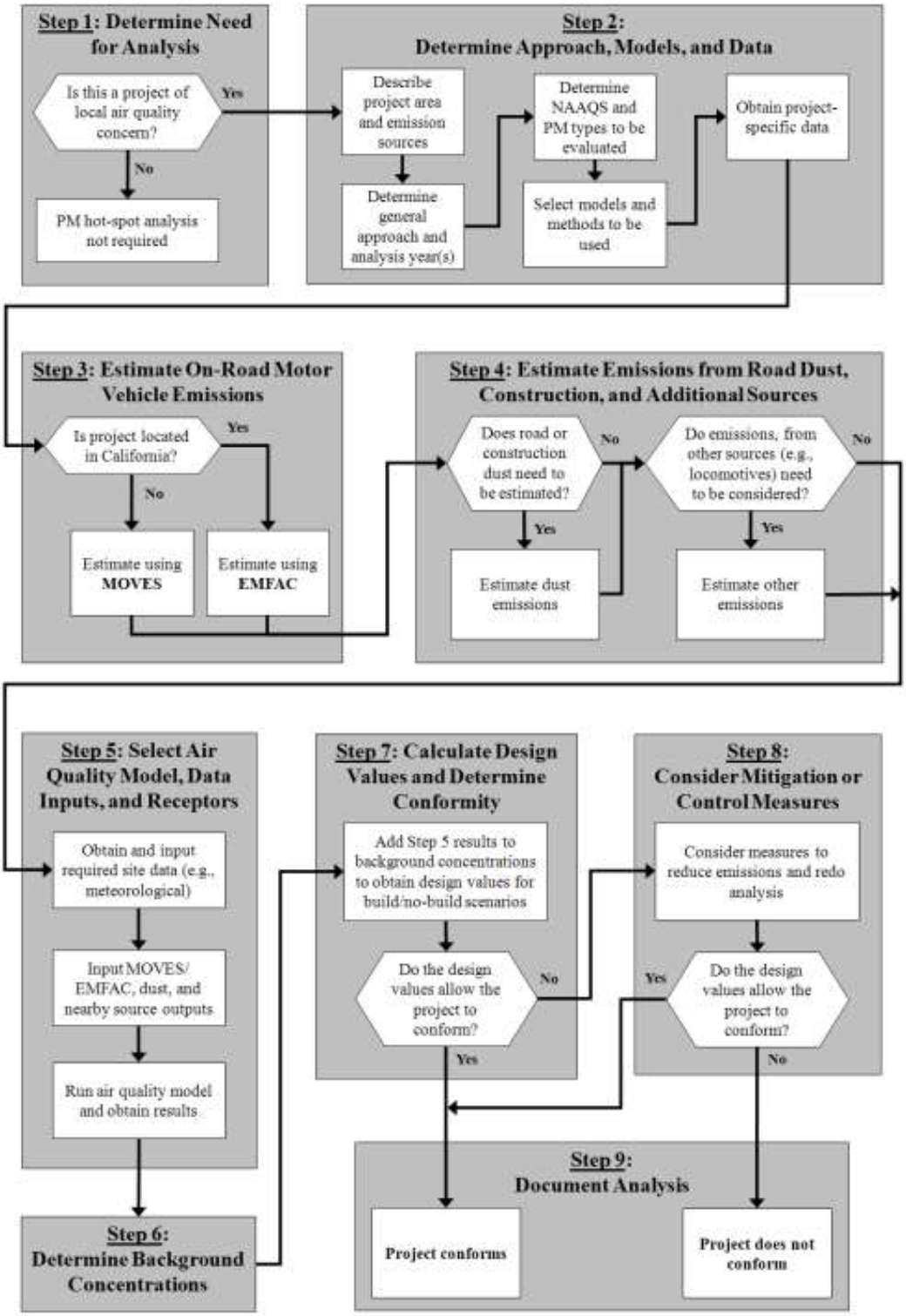


Table 2-6. Preliminary Projected 2040 Change in Bi-Directional AADT

Illiana Corridor Section	Projected 2040 Change in AADT (Build vs. No Build)		
	Passenger Car	Diesel Truck	Total
Illiana Corridor from I-55 to IL-53	23,600	6,600	30,200
Illiana Corridor from IL-53 to Wilton-Center Road	12,800	6,100	18,900
Illiana Corridor from Wilton-Center Road to US 45	16,100	8,100	24,200
Illiana Corridor from US 45 to I-57	11,800	8,000	19,800
Illiana Corridor from I-57 to IL-50	17,7 00	7,700	25,400
Illiana Corridor from IL-50 to IL-1	11,300	7,100	18,400
Illiana Corridor from IL-1 to US 41	9,700	7,500	17,200
Illiana Corridor from US 41 to SR 55	9,200	7,400	16,600
Illiana Corridor from SR 55 to I-65	11,200	7,300	18,500
I-55 north of Illiana Corridor	-600	-600	-1,200
I-55 south of Illiana Corridor	4,200	1,400	5,600
I-57 north of Illiana Corridor	-8,000	-800	-8,800
I-57 south of Illiana Corridor	-9,100	-1,400	-10,500
I-65 north of Illiana Corridor	3,800	1,400	5,200
I-65 south of Illiana Corridor	2,400	1,000	3,400

Source – PB Travel Demand Modeling, No Build and B3 Alternatives

Table 2-7. Preliminary Projected 2018 Change in Bi-Directional AADT

Illiana Corridor Section	Projected 2018 Change in AADT (Build vs. No Build)		
	Passenger Car	Diesel Truck	Total
Illiana Corridor from I-55 to IL-53	10,720	3,980	14,700
Illiana Corridor from IL-53 to Wilton-Center Road	6,450	3,450	9,900
Illiana Corridor from Wilton-Center Road to US 45	10,550	5,250	15,800
Illiana Corridor from US 45 to I-57	6,860	5,340	12,200
Illiana Corridor from I-57 to IL-50	9,760	4,640	14,400
Illiana Corridor from IL-50 to IL-1	5,210	4,490	9,700
Illiana Corridor from IL-1 to US 41	3,470	4,530	8,000
Illiana Corridor from US 41 to SR 55	3,840	4,460	8,300
Illiana Corridor from SR 55 to I-65	8,260	4,840	13,100
I-55 north of Illiana Corridor	-560	-40	-600
I-55 south of Illiana Corridor	2,880	1,320	4,200
I-57 north of Illiana Corridor	-5,940	-260	-6,200
I-57 south of Illiana Corridor	6,210	990	-7,200
I-65 north of Illiana Corridor	2,050	550	2,600
I-65 south of Illiana Corridor	-430	630	200

