NORTH I-25 EIS

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# Air Quality Technical Report

**October 2008**

**Prepared for:**

Federal Highway Administration
Federal Transit Administration
Colorado Department of Transportation

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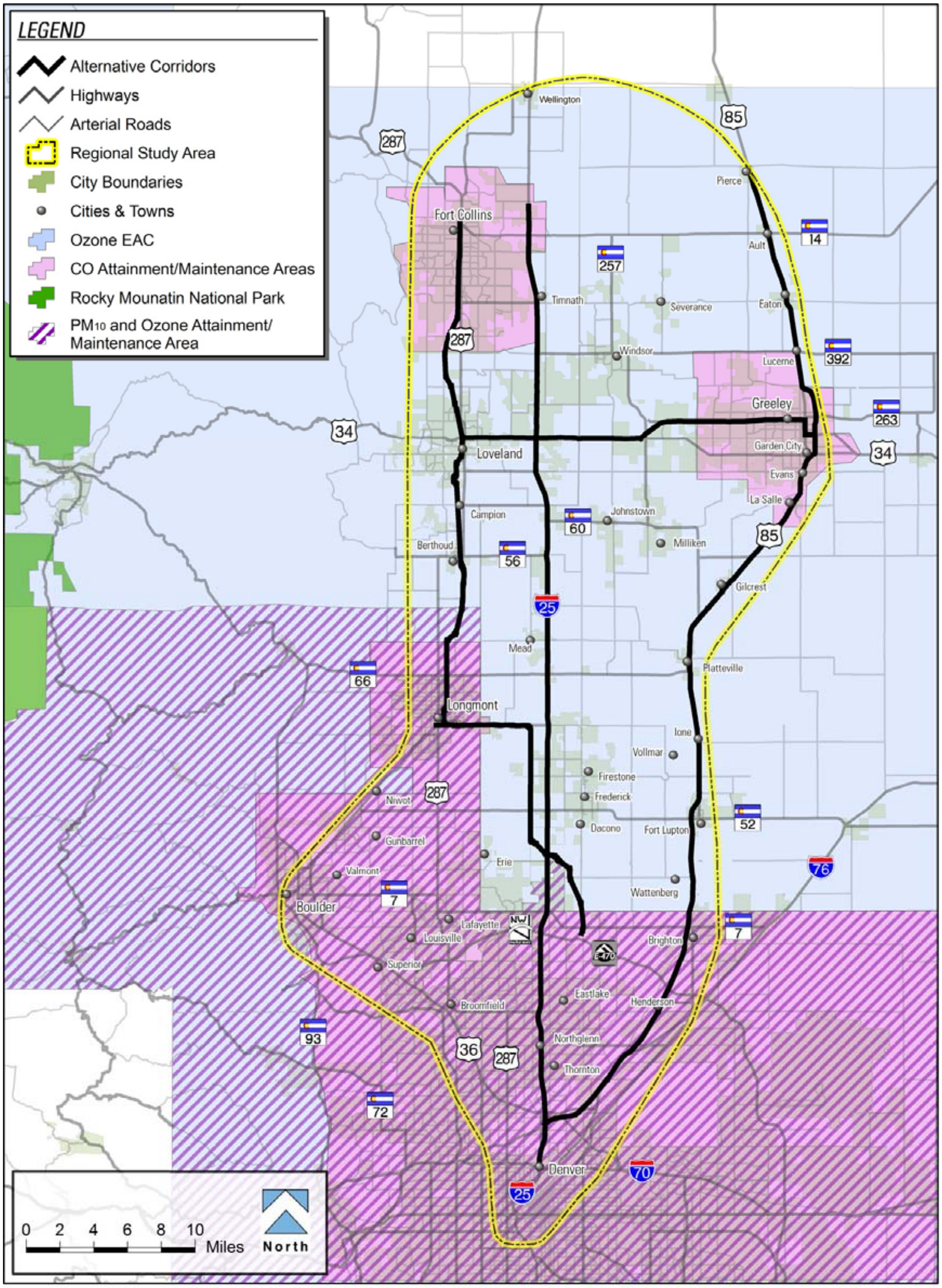
# 1.0 INTRODUCTION

The Federal Highway Administration (FHWA) and the Federal Transit Administration (FTA), in cooperation with the Colorado Department of Transportation (CDOT), have initiated preparation of a Draft Environmental Impact Statement (DEIS) to identify and evaluate multi-modal transportation improvements along approximately 70 miles of the I-25 corridor from the Fort Collins-Wellington area to Denver. The improvements being considered in this Draft EIS will address regional and inter-regional movement of people, goods, and services in the I-25 corridor.

To include consideration of multi-modal transportation alternatives, the study area extends from US 287 and the Burlington Northern and Santa Fe (BNSF) Railway routes on the west to US 85 and the Union Pacific Railroad (UPRR) routes on the east. The alternatives for package A and package B can be found in chapter 2 of the North I-25 Air Quality Report. The study area, depicted in **Figure 1**, spans portions of seven counties: Adams, Boulder, Broomfield, Denver, Jefferson, Larimer, and Weld. The study area includes more than 30 communities, two metropolitan planning organizations; the Denver Regional Council of Governments (DRCOG) and the North Front Range Metropolitan Planning Organization (NFRMPO), as well as the Upper Front Range Regional Planning Commission (UFRRPC). Major population centers in the study area include Fort Collins, Greeley, Loveland, and the communities in the northern portion of the Denver metropolitan area (Denver Metro Area).

A number of communities in the study area have developed transportation plans that recommend transportation improvements to accommodate the travel needs of their communities now and in the future. The three Transportation Planning Regions (TPRs) in the study area coordinate the efforts of these local communities to create a comprehensive, fiscally-constrained, transportation plan for each region. The NFRMPO coordinates the planning efforts of the urban area including Fort Collins, Greeley, and Loveland. UFRRPC provides the same type of planning coordination efforts for rural portions of Larimer, Morgan, and Weld counties that are not part of NFRMPO. DRCOG coordinates efforts in the Denver Metro Area.

**Figure 1 Regional Study Area and Attainment/ Maintenance and EAC/Ozone Non-attainment Areas**




Map Document - C&B: (Air_eis.mxd)
1/22/2007

# 2.0 AIR QUALITY

In accordance with the Clean Air Act, the Environmental Protection Agency (EPA) requires all states to submit a State Implementation Plan (SIP) to address all areas that do not comply with the National Ambient Air Quality Standards (NAAQS). A SIP contains the set of actions or control measures that the state plans to implement to meet NAAQS. Non-attainment areas contain one or more pollutants levels that are in violation of NAAQS.

Attainment/maintenance areas are those areas where relevant pollutant levels have been reduced and maintained over a prolonged period of time to EPA-approved NAAQS levels. Four areas in the regional study area are in carbon monoxide (CO) attainment/ maintenance: Denver, Fort Collins, Greeley, and Longmont. Denver is also in attainment/maintenance for 1-hour ozone and for particulate matter under 10 micrometers in size ($PM_{10}$). However, ozone levels are an imminent concern for the northern Front Range. Because of ozone exceedances recorded in the last three summers, the regional study area is likely to be designated by EPA as an 8-hour ozone non-attainment area.

Results from regional and project level pollutant emissions analyses support that neither Package A nor Package B would likely cause or contribute to any new localized CO or $PM_{10}$ violations or increase the frequency or severity of any existing violations (40 CFR 93.116). Emerging topics of concern for the regional study area include mobile source air toxics associated with urbanized and high-density transit areas, re-entrained dust from vehicle tires and excess roadside sand, and nitrogen deposition affecting sensitive high-alpine environments in Rocky Mountain National Park.

## 2.1 REGULATORY FRAMEWORK

Air quality standards establish the concentration above which a pollutant is known to cause adverse health effects to sensitive groups in the population, such as children and the elderly. The amount of pollutants released and the atmosphere's ability to transport and disperse the pollutants affect a given pollutant's concentration in the atmosphere. Factors affecting transport and dispersion include terrain, wind, atmospheric stability, and, for photochemical pollutants, sunlight. The Front Range's air quality can largely be attributed to emissions, geography, and meteorology.

The Clean Air Act and its amendments led EPA to establish NAAQS for each of six criteria pollutants to protect the public from the health hazards associated with air pollution. The six criteria pollutants are CO, lead, nitrogen dioxide, ozone, particulate matter less than 10 microns and 2.5 microns in diameter ($PM_{10}$, $PM_{2.5}$), and sulfur dioxide. NAAQS for these criteria pollutants were established based on known human health effects and measurable, health-related threshold values.

**Carbon monoxide** is a gas produced when carbon contained in fuel is not completely burned. Sources include motor-vehicle exhaust, industrial processes, or forest fires. Carbon monoxide affects the central nervous system by depriving the body of oxygen and mostly affects people with respiratory, cardiovascular, or blood anemia sensitivities.

**Lead** is a metal that is typically ingested and accumulates in blood, bones, and soft tissues. It can adversely affect the kidneys, liver, nervous system, and other organs. With the near elimination of lead as an additive in gasoline, the non-industrial emissions of lead have been reduced significantly.

**Nitrogen dioxide** is a gas that can be an irritant to the eyes and throat. Oxides of nitrogen (nitric oxide and nitrogen dioxide) are formed when the nitrogen and oxygen in the air are combined in high-temperature combustion, such as at power plants and in motor vehicle engines.

Ground-level **ozone** is a gas that is not emitted directly from a source, as are other pollutants, but forms as a secondary pollutant. Its precursors are certain reactive hydrocarbons and nitrogen oxides, which react chemically in sunlight to form ozone. The main sources for these reactive hydrocarbons are automobile exhaust, gasoline, oil storage and transfer facilities, industrial paint and ink solvents, degreasing agents, and cleaning fluids. Exposure to ozone has been linked to a number of health effects, including significant decreases in lung function, inflammation of the airways, and increased respiratory symptoms, such as cough and pain when taking a deep breath.

**Particle pollution (particulate matter)** is a mixture of suspended microscopic solids and liquid droplets made up of various components, including acids, organic chemicals, metals, dust particles, and pollen or mold spores. The size of a particle is directly linked to its potential for causing health problems. Small particles, that is, those less than 10 micrometers in diameter ($PM_{10}$), pose the greatest problems because of their ability to penetrate deeply into the lungs and bloodstream. Exposure to such particles can affect both the lungs and heart. Particles larger than 10 micrometers act as an irritant to the eyes and throat.

Fine particulate matter with a diameter less than 2.5 micrometers is called $PM_{2.5}$. Sources of fine particles include all types of combustion, including motor vehicles, particularly diesel exhaust, power plants, residential wood burning, forest fires, agricultural burning, and some industrial processes. Because these smaller particles penetrate deeper into the cardiovascular system, they have a strong association with circulatory (heart disease and strokes) disease and mortality.

**Sulfur dioxides** are formed when fuels containing sulfur (mainly coal and oil) are burned at power plants or for other industrial processes. Fuel combustion, largely from electricity generation, accounts for most of the total sulfur dioxide emissions. High concentrations of sulfur dioxide can result in temporary breathing impairment for asthmatic children and adults who are active outdoors.

The National Ambient Air Quality Standards for the six criteria pollutants are shown in **Table 1**.