Source – PB Travel Demand Modeling, No Build and B3 Alternatives

2.5.2 Determination of Approach, Models and Data

2.5.2.1 Approach

In consultation with the interagency working group, those locations of the project with the highest expected air quality concentrations were analyzed. Based on the data in Table 2-6 and in consultation with the interagency group, the following sites were analyzed:

- **I-55 to IL-53** – has the highest overall AADT and sensitive receptors nearby such as Midewin Tallgrass Prairie – 8th highest truck volumes, but 1st highest total traffic. Includes the I-55 interchange.
- **US 45 to I-57** – (including west of US 45) highest truck volumes, nearby residential, new interchange and farm nearby – will also encompass 3rd highest truck volume site (I-57 to IL-50).
- **IL-1 to US 41** – 4th highest truck volumes, crosses both states, new interchange, has nearby sensitive receptors.
- **SR 55 to I-65** – nearby sensitive receptors, 6th highest truck volumes, 6th highest total traffic, Indiana location. In addition the AADT on I-65 is the highest within the

Study Area. As such, this location is expected to have the highest air quality concentrations within the Study Area.

SR 55 to I-65 (Site 4) is the focus of the $PM_{2.5}$ hot-spot analysis and will be analyzed in greater detail to ensure that the project does not cause or exacerbate a violation of the applicable NAAQS. Information on other sites is provided for informational purposes.

2.5.2.2 Years

The analysis was performed for both the opening (2018) and design (2040) years of the project, for the predicted traffic conditions at each location identified above. Since the project is located in an area designated as nonattainment for the annual 1997 $PM_{2.5}$ NAAQS, but attainment for the 24-hour $PM_{2.5}$ NAAQS and 24-hour PM_{10} NAAQS, the quantitative PM hot-spot analysis was limited to comparing the project's impact to the 1997 annual $PM_{2.5}$ standard (15 $\mu g/m^3$).

2.5.2.3 PM Emissions

As agreed upon during the June 20, 2013 Tier Two Consultation Meeting, the PM hot-spot analysis included directly emitted $PM_{2.5}$ emissions. $PM_{2.5}$ precursors were 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 were included in the project's $PM_{2.5}$ analysis. For this analysis, both running and crankcase running exhaust were considered because start exhaust is unlikely to occur on the roadways included in the model domain. Re-entrained road dust was not included because the SIPs do not identify that such emissions are a substantial contributor to the $PM_{2.5}$ air quality in the nonattainment area. Emissions from construction-related activities were not 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).

2.5.2.4 Model

The analysis was performed using the current version of USEPA's MOVES emissions model (MOVES2010b) and the latest version of Trinity's BREEZE roads model which incorporates USEPA's CAL3QHCR.

2.5.2.5 Data

MOVES input files were obtained from CMAP and NIRPC. Project-specific traffic data, including link specific hourly volume, average vehicle speeds, and facility type, were obtained from the traffic network developed for the traffic analysis presented in this Tier Two FEIS, for each roadway section in the project area. Hourly vehicle volumes were obtained for A.M. peak, midday, P.M. peak, and off-peak traffic conditions. Detailed information regarding each analysis link can be found in Appendix B.

In consultation with USEPA, meteorological data for the years 2006-2010 measured at the Greater Kankakee Airport was obtained in the format required for use in CAL3QHCR. This meteorological data is representative of the terrain, climate, and topography of the Study Area.

2.5.3 Estimation of On-Road Vehicle Emissions

On-road vehicle emissions were estimated using MOVES2010b. MOVES input files were provided by each of the MPOs. MOVES input relies on link-specific data. The PM emissions vary by time of day and time of year. Volume and speed data for each link were obtained from the traffic analysts for A.M. peak, P.M. peak, midday, and off-peak traffic conditions. MOVES was run 16 times (A.M. peak, P.M. peak, midday, and off-peak) using quarterly climate conditions, as developed by the MPO staff. For every link, a set of 4 emission factors in units of grams per mile were developed for use. Traffic projection time periods and time period groupings that were used in the analysis are shown in Table 2-8.

Table 2-8. Traffic Analysis Time Periods

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

Source – Parsons Brinckerhoff Travel Demand Modeling

Emission factors were developed for Will County, Illinois and Lake County, Indiana. All possible combinations of gasoline and diesel fueled vehicles on rural roadways were selected since all vehicle types are present in the project area. Link specific emission factors were obtained using link specific vehicle mix information developed from the project specific traffic model. The Illiana Corridor and major crossroads such as I-55, I-57, and I-65 were classified as rural restricted roadways. Other smaller local roadways were classified as rural unrestricted roadways. Further information regarding MOVES input and output values can be found in Appendix B.

2.5.4 Estimation of Emissions from Road Dust, Construction and Additional Sources

As mentioned earlier, road dust emissions were not included in the analysis. Construction emissions were not included because construction is not expected to occur at any individual location for more than five years. No additional sources of $PM_{2.5}$ emissions were included. It is assumed that $PM_{2.5}$ concentrations due to any other nearby emissions sources were 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.

2.5.5 Selection of Air Quality Model, Data Inputs and Receptors

2.5.5.1 Model

The USEPA's CAL3QHCR air dispersion model was 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 alternative, the model setup included a series of links, or roadway sections, in the vicinity of the freeflow section or interchange modeled.