The Colorado Department of Public Health and Environment's (CDPHE's) Air Pollution Control Division (APCD) monitors concentrations of these pollutants. Geographic areas that violate a particular NAAQS are considered "non-attainment" areas for that pollutant. Violations are determined by a prescribed number of exceedances of the particular standard.

## 2.2 METHODOLOGY

The North I-25 Corridor air quality methodology was coordinated with the Colorado Department of Public Health and Environment—Air Pollution Control Division (APCD), the EPA, CDOT Region 4 and Environmental Programs Branch, and local agency stakeholders in a series of meetings scheduled between the initial air quality scoping in February 26, 2004 and the final APCD approval of methodologies on March 20, 2007.

The North I-25 Corridor has been analyzed for criteria pollutants of CO, VOCs, NOx, and $PM_{10}$, as well as the primary 6 mobile source air toxics (MSATs). The multi-tiered analysis incorporates emission inventories for each pollutant on gross regional and attainment area bases. CO and $PM_{10}$ project level analyses complete the third level of analysis. The FHWA EMIT software supplemental interface to MOBILE 6.2 has utilized detailed vehicle miles traveled (VMT) linkages from the composite regional travel model to generate and compare pollutant emissions and speed—VMT—facility relationships among the various North I-25 packages.  The composite travel model used in these analyses was constructed from DRCOG, NFRMPO traffic data to formulate a master roadway network covering the entire North I-25 regional study area. All analyses compare the incremental emissions level from vehicular mobile sources (tailpipe emissions only) caused by each package against existing and no-action conditions for the interim year (opening day) 2015 and the long-term planning horizon year of 2030. Fugitive dust generated from on-road vehicle entrainment of roadway dust was not included in these calculations.

Regional analyses incorporate the entire existing and proposed roadway network within the regional project study area boundary. Transit components for commuter rail were added to this network manually to provide total emissions levels for each package.  Relationships discerned among the No-Action, Package A and Package B roadway facility types, VMT and speed are discussed.

## Table 1 National Ambient Air Quality Standards for Criteria Pollutants

| Pollutant/Averaging Time | Primary Standard* | Secondary Standard* |
|---|---|---|
| **Carbon monoxide (CO)** | | |
| 8-hour[1] | 10,000 µg/m$^3$ (9.0 ppm) | -- |
| 1-hour[1] | 40,000 µg/m$^3$ (35 ppm) | -- |
| **Lead (Pb)** | | |
| Calendar quarter | 1.5 µg/m$^3$ | -- |
| **Nitrogen dioxide ($NO_2$)** | | |
| Annual Arithmetic Mean | 100 µg/m$^3$ (0.053 ppm) | 100 µg/m$^3$ (0.053 ppm) |
| **Ozone ($O_3$)** | | |
| 1-hour [2] | 235 µg/m$^3$ (0.12 ppm) | 235 µg/m$^3$ (0.12 ppm) |
| 8-hour[3] | 157 µg/m$^3$ (0.08 ppm) | 157 µg/m$^3$ (0.08 ppm) |
| **Particulate matter less than - 10 microns ($PM_{10}$)** | | |
| Annual [4] | 50 µg/m$^3$ | 50 µg/m$^3$ |
| 24-hour[5] | 150 µg/m$^3$ | 150 µg/m$^3$ |
| **Particulate matter less than 2.5 microns ($PM_{2.5}$)** | | |
| Annual[*6] | 15 µg/m$^3$ | 15 µg/m$^3$ |
| 24-hour[*7] | 35 µg/m$^3$ | 35 µg/m$^3$ |
| **Sulfur dioxide ($SO_2$)** | | |
| Annual Arithmetic Mean | 80 µg/m$^3$ (0.03 ppm) | -- |
| 24-hour[1] | 365 µg/m$^3$ (0.14 ppm) | -- |
| 3-hour[1] | -- | 1300 µg/m$^3$ (0.5 ppm) |

* Primary standards set limits to protect public health, including the health of "sensitive" populations such as asthmatics, children, and the elderly. Secondary standards set limits to protect public welfare, including protection against visibility impairment, damage to animals, crops, vegetation, and buildings.

** Due to mathematical rounding, a measured value of 9.5 ppm or greater is necessary to exceed the standard.
µg/m3 = micrograms per cubic meter ppm = parts per million

(1) Not to be exceeded more than once per year.

(2) (a) The standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above 0.12 ppm is $\leq$ 1.
(b) As of June 15, 2005, EPA revoked the 1-hour ozone standard in all areas except the fourteen 8-hour ozone non-attainment Early Action Compact (EAC) Areas.

(3) To attain this standard, the 3-year average of the fourth-highest daily maximum 8-hour average ozone concentrations measured at each monitor within an area over each year must not exceed 0.08 ppm.

(4) Due to a lack of evidence linking health problems to long-term exposure to coarse particle pollution, the EPA revoked the annual $PM_{10}$ standard in 2006, effective December 17, 2006.

(5) Not to be exceeded more than once per year on average over 3 years.

(6) To attain this standard, the 3-year average of the weighted annual mean $PM_{2.5}$ concentrations from single or multiple community-oriented monitors must not exceed 15.0 µg/m$^3$.

(7) To attain this standard, the 3-year average of the 98th percentile of 24-hour concentrations at each population-oriented monitor within an area must not exceed 35 µg/m$^3$, effective December 17, 2006.

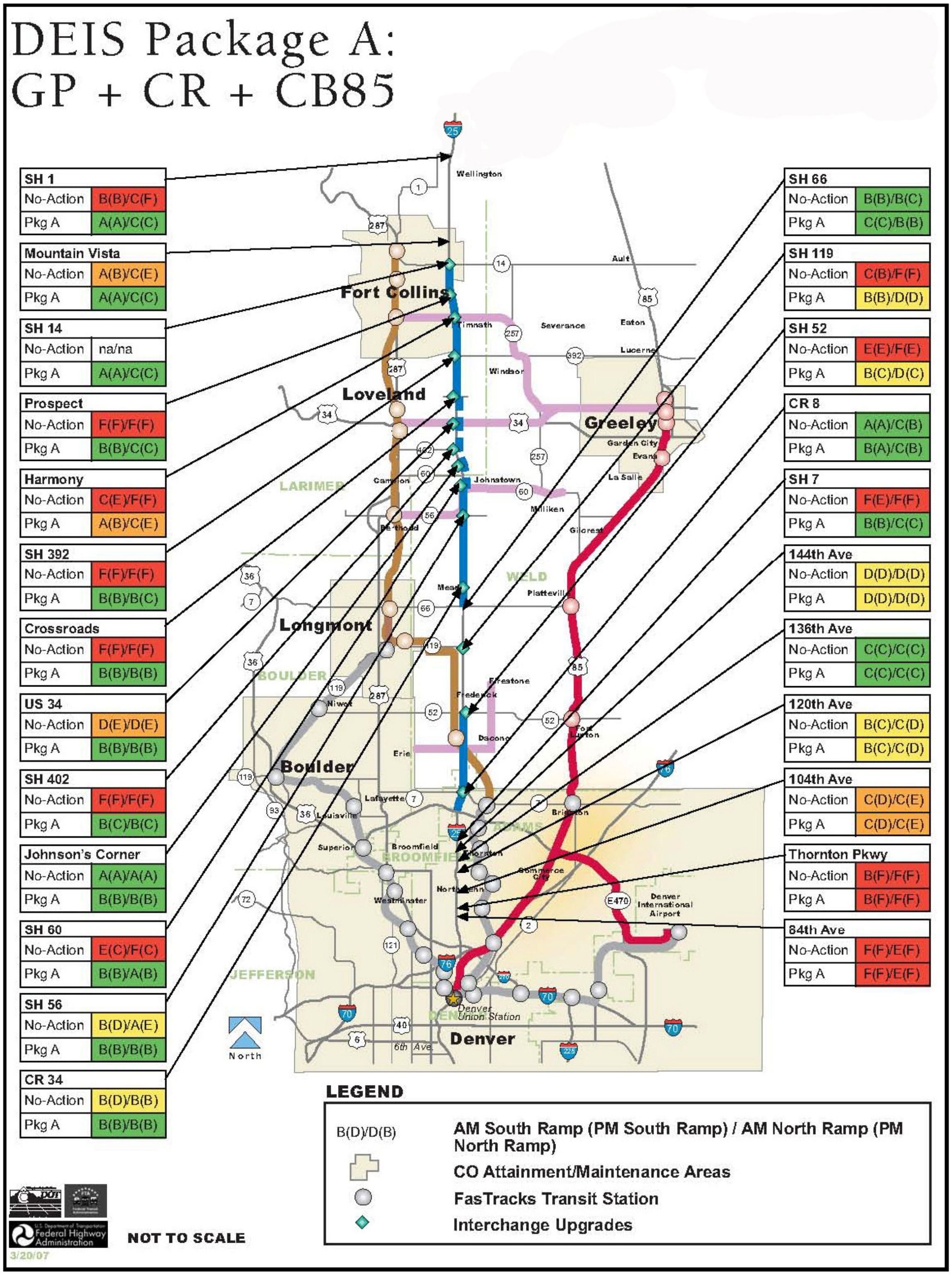
Attainment area analyses incorporated all roadway and transit networks that intersect the attainment area boundaries for each of the Fort Collins, Greeley, Longmont, and Denver attainment/maintenance area boundaries. New package roadway and transit components located within ½ mile of the attainment area boundary for each area were also included in these analyses.

Project level analyses include quantitative CO dispersion modeling at five signalized interchange and intersection localities where traffic volumes were high and operational levels of service were deficient in the future (see **Figure 2** and **Figure 3**). At least one representative CO hot spot analysis was conducted in each of the attainment/maintenance areas.