2.5.5.2 Data Inputs

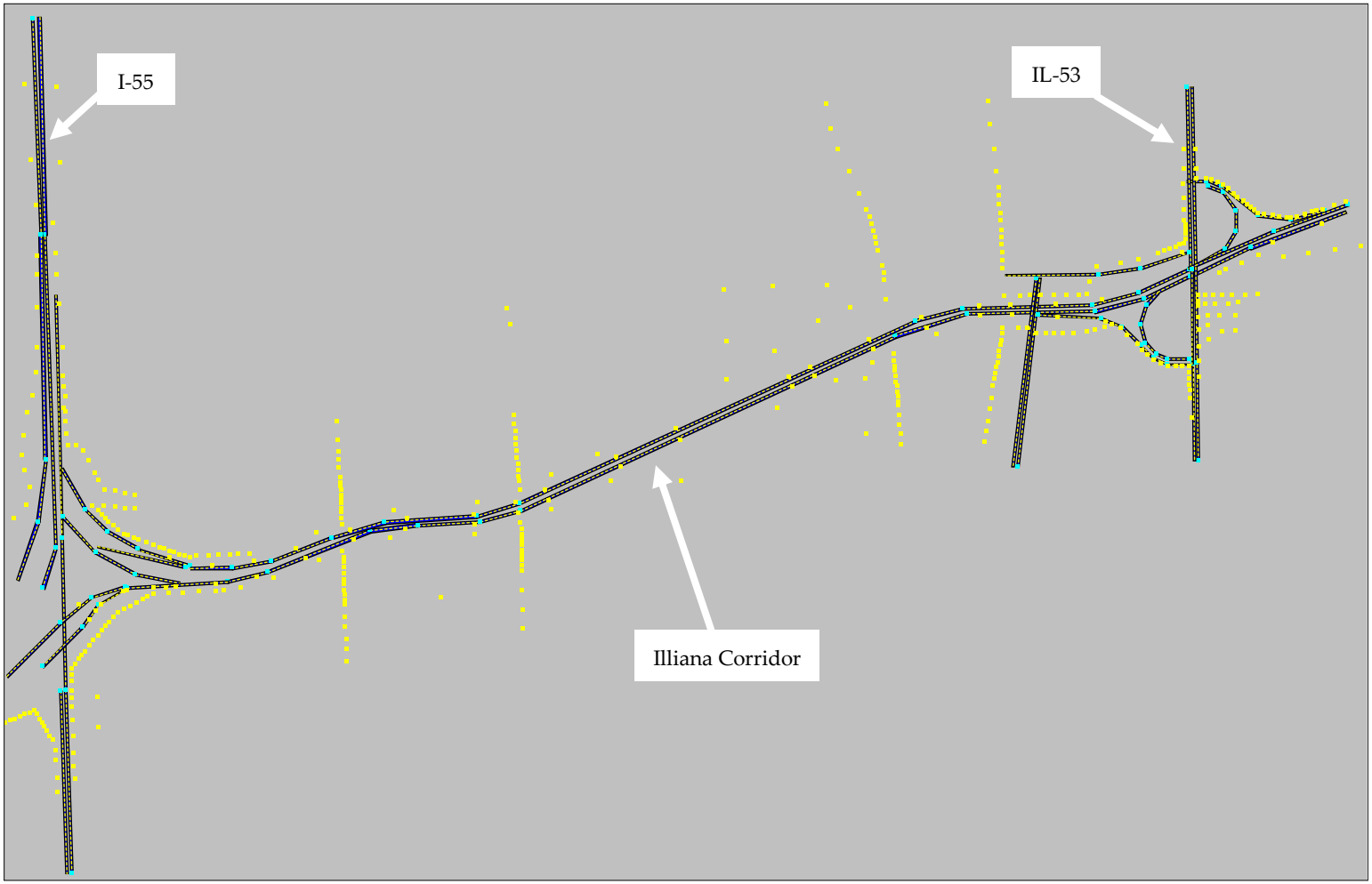
Link-specific inputs included length, mixing zone width, hourly volume, and emission factor. A conservative link height of zero feet was assumed for all links, as confirmed at the Tier Two Consultation Meeting on June 20, 2013.

Meteorological input files were processed using surface data and upper air data as detailed earlier. As recommended in USEPA'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 were used for the dispersion modeling analysis. For this area, the 2006-2010 meteorological surface data from the Greater Kankakee Airport and upper air data from Lincoln, Illinois was used. CAL3QHCR was run separately for each of the five years of meteorological data. CAL3QHCR can only be run for one season at a time, therefore a total of 20 model runs were executed for each scenario. A surface roughness of 74 cm (corn fields) and an averaging time of 60 minutes were used in the model.

2.5.5.3 Receptors

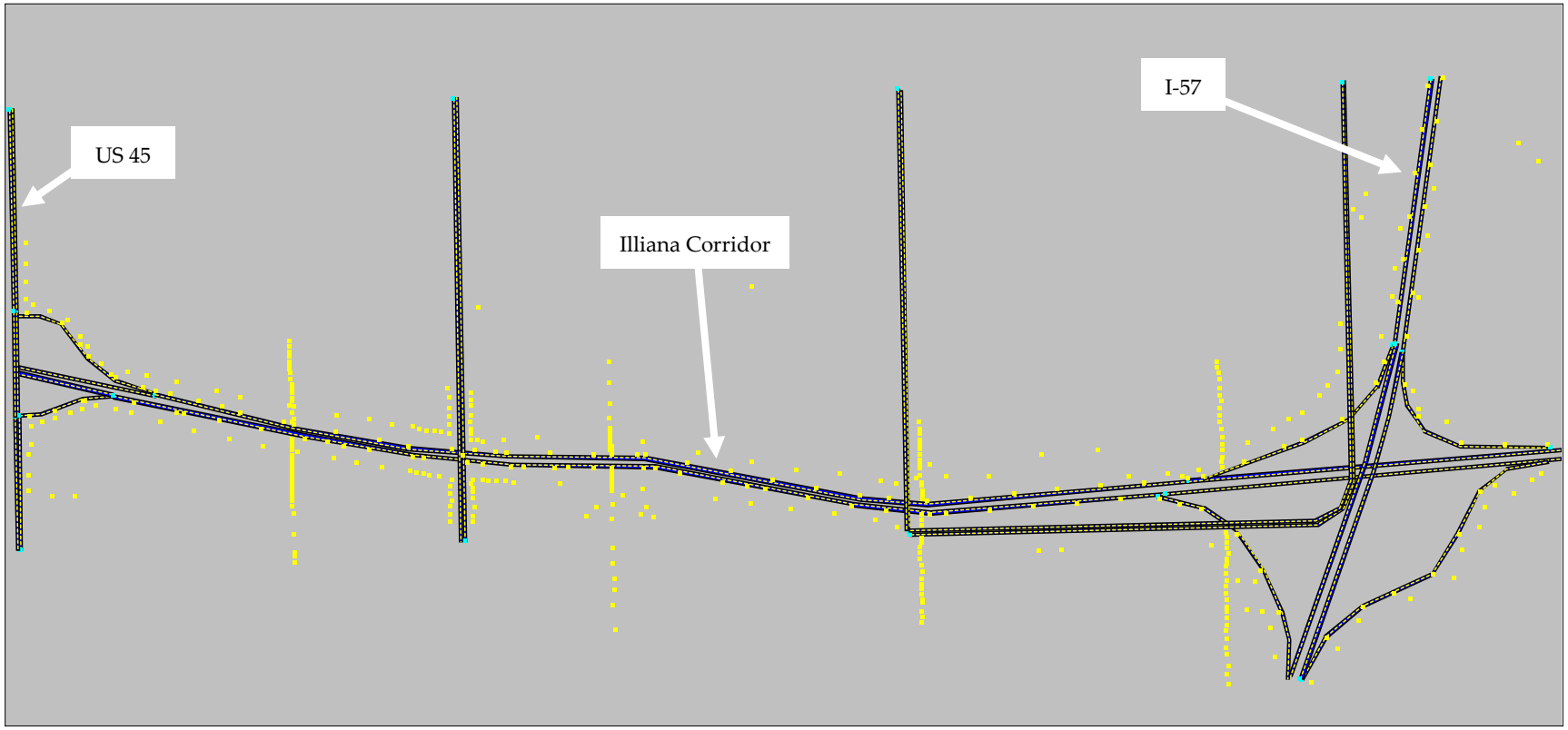
Receptors were placed in order to estimate the highest concentrations of $PM_{2.5}$ to determine any possible violations of the NAAQS. Highest concentrations are expected to occur at the intersections/interchanges with the highest-volume roadways. Receptors were placed along the right of way and five meters away from any project features, as well as at sensitive receptors and on stringlines back from the project corridor. These receptor locations are expected to capture the highest concentrations from the project (at the edge of roadway and right of way), concentrations at sensitive receptors in the project area (homes, farms, etc.), as well as demonstrate the pollutant concentrations at varying distances from the project corridor with the stringlines. Identical receptor locations were used for No-Action and build alternatives in order to directly compare project effects. Receptors that fall within five meters of any project feature or other locations where the public would normally be present for a limited timed were removed, according to the PM guidance. Receptors and roadway links included at each analysis sites are shown in Figure 2-4, Figure 2-5, Figure 2-6, and Figure 2-7.