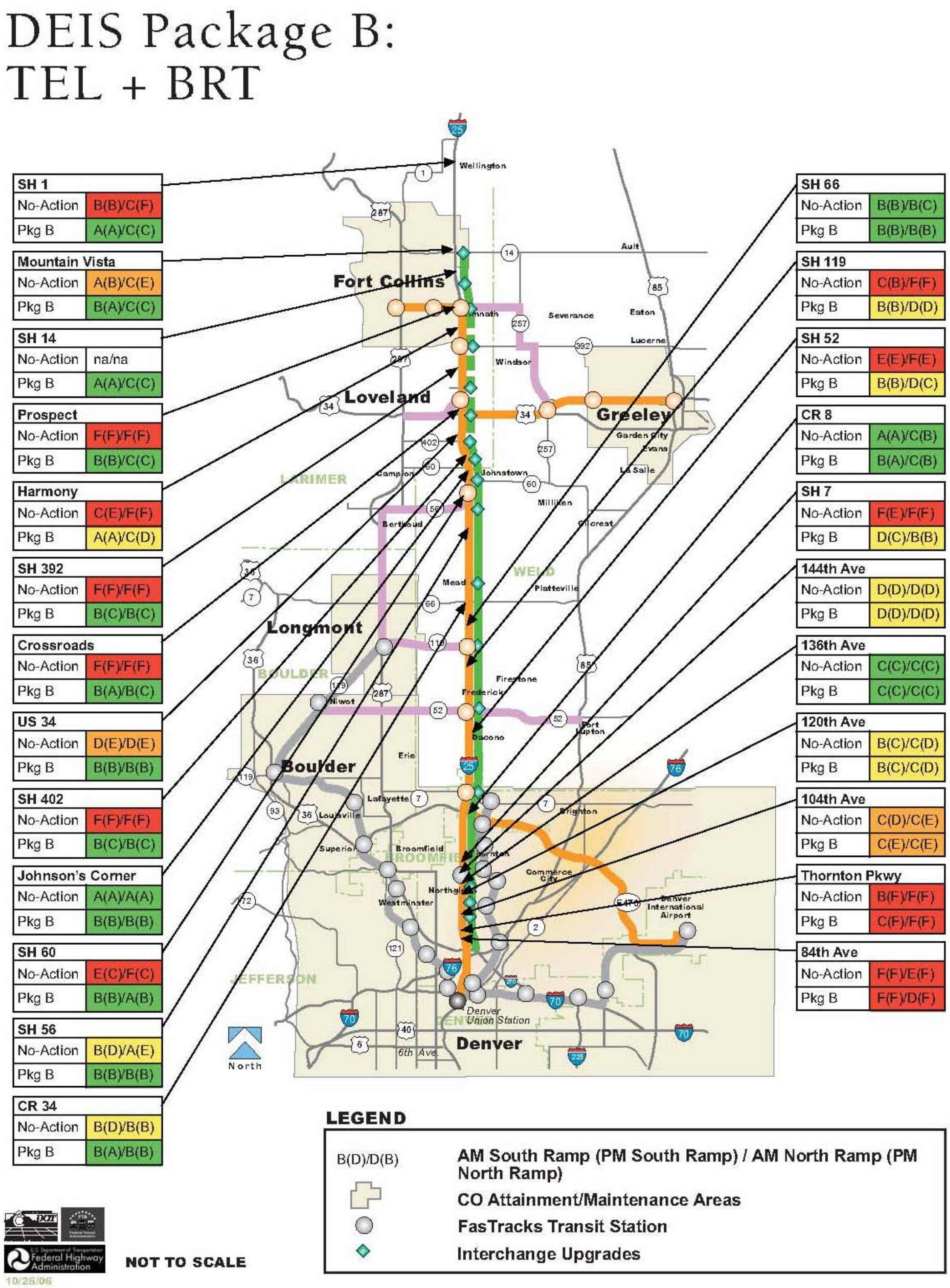
$PM_{10}$ qualitative hotspot analyses were conducted for the worst-case transit station and parking facility within the regional study area (located within the Denver $PM_{10}$ attainment/maintenance area), and at all commuter bus, bus rapid transit (BRT) and commuter rail maintenance facilities. Where regional conformity modeling exists, the analyses used comparisons of nodal emissions estimated values for future years. The commuter rail comparative analysis incorporated dispersion modeling and analysis undertaken for a nearby transit project. The Regional Transportation District (RTD) sourced emissions factors were used by that project.

Project level MSAT analyses was conducted for commuter bus and BRT maintenance facilities using emission factors generated specifically for bus emissions through diesel research conducted by the California Air Resources Board (Ayala, 2003). Overall VMT relationships among packages were utilized to estimate future trends in MSAT emissions.

## Figure 2 Level of Service for Package A



## Figure 3 Level of Service for Package B



# 3.0 AFFECTED ENVIRONMENT

The North I-25 regional study area includes the cities of Boulder, Brighton, Fort Collins, Greeley, Longmont, Loveland, Northglenn, Thornton, and northern Denver, plus numerous other small towns. The core of the regional study area is experiencing urban growth resulting in increased conversion of farmland and open ranchlands to residential development and urbanization.

Ozone is formed as a by-product of combining the precursor pollutants of oxides of nitrogen ($NO_x$) and volatile organic compounds (VOCs) with sunlight. Dispersion and point source air quality modeling are establishing emission levels for base 2002 and target 2007 years, incorporating mobile source and non-road, industrial, and agricultural source ozone precursor emissions of $NO_x$ and VOCs.

**Figure 1** shows the location of the Denver, Fort Collins, Greeley, and Longmont criteria pollutant attainment/maintenance areas, as well as the boundary of the Ozone Early Action Compact (EAC) area. Other criteria pollutants are no longer pollutants of concern in the regional study area and the Front Range area.

## 3.1 METEOROLOGY

Regionally, weather systems emanate from the west across the Front Range to the plains. Winds are generally strong when associated with a low-pressure system or temperature front. These turbulent weather conditions help disperse atmospheric pollutants.

Atmospheric inversions are common in the Front Range where geomorphic basin landforms are configured to allow cold mountain air to override warm basin-filling air, forming a “ceiling” to atmospheric mixing. The air trapped in the “inversion” layer remains stagnant, concentrating pollutants, and leading to poor air quality conditions. This is a particularly important factor in ozone formation where VOCs and oxides of nitrogen react in warm temperatures and sunshine. These temperature inversions are common occurrences during the winter season.

Wind direction data from monitoring sites west of I-25 along the foothills demonstrate westerly and northwesterly prevailing winds. Wind distributions from farther east along the I-25 corridor show more widely distributed wind patterns, but include a strong bi-directional north and south wind preference. Denver area sites located in the Platte River valley have wind patterns favoring the elongated southwest-northeast axis of the valley.

The dry, windy climate of the I-25 corridor from north Denver to the Wyoming border is prone to blowing soil particles disturbed by grazing, farming, or construction. The area averages 10 to 19 inches of precipitation per year, and 48 to 83 inches of snowfall annually. Temperatures average 32°F and 73°F for January and July, respectively.

## 3.2 AIR QUALITY MONITORING RESULTS

There are 27 active air quality monitoring stations located in the regional study area. Monitoring station locations and monitored mobile source related criteria pollutants are summarized in **Table 2**. Carbon monoxide, $NO_x$, ozone, $PM_{10}$, $PM_{2.5,}$ total suspended particulates (that is, particulate matter approximately 40 microns in diameter), lead, and sulfur dioxide are monitored in the general area. Lead and sulfur dioxide are generally considered to be industrial pollutants and are not included in **Table 2.**

**Table 2 2005 Criteria Pollutant Monitoring Station Data**

| Monitoring Stations | | | Criteria Pollutants | | | | | |
|---|---|---|---|---|---|---|---|---|
| **County** | **Site Name** | **Location** | **CO** | **$NO_2$** | **$O_3$** | **$PM_{10}$** | **$PM_{2.5}$** | **TSP** |
| Adams | Brighton | 22 South 4th Avenue | | | | X | | |
| | Commerce City | 7101 Birch Street | | | | X | X | X |
| | Globeville | 5400 Washington Street | | | | | | X |
| | Welby | 78th Avenue & Steele Street | X | X | X | X | | |
| Boulder | Boulder | 2440 Pearl Street | | | | X | X | |
| | Boulder | 2102 Athens Street | | | | | X | |
| | Boulder | 1405 ½ South Foothills Hwy | | | X | | | |
| | Longmont | 350 Kimbark Street | | | | X | X | |
| | Longmont | 440 Main Street | X | | | | | |
| Denver | Denver CAMP | 2105 Broadway | X | X | X | X | X | X |
| | Denver Firehouse #6 | 1300 Blake Street | X | | | | | |
| | Denver Visitors Center | 225 West Colfax Avenue | | | | X | | |
| Larimer | Fort Collins | 251 Edison Street | | | | X | X | |
| | Fort Collins | 708 South Madison Street | X | | X | | | |
| | Fort Collins | 4407 South College Avenue | X | | | | | |
| Weld | Greeley | 1516 Hospital Road | | | | X | X | |
| | Greeley | 3101 35th Avenue | | | X | | | |
| | Greeley | 905 10th Avenue | X | | | | | |
| | Platteville | 1004 Main Street | | | | | X | |

Data were obtained from CDPHE-APCD, 2005 Annual Data Report (September, 2006a) and the 2007 Annual Monitoring Network Assessment (2007). Not all 27 sites are included in this table.
CAMP – Continuous Ambient Monitoring Program
O3 – ozone
TSP – total suspended particulates

### 3.2.1 Criteria Pollutants and Critical Pollutant Data Trends

Monitoring data from the stations noted in **Table 2** illustrate the following trends in criteria pollutants concentrations:

- CO 8-hour concentrations (2nd maximum) have declined steadily across the regional study area over the past 10 years and are below the 9.0 parts per million (ppm) standard.
- $NO_2$ levels have remained relatively flat in spite of increasing vehicle miles traveled.
- Ozone concentrations have shown no consistent trend. Concentrations exceeded the 8-hour standard in 1998 and 2003. Concentrations at monitoring stations throughout the regional study area returned to levels below the 8-hour standard concentrations after the 2003 peak. Although ozone concentrations remain below the 1-hour threshold, the Fort Collins Mason Street monitoring station data show a steady increase in 1-hour ozone concentrations since 1999.
- $PM_{10}$ and $PM_{2.5}$ annual average concentrations have remained flat and below the particulate matter standards over the past 10 years throughout the regional study area.
- $PM_{10}$ 24-hour maximum concentrations have been much more irregular, but show a trend of gradually increasing in concentration in many areas. Concentrations at all stations remained below the 150 $\mu g/m^3$ standard.
- $PM_{2.5}$ 24-hour maximum concentrations show a steady decrease over the last few years and remain well under the 65 $\mu g/m^3$ standard.