Figure 2-4. $PM_{2.5}$ Analysis Site 1 – I-55 to IL-53



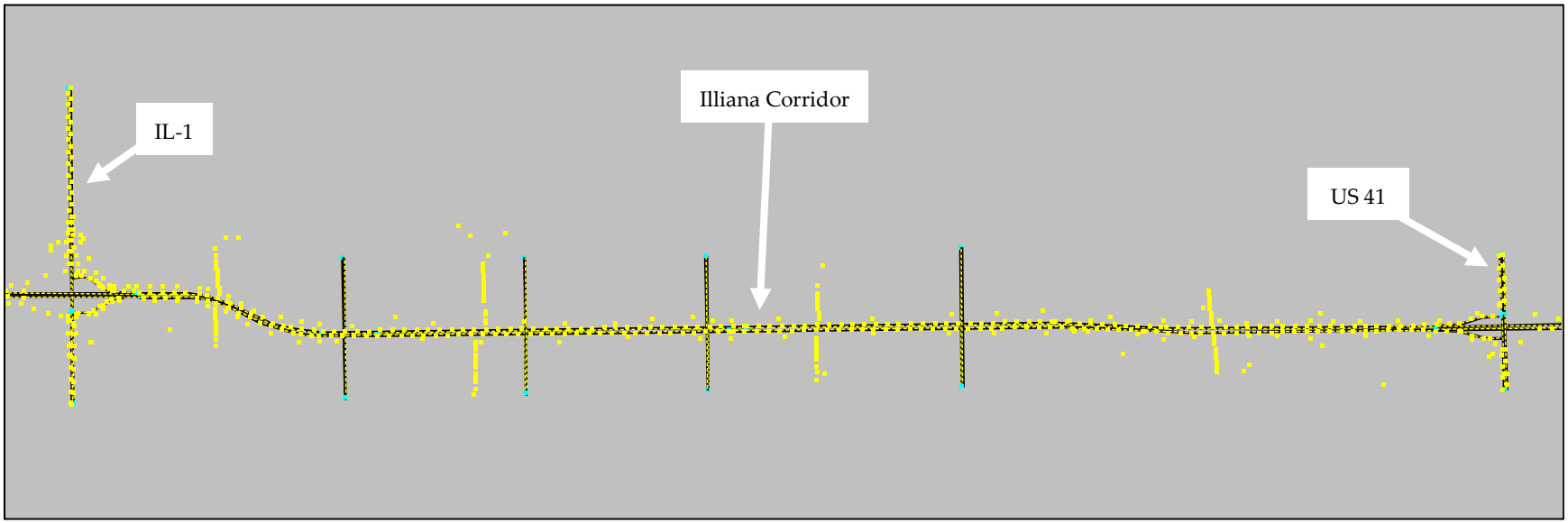
Note: yellow dots = receptors; blue lines = roadway links; blue dots = link endpoints

Figure 2-5. $PM_{2.5}$ Analysis Site 2 – US 45 to I-57



Note: yellow dots = receptors; blue lines = roadway links; blue dots = link endpoints

Figure 2-6. $PM_{2.5}$ Analysis Site 3 – IL-1 to US 41



Note: yellow dots = receptors; blue lines = roadway links; blue dots = link endpoints

Figure 2-7. $PM_{2.5}$ Analysis Site 4 – SR 55 to I-65

Note: yellow dots = receptors; blue lines = roadway links; blue dots = link endpoints

For the site with the highest AADT (Site 4), a detailed analysis was done with grid receptors placed in the geometry in addition to the receptors described above. Grid receptors were placed 50, 100, 200, 300, 400, and 500 meters from the centerline of the roadway with 100 meter horizontal spacing, as shown in Figure 2-8

A receptor height of 1.8 meters was used to reflect breathing height for ground-level receptors.

2.5.6 Determination of Background Concentrations from Nearby and Other Sources

As recommended in the Tier Two Consultation Meeting, monitored data from the Braidwood monitoring site was used as background concentrations. This monitor was used due to its proximity to the project area, its location in a similar rural setting as the project area, as well as its classification as a "regional scale" monitor (Figure 2-9). Other monitors, such as the East Chicago monitor in Indiana, were discussed as possible background monitors; however, these monitors did not reflect the nature of the Study Area as accurately as the Braidwood monitor. The Braidwood monitor location was approved by the Tier Two Consultation Meeting on June 20, 2013, and reconfirmed as the appropriate monitor for use in this study on the October 24, 2013. Using USEPA's design value database, (http://www.epa.gov/airtrends/values.html), the 2010-2012 design value is 9.9 $\mu g/m^3$ at this location.

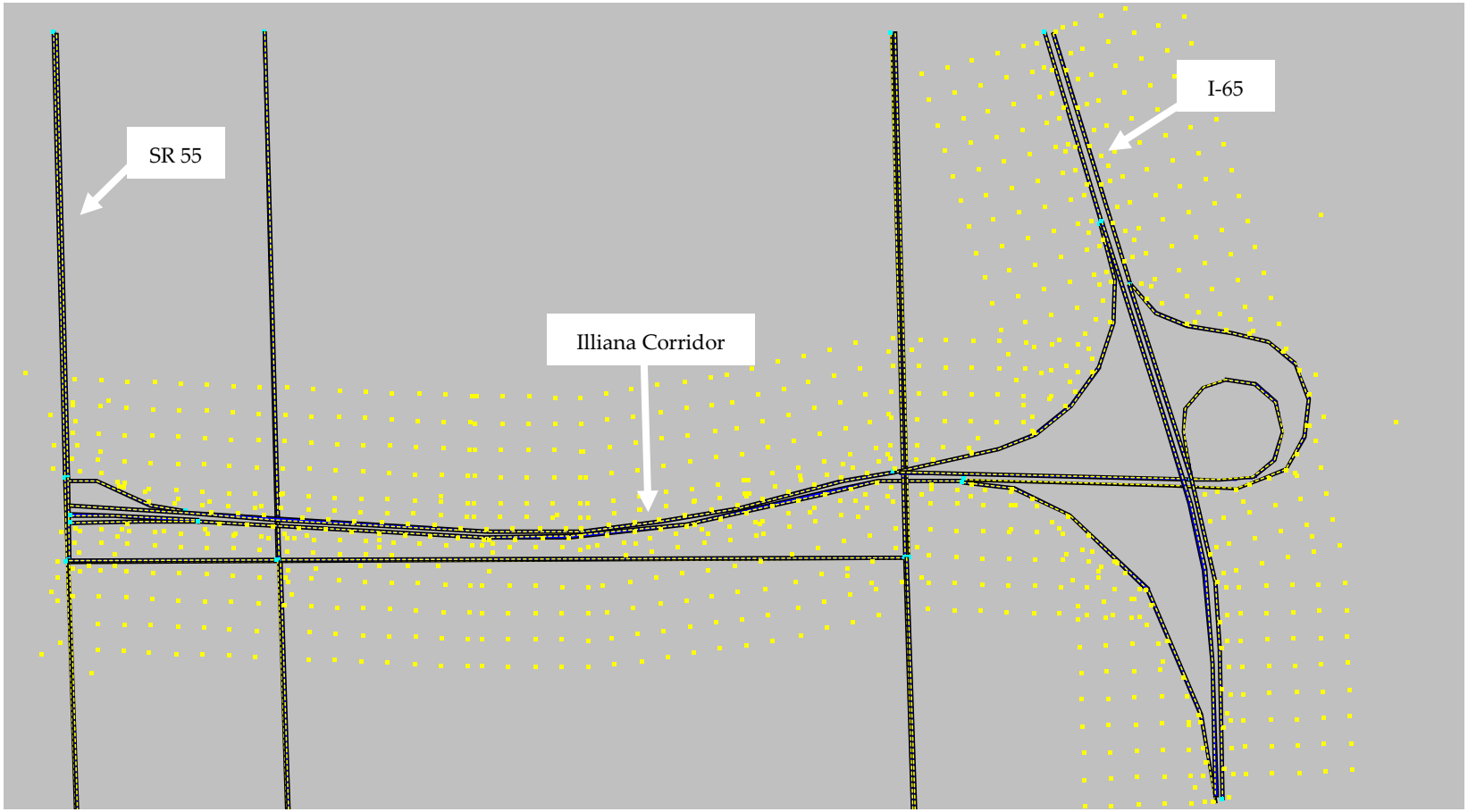
The background value(s) were added to the CAL3QHCR modeled design values for comparison to the NAAQS. The background values are likely conservative, because it is expected that ambient $PM_{2.5}$ concentrations will be lower in future years as a result of SIPs and the general trend in declining vehicle emissions due to technological advances. It is assumed that emissions from other nearby sources are already included in the ambient monitoring data.

2.5.7 Calculation of Design Values and Conformity Determination

The model results were added to the background concentration(s) 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 provided the maximum quarterly average $PM_{2.5}$ concentration at each receptor. For the receptor with the maximum modeled concentration, the following steps were used to determine the design value, as outlined in the guidance:

i. For each year of meteorological data, the average concentration in each quarter was determined.
ii. Within each year of meteorological data, the average concentrations of all four quarters were added and divided by four to calculate the average annual modeled concentration for each year of meteorological data.

Figure 2-8. $PM_{2.5}$ Analysis Site 4 – SR 55 to I-65 with Grid Receptor System



Note: yellow dots = receptors; blue lines = roadway links; blue dots = link endpoints

Figure 2-9. $PM_{2.5}$ Air Monitoring Locations

Source: US EPA

iii. The modeled average annual concentrations from each year of meteorological data were summed and divided by five, which is the number of years of meteorological data used.

iv. The average annual background concentration was added to the average annual modeled concentration to determine the total average annual concentration.

The maximum design values at each of the project sections are shown in Table 2-9. As shown in the table, all values are below the 1997 standard of 15 ug/m^3. The highest value, 10.8 ug/m^3, is predicted to occur at site 4 (Illiana Corridor and I-65) in 2018. As the design values for the Build alternative are less than or equal to the 1997 PM NAAQS at appropriate receptors, the project meets the $PM_{2.5}$ hot-spot conformity requirements. CAL3QHCR input and output files for the hot-spot analysis along with maps showing the highest receptor locations can be found in Appendix C.

Table 2-9. Annual $PM_{2.5}$ Concentrations (μg/m^3)

Site Number	Site Description	2018 Opening Year	2040 No Build Alternative	2040 Build Alternative[1]
1	Illiana Corridor between I-55 and IL-53, including I-55 and IL-53 interchanges	10.5	10.1	10.2
2	Illiana Corridor between US 45 and I-57, including US 45 and I-57 interchanges	10.5	10.1	10.1
3	Illiana Corridor between IL-1 and US 41, including IL-1 and US 41 interchanges	10.4	10.0	10.1
4[2]	Illiana Corridor between SR 55 and I-65, including SR 55 and I-65 interchanges	10.8	10.2	10.2

[1] The Build Alternative represents the worst-case traffic alternative for that section
Annual $PM_{2.5}$ Concentrations include a background design value of 9.9 μg/m^3.
[2] Focus of the $PM_{2.5}$ hot-spot analysis

2.5.8 Changes Not Significantly Impacting Concentrations

The $PM_{2.5}$ hot-spot analysis includes the major design features that would significantly impact $PM_{2.5}$concentrations. In two locations, the IL-53 interchange design options and at I-65, the $PM_{2.5}$ hot-spot analysis differs from the Preferred Alternative. A sensitivity analysis was completed to confirm that major design features that significantly impact concentrations had been included. It is described below for each of these locations, and demonstrates that the changes would not significantly impact concentrations.