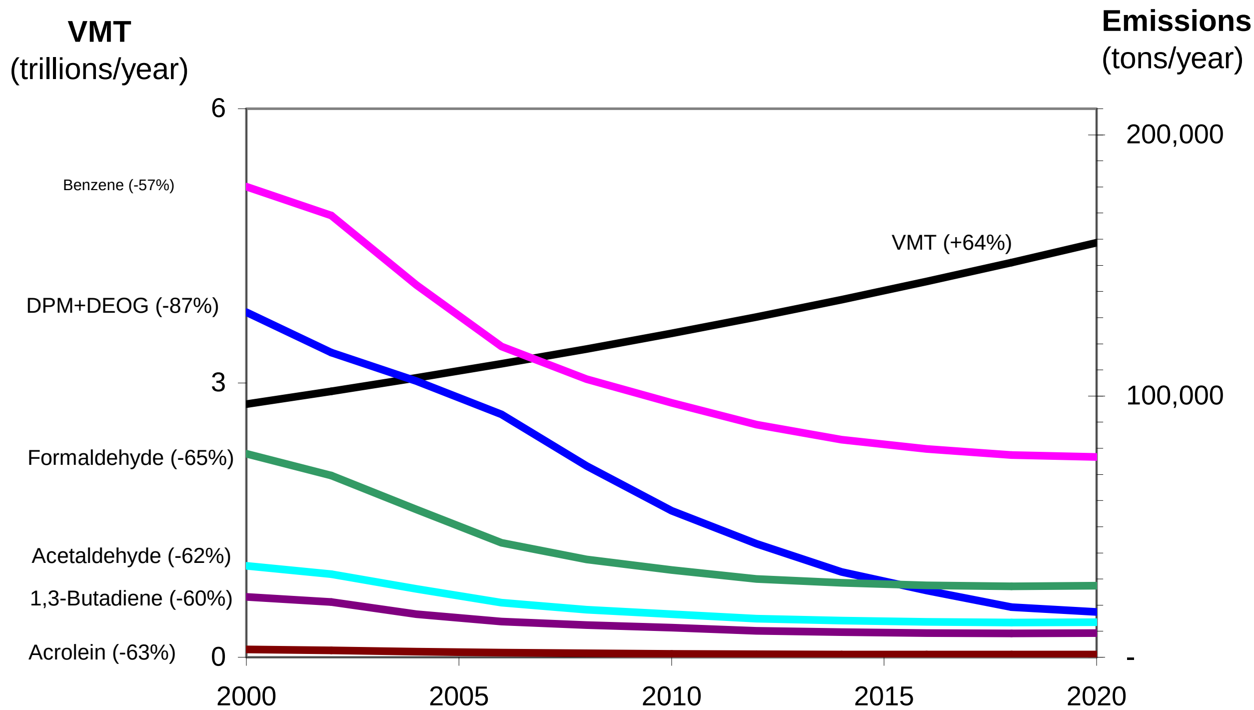
### 3.2.2 Mobile Source Air Toxics

In addition to the criteria air pollutants for which there are NAAQS, EPA also regulates air toxics. 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).

MSATs are a subset of the 188 air toxics defined by the Clean Air Act. MSATs are compounds emitted from highway vehicles and non-road equipment. Some toxic compounds are present in fuel and are emitted to the air when the fuel evaporates or passes through the engine unburned. Other toxics are emitted from the incomplete combustion of fuels or as secondary combustion products. Metal air toxics also result from engine wear or from impurities in oil or gasoline.

EPA is the lead federal agency for administering the Clean Air Act and has certain responsibilities regarding the health effects of MSATs. EPA issued a Final Rule on Controlling Emissions of Hazardous Air Pollutants from Mobile Sources (66 Federal Register [FR] 17229, March 29, 2001). This rule was issued under the authority in Section 202 of the Clean Air Act. In its rule, EPA 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 sulfur control requirements. Between 2000 and 2020, FHWA projects that even with a 64 percent increase in VMT, these programs would reduce on-highway emissions of benzene, formaldehyde, 1,3-butadiene, and acetaldehyde by 57 percent to 65 percent, and would reduce on-highway diesel PM emissions by 87 percent, as shown in **Figure 4.**

**Figure 4 U.S. Annual Vehicle Miles Traveled (VMT) vs. Mobile Source Air Toxics Emissions, 2000-2020**




Notes: For on-road mobile sources. Emissions factors were generated using MOBILE6.2. MTBE proportion of market for oxygenates is held constant, at 50%. Gasoline RVP and oxygenate content are held constant. VMT: *Highway Statistics 2000*, Table VM-2 for 2000, analysis assumes annual growth rate of 2.5%. "DPM + DEOG" is based on MOBILE6.2-generated factors for elemental carbon, organic carbon and SO4 from diesel-powered vehicles, with the particle size cutoff set at 10.0 microns.

EPA is preparing another rule under authority of Clean Air Act Section 202(l) that would address these issues and could make adjustments to the full 21 and the primary six MSATs.

**Unavailable Information for Project-Specific MSAT Impact Analysis.** This study includes a basic analysis of the likely MSAT emission impacts of this project. However, available technical tools do not allow prediction of project-specific health impacts of the emission changes associated with the alternatives in this DEIS. Due to these limitations, the following discussion is included in accordance with Council on Environmental Quality regulations (40 CFR 1502.22(b)) regarding incomplete or unavailable information:

Evaluating the environmental and health impacts from MSATs on a proposed transportation project would involve several key elements, including emissions modeling, dispersion modeling to estimate ambient concentrations resulting from the estimated emissions, exposure modeling to estimate human exposure to the estimated concentrations, and then final determination of health impacts based on the estimated exposure. Each of these steps is encumbered by technical shortcomings or uncertain science that prevents a more complete determination of the MSAT health impacts of this project.

1. Emissions. EPA tools to estimate MSAT emissions from motor vehicles are not sensitive to key variables determining emissions of MSATs in the context of highway projects. While MOBILE 6.2 is used to predict emissions at a regional level, it has limited applicability at the project level. MOBILE 6.2 is a trip-based model—emission factors are projected based on a typical trip of 7.5 miles, and on average speeds for this typical trip. This means that MOBILE 6.2 does not have the ability to predict emission factors for a specific vehicle operating condition at a specific location at a specific time. Because of this limitation, MOBILE 6.2 can only approximate the operating speeds and levels of congestion likely to be present on the largest-scale projects, and cannot adequately capture emissions effects of smaller projects. For particulate matter, the model results are not sensitive to average trip speed, although the other MSAT emission rates do change with changes in trip speed. Also, the emissions rates used in MOBILE 6.2 for both particulate matter and MSATs are based on a limited number of tests of mostly older-technology vehicles. Lastly, in its discussions of particulate matter under the conformity rule, EPA has identified problems with MOBILE 6.2 as an obstacle to quantitative analysis.

   These deficiencies compromise the capability of MOBILE 6.2 to estimate MSAT emissions. MOBILE6.2 is an adequate tool for projecting emissions trends and for performing relative analyses between alternatives for very large projects, but it is not sensitive enough to capture the effects of travel changes tied to smaller projects or to predict emissions near specific roadside locations.