IL-53 Area Interchange Design Options

The $PM_{2.5}$ hot-spot analysis used traffic conditions that assumed an Illiana Corridor interchange at IL-53, because it would have the highest traffic volumes compared to the other design options near IL-53. The Preferred Alternative does not include an interchange at IL-53, but includes an interchange just west of Riley Road (Riley Road is located one-mile east of IL-53). As part of the sensitivity analysis, the expected 2040

intersection level of service (LOS), delay, and intersection volumes were analyzed for both the Riley Road and IL-53 interchanges with the Illiana Corridor. As seen in Table 2-10 below, the traffic volumes and delay are higher for the interchange at IL-53 design option than the interchange at Riley Road design option. The projected 2040 truck percentages for the Riley Road interchange ramps and the IL-53 ramps are similar. The table and lack of change in truck percentages demonstrates that the footprint modification change from an interchange at IL-53 to an interchange at Riley Road would not be expected to significantly impact concentrations.

Table 2-10. 2040 Build Traffic Conditions: Interchanges at IL-53 and Riley Road

Interchange Location	2040 Build					
	AM			PM		
	LOS	Delay	Volume	LOS	Delay	Volume
Riley @ Illiana EB Ramps (Preferred)	B	11.0	917	A	8.0	702
Riley @ Illiana WB Ramps (Preferred)	A	6.0	1,017	B	6.4	885
IL-53 @ Illiana EB Ramps (Worst Case)	B	17.2	2,964	B	13.7	3,005
IL-53 @ Illiana WB Ramps (Worst Case)	B	13.6	2,682	A	9.6	2,613

I-65 Interchange

The $PM_{2.5}$ hot-spot analysis used traffic conditions that assumed an Illiana Corridor interchange at I-65. For the $PM_{2.5}$ hot-spot analysis, I-65 was assumed to be a four-lane facility at the Illiana Corridor interchange location, between US 231 and SR 2. As part of a separate project from the Illiana Corridor, with independent utility and its own separate environmental review process under NEPA, INDOT committed to widening I-65 from SR 2 to US 231 from four-lanes to six-lanes. This widening of I-65 from US 231 to SR 2 was amended into the fiscally constrained long range transportation plan of NIRPC at their April 17, 2014 meeting. As seen below, the difference in projected 2040 daily traffic on the Illiana Corridor and I-65 is minor.

- For the Illiana Corridor (just west of the I-65 interchange) there is a projected difference in 2040 daily traffic of approximately 150 vehicles per day (vpd) out of a total of 18,500 vpd.
- For I-65 (just north of the Illiana Corridor interchange) there is a projected difference in 2040 daily traffic of approximately 1,200 vpd out of a total of 61,000 vpd.
- For I-65 (just south of the Illiana Corridor interchange) there is a projected difference in 2040 daily traffic of approximately 1,100 vpd out of a total of 59,000 vpd.

- Projected 2040 truck percentages for I-65 and Illiana Corridor traffic remain the same.

The projected 2040 daily traffic is less than two percent difference on I-65 and less than one percent on the Illiana Corridor when comparing a four-lane I-65 versus a six-lane I-65. The change in I-65 from 4-6 lanes is not a design feature of the Illiana project; and traffic changes were evaluated and found to be minimal. Furthermore, a separate consultation among FHWA, USEPA, and Indiana Department of Environmental Management was held for the I-65 project and it was determined that the I-65 project was not a project of air quality concern per EPA regulation. This demonstrates that the change at the I-65 interchange is not expected to significantly impact concentrations. Therefore, the PM2.5 hot-spot analysis considered the entire project and includes the major design features that are expected to significantly impact concentrations.

2.5.9 2012 $PM_{2.5}$ NAAQS

While the project meets $PM_{2.5}$ conformity requirements, as outlined above, it is additionally noted that the design value concentrations are below the 2012 $PM_{2.5}$ NAAQS of 12 $\mu g/m^3$. USEPA has yet to designate areas that do not meet the 2012 $PM_{2.5}$ NAAQS; therefore, conformity does not apply to this standard.

2.6 Climate Change Analysis

2.6.1 Introduction

Climate change is an important national and global concern. The earth has gone through many natural changes in climate in its history. There is general agreement that the earth's climate is currently changing at an accelerated rate and will continue to do so for the foreseeable future. Anthropogenic (human-caused) greenhouse gas (GHG) emissions have been documented as contributing to this rapid change. CO_2 makes up the largest anthropogenic component of these GHG emissions. Other prominent transportation GHGs include methane (CH_4) and nitrous oxide (N_2O).

Many GHGs occur naturally. Water vapor is the most abundant GHG and makes up approximately two thirds of the natural greenhouse effect. However, the burning of fossil fuels and other human activities are adding to the concentration of GHGs in the atmosphere. Many GHGs remain in the atmosphere for time periods ranging from decades to centuries. GHGs trap heat in the earth's atmosphere. Because atmospheric concentration of GHGs continues to climb, our planet will continue to experience climate-related phenomena. For example, warmer global temperatures can cause changes in precipitation and sea levels.

To date, no national standards have been established regarding GHGs, nor has the USEPA established criteria or thresholds for ambient GHG emissions pursuant to its authority to establish motor vehicle emission standards for CO_2 under the CAA. However, there is a considerable body of scientific literature addressing the sources of GHG emissions and their adverse effects on climate, including reports from the Intergovernmental Panel on Climate Change, the US National Academy of Sciences, and USEPA and other federal agencies.

GHGs are different from other air pollutants evaluated in federal environmental reviews because their impacts are not localized or regional due to their rapid dispersion into the global atmosphere, which is characteristic of these gases. The affected environment for CO_2 and other GHG emissions is the entire planet. From a quantitative perspective, global climate change is the cumulative result of numerous and varied emissions sources (in terms of both absolute numbers and types), each of which makes a relatively small addition to global atmospheric GHG concentrations. In contrast to broad scale actions such as actions involving an entire industry sector or very large geographic areas, it is difficult to isolate and understand the GHG emissions impacts for a particular transportation project. Furthermore, presently there is no scientific methodology for attributing specific climatological changes to a particular transportation project's emissions.

Under NEPA, detailed environmental analysis should be focused on issues that are significant and meaningful to decision-making.[7] FHWA has concluded, based on the nature of GHG emissions and the exceedingly small potential GHG impacts of the proposed action, as discussed below and shown in Table 2-11, that the GHG emissions from the proposed action will not result in "reasonably foreseeable significant adverse impacts on the human environment" (40 CFR 1502.22(b)). The GHG emissions from the project build alternatives will be insignificant, and will not play a meaningful role in a determination of the environmentally preferable alternative or the selection of the preferred alternative. More detailed information on GHG emissions "is not essential to a reasoned choice among reasonable alternatives" (40 CFR 1502.22(a)) or to making a decision in the best overall public interest based on a balanced consideration of transportation, economic, social, and environmental needs and impacts (23 CFR 771.105(b)). For these reasons, no alternatives-level GHG analysis has been performed for this project.

[7] See 40 CFR 1500.1(b), 1500.2(b), 1500.4(g), and 1501.7

Table 2-11. Statewide and Project Emissions Potential, Relative to Global Totals

	Global CO_2Emissions (MMT[8])	Illinois and Indiana Motor Vehicle CO_2 Emissions (MMT[9])	Illinois and Indiana Motor Vehicle Emissions (Percentage of Global Total)	Percent Change in Statewide VMT Due to Project (Alternatives 1, 2 and 3)
Current Conditions (2010)	29,670	102.7	0.346%	(None)
Future Projection (2040)	45,500	118.0	0.259%	0.041%

MMT = million metric tons. Global emissions estimates are from International Energy Outlook 2010, data for Figure 104, projected to 2040. Illinois and Indiana emissions and statewide VMT estimates are from MOVES2010b.

The context in which the emissions from the proposed project will occur, together with the expected GHG emissions contribution from the project, illustrate why the project's GHG emissions will not be significant and will not be a substantial factor in the decision-making. The transportation sector is the second largest source of total GHG emissions in the US, behind electricity generation. The transportation sector was responsible for approximately 27 percent of all anthropogenic (human caused) GHG emissions in the US in 2010.[10] The majority of transportation GHG emissions are the result of fossil fuel combustion. CO_2 makes up the largest component of these GHG emissions. US CO_2 emissions from the consumption of energy accounted for about 18 percent of worldwide energy consumption CO_2 emissions in 2010.[11] US transportation CO_2 emissions accounted for about 6 percent of worldwide CO_2 emissions.[12]

While the contribution of GHGs from transportation in the US as a whole is a large component of US GHG emissions, as the scale of analysis is reduced the GHG contributions become quite small. Using CO_2 because of its predominant role in GHG emissions, Table 2-11 presents the relationship between current and projected Illinois

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[8] These estimates are from the EIA's *International Energy Outlook 2010*, and are considered the best-available projections of emissions from fossil fuel combustion. These totals do not include other sources of emissions, such as cement production, deforestation, or natural sources; however, reliable future projections for these emissions sources are not available.
[9] MOVES projections suggest that Illinois and Indiana motor vehicle CO_2 emissions may increase by 15 percent between 2010 and 2040; more stringent fuel economy/GHG emissions standards will not be sufficient to offset projected growth in VMT.
[10] Calculated from data in USEPA, Inventory of Greenhouse Gas Emissions and Sinks, 1990-2010. http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html
[11] Calculated from data in US Energy Information Administration International Energy Statistics, Total Carbon Dioxide Emissions from the Consumption of Energy, http://www.eia.gov/cfapps/ipdbproject/IEDIndex3.cfm?tid=90&pid=44&aid=8, accessed 2/25/13.
[12] Calculated from data in EIA figure 104: http://www.eia.gov/forecasts/archive/ieo10/emissions.html and USEPA table ES-3: : http://www.epa.gov/climatechange/ghgemissions/usinventoryreport.html

and Indiana highway CO_2 emissions and total global CO_2 emissions, as well as information on the scale of the project relative to statewide travel activity.

Based on emissions estimates from USEPA's Motor Vehicle Emissions Simulator (MOVES) model[13], and global CO_2 estimates and projections from the Energy Information Administration, CO_2 emissions from motor vehicles in the entire states of Illinois and Indiana contributed less than one half of one percent of global emissions in 2010 (0.346 percent). These emissions are projected to contribute an even smaller fraction (0.259 percent) in 2040.[14] VMT in the Study Area under 2040 No Build conditions represents approximately two percent of total Illinois and Indiana travel activity; and the project itself would increase statewide VMT by approximately 0.041 percent. (Note that the project Study Area includes travel on many other roadways in addition to the proposed project.) As a result, based on the build alternatives, FHWA estimates that the proposed project could result in a potential increase in global CO_2 emissions in 2040 of 0.0001 percent (less than one thousandth of one percent). This very small change in global emissions is well within the range of uncertainty associated with future emissions estimates.[15, 16]

2.6.2 Mitigation for Global GHG Emissions

To help address the global issue of climate change, USDOT is committed to reducing GHG emissions from vehicles traveling on our nation's highways. USDOT and USEPA are working together to reduce these emissions by substantially improving vehicle

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[13] http://www.epa.gov/otaq/models/moves/index.htm. USEPA's MOVES model can be used to estimate vehicle exhaust emissions of CO_2 and other GHGs. CO_2 is frequently used as an indicator of overall transportation GHG emissions because the quantity of these emissions is much larger than that of all other transportation GHGs combined, and because CO_2 accounts for 90-95 percent of the overall climate impact from transportation sources. MOVES include estimates of both emissions rates and VMT, and these were used to estimate the Illinois and Indiana statewide highway emissions in Table 2-11.

[14] Illinois and Indiana emissions represent a smaller share of global emissions in 2040 because global emissions increase at a faster rate.

[15] For example, Figure 114 of the Energy Information Administration's *International Energy Outlook 2010* shows that future emissions projections can vary by almost 20%, depending on which scenario for future economic growth proves to be most accurate.

[16]When an agency is evaluating reasonably foreseeable significant adverse effects on the human environment in an environmental impact statement and there is incomplete or unavailable information, the agency is required make clear that such information is lacking (40 CFR 1502.22). The methodologies for forecasting GHG emissions from transportation projects continue to evolve and the data provided should be considered in light of the constraints affecting the currently available methodologies. As previously stated, tools such as USEPA's MOVES model can be used to estimate vehicle exhaust emissions of CO_2 and other GHGs. However, only rudimentary information is available regarding the GHG emissions impacts of highway construction and maintenance. Estimation of GHG emissions from vehicle exhaust is subject to the same types of uncertainty affecting other types of air quality analysis, including imprecise information about current and future estimates of vehicle miles traveled, vehicle travel speeds, and the effectiveness of vehicle emissions control technology. Finally, there presently is no scientific methodology that can identify causal connections between individual source emissions and specific climate impacts at a particular location.

efficiency and shifting toward lower carbon intensive fuels. The agencies have jointly established new, more stringent fuel economy and first ever GHG emissions standards for model year 2012-2025 cars and light trucks, with an ultimate fuel economy standard of 54.5 miles per gallon for cars and light trucks by model year 2025. Further, on September 15, 2011, the agencies jointly published the first ever fuel economy and GHG emissions standards for heavy-duty trucks and buses.[17] Increasing use of technological innovations that can improve fuel economy, such as gasoline- and diesel-electric hybrid vehicles, will improve air quality and reduce CO_2 emissions for future years.