2. Dispersion. The tools to predict how MSATs disperse are also limited. EPA's current regulatory models, CALINE3 and CAL3QHC, were developed and validated more than a decade ago for the purpose of predicting episodic concentrations of CO to determine compliance with NAAQS. The performance of dispersion models is more accurate for predicting maximum concentrations that can occur at some time at some location within a geographic area. This limitation makes it difficult to predict accurate exposure patterns at specific times at specific highway project locations across an urban area to assess potential health risk. The National Cooperative Highway Research Program is conducting research on best practices in applying models and other technical methods in the analysis of MSATs. This work also would focus on identifying appropriate methods of documenting and communicating MSAT impacts in the NEPA process and to the general public. Along with these general limitations of dispersion models, FHWA is also faced with a lack of monitoring data in most areas for use in establishing project-specific MSAT background concentrations.

3. Exposure Levels and Health Effects. Finally, even if emission levels and concentrations of MSATs could be accurately predicted, shortcomings in current techniques for exposure assessment and risk analysis preclude one from reaching meaningful conclusions about project-specific health impacts. Exposure assessments are difficult because it is difficult to accurately calculate annual concentrations of MSATs near roadways, and to determine the portion of a year that people are actually exposed to those concentrations at a specific location. These difficulties are magnified for 70-year cancer assessments, particularly because unsupportable assumptions would have to be made regarding changes in travel patterns and vehicle technology (which affects emissions rates) over a 70-year period. There are also considerable uncertainties associated with the existing estimates of toxicity of the various MSATs, because of factors such as low-dose extrapolation and translation of occupational exposure data to the general population. Because of these shortcomings, any calculated difference in health impacts between alternatives is likely to be much smaller than the uncertainties associated with calculating the impacts. Consequently, the results of such assessments would not be useful to decision-makers who would need to weigh this information against other project impacts that are better suited for quantitative analysis.

**Summary of Existing Credible Scientific Evidence Relevant to Evaluating the Impacts of MSATs.** Research into the health impacts of MSATs is ongoing. For different emission types, there are a variety of studies that show that some either are statistically associated with adverse health outcomes through epidemiological studies (frequently based on emissions levels found in occupational settings) or that animals demonstrate adverse health outcomes when exposed to large doses.Exposure to toxics has been a focus of a number of EPA efforts. Most notably, the agency conducted the National Air Toxics Assessment (NATA) in 1996 to evaluate modeled estimates of human exposure applicable to the county level. While not intended for use as a measure of or benchmark for local exposure, the modeled estimates in the NATA database best illustrate the levels of various toxics when aggregated to a national or state level.

EPA is in the process of assessing the risks of various kinds of exposures to these pollutants. EPA's Integrated Risk Information System (IRIS) is a database of human health effects that may result from exposure to various substances found in the environment. The IRIS database is located at http://www.epa.gov/iris. The following toxicity information for the six prioritized MSATs was taken from the IRIS database Weight of Evidence Characterization summaries. This information is taken verbatim from EPA's IRIS database and represents the Agency's most current evaluations of the potential hazards and toxicology of these chemicals or mixtures.

- **Benzene** is characterized as a known human carcinogen.
- The potential carcinogenicity of **acrolein** cannot be determined because the existing data are inadequate for an assessment of human carcinogenic potential for either the oral or inhalation route of exposure.
- **Formaldehyde** is a probable human carcinogen, based on limited evidence in humans, and sufficient evidence in animals.
- **1,3-butadiene** is characterized as carcinogenic to humans by inhalation.
- **Acetaldehyde** is a probable human carcinogen based on increased incidence of nasal tumors in male and female rats and laryngeal tumors in male and female hamsters after inhalation exposure.
- **Diesel exhaust** is likely to be carcinogenic to humans by inhalation from environmental exposures. (Diesel exhaust as reviewed in this document is the combination of diesel particulate matter and diesel exhaust organic gases.) Diesel exhaust also represents chronic respiratory effects, possibly the primary non-cancer hazard from MSATs. Prolonged exposures may impair pulmonary function and could produce symptoms, such as cough, phlegm, and chronic bronchitis. Exposure relationships have not been developed from these studies.

There have been other studies that address MSAT health impacts in proximity to roadways. The Health Effects Institute, a non-profit organization funded by EPA, FHWA, and industry, has undertaken a major series of studies to research near-roadway MSAT hot spots, the health implications of the entire mix of mobile source pollutants, and other topics. The final summary of the series is not expected for several years.

Some recent studies have reported that proximity to roadways is related to adverse health outcomes -- particularly respiratory problems (South Coast Air Quality Management District, 2000). Much of this research is not specific to MSATs, instead surveying the full spectrum of both criteria and other pollutants. FHWA cannot evaluate the validity of these studies, but more importantly, they do not provide information that would be useful to alleviate the uncertainties listed above and enable us to perform a more comprehensive evaluation of the health impacts specific to this project.

**Relevance of Unavailable or Incomplete Information.** Because of the uncertainties outlined above, a quantitative assessment of the effects of air toxic emissions impacts on human health cannot be made at the project level. While available tools do allow us to reasonably predict relative emissions changes between alternatives for larger projects, the amount of MSAT emissions from each of the packages, including No-Action Alternative, and MSAT concentrations or exposures created by each of the packages cannot be predicted with enough accuracy to be useful in estimating health impacts. Therefore, the relevance of the unavailable or incomplete information is that it is not possible to make a determination of whether any of the alternatives would have "significant adverse impacts on the human environment."

In this document, FHWA has provided a quantitative analysis of MSAT emissions relative to the various alternatives, (see Section 3.5.3.5. *Project-Level MSAT Analyses*) and has acknowledged that the build packages could result in increased exposure to MSAT emissions in certain locations, although the concentrations and duration of exposures are uncertain, and because of this uncertainty, the health effects from these emissions cannot be estimated.

### 3.2.3 Fugitive