Consistent with its view that broad-scale efforts hold the greatest promise for meaningfully addressing the global climate change problem, FHWA is engaged in developing strategies to reduce transportation's contribution to GHGs—particularly CO_2 emissions—and to assess the risks to transportation systems and services from climate change. In an effort to assist States and MPOs in performing GHG analyses, FHWA has developed a *Handbook for Estimating Transportation GHG Emissions for Integration into the Planning Process* (March 2013)[18]. The Handbook presents methodologies reflecting good practices for the evaluation of GHG emissions at the transportation program level, and will demonstrate how such evaluation may be integrated into the transportation planning process. FHWA has also developed a tool for use at the statewide level to model a large number of GHG reduction scenarios and alternatives for use in transportation planning, climate action plans, scenario planning exercises, and in meeting state GHG reduction targets and goals[19]. To assist states and MPOs in assessing climate change vulnerabilities to their transportation networks, FHWA has developed the FHWA Climate Change and Extreme Weather Vulnerability Assessment Framework[20].

At the state level, project planning activities are key to reducing GHGs from highway projects, and mitigation of GHGs. To this end, Illinois and Indiana have identified measures to mitigate emissions from transportation, including:

- The launch of the Energy Biosciences Institute based at the University of Illinois Urbana/Champaign and the University of California, Berkeley. The $500 million effort funded by BP will invest in research on next-generation homegrown biofuels made from crops that will cut GHG emissions, boost America's energy independence and create new markets for Illinois farmers.

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[17] For more information on fuel economy proposals and standards, see the National Highway Traffic Safety Administration's Corporate Average Fuel Economy website: http://www.nhtsa.gov/fuel-economy/.
[18] Available at http://www.fhwa.dot.gov/environment/climate_change/mitigation/resources_and_publications/ghg_handbook/chapter00.cfm
[19] For more information refer to FHWA's Climate Change Mitigation website: http://www.fhwa.dot.gov/environment/climate_change/mitigation/
[20] Available at http://www.fhwa.dot.gov/environment/climate_change/adaptation/resources_and_publications/vulnerability_assessment_framework/index.cfm

- The State of Illinois has taken numerous steps to reduce GHG emissions from its vehicle fleet, including reducing the overall number of state vehicles by 11 percent, from 13,635 in 2003 to 12,100 in 2007; increasing the number of flex fuel vehicles in the state fleet from 1,339 in 2000 (10 percent of fleet), to 1,944 now (16 percent of fleet); and increasing the use of renewable and cleaner burning ethanol and biodiesel in the state fleet. More than 1 million gallons of biofuels have been consumed by state vehicles since April 2004.
- The Governor of Illinois has approved incentives and programs that helped make Illinois the number one consumer of biodiesel in the nation and the state with the second largest number of retail gasoline stations that offer 85 percent ethanol fuel (E85). Biodiesel and E85 reduce CO2 emissions compared to diesel and gasoline.
- In 2006, the Governor of Illinois signed legislation to limit idling by diesel vehicles in the state's air quality nonattainment areas (metropolitan Chicago and E. St. Louis). This reduces fuel consumption and greenhouse gas emissions.
- The Governor of Illinois introduced open road tolling on the Illinois Toll Highway System, which reduces congestion, idling, fuel use and greenhouse gas emissions.
- CMAP had an Action Strategy Paper entitled "Climate Change and Energy"(October, 2008)[21] prepared for them by the Volpe Center with the intent that the strategies suggested would aid CMAP as it incorporates polices, investments, and other actions within scenarios to accomplish climate change and energy goals.
- Midwest Clean Diesel Initiative (MCDI) is a collaboration of federal, state and local agencies, along with communities, nonprofit organizations and private companies working together to reduce emissions from diesel engines in the Midwest. The USEPA estimates there are approximately 3.3 million diesel-powered engines in the Midwest that can be affected through voluntary action. MCDI reduced emissions through supporting operational changes, technological improvements and use of cleaner fuels in diesel engines across all fleets. The initiative also supports USEPA Region 5 state clean diesel coalitions such as Diesel Wise Indiana and the Indiana Clean Diesel Coalition. As of December 2010, MCDI has impacted more than 1 million engines, including construction equipment, locomotives, municipal vehicles, school buses, transit buses, heavy-duty trucks, cargo-handling equipment, marine vessels and more.

Illinois and Indiana have also initiated activities to prepare infrastructure in the state for current and future impacts of climate change.

Even though project-level mitigation measures will not have a substantial impact on global GHG emissions because of the exceedingly small relative amount of GHG emissions involved, the following measures that will be implemented during construction, in addition to the MCDI, will have the effect of reducing GHG emissions:

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[21] Available at http://www.cmap.illinois.gov/documents/20583/a8abf2c4-aaaf-49ae-93ec-4b803a30debc

- Adhere to construction practices that encourage efficient energy use, such as limiting idling equipment and designating staging areas near work sites;
- Encourage carpooling for workers to the project site;
- Purchase construction materials from local suppliers to minimize long-distance hauling;
- Promote regular vehicle and equipment maintenance to improve efficiency;
- Optimize construction schedules and methods; and
- Increase the use of fuel efficient vehicles in the construction fleet.

These activities are part of a program-wide effort by FHWA to adopt practical means to avoid and minimize environmental impacts in accordance with 40 CFR 1505.2(c).

2.6.3 Summary

This document does not incorporate an analysis of the GHG emissions or climate change effects of each of the alternatives because the potential change in GHG emissions is very small in the context of the affected environment. Because of the insignificance of the GHG impacts, they will not be meaningful to a decision on the environmentally preferable alternative or to a choice among alternatives. As outlined above, FHWA is working to develop strategies to reduce transportation's contribution to GHGs—particularly CO_2 emissions—and to assess the risks to transportation systems and services from climate change. FHWA will continue to pursue these efforts as productive steps to address this important issue. Finally, the construction best practices described above represent practicable project-level measures that, while not substantially reducing global GHG emissions, may help reduce GHG emissions on an incremental basis and could contribute in the long term to meaningful cumulative reduction when considered across the Federal-aid highway program.

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Appendix A

COSIM Pre-screen Modeling Results (Available electronically upon request)

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Appendix B

MOVES Input Run Specifications and Output (Available electronically upon request)

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Appendix C

CAL3QHC Input and Output Files (Available electronically upon request)

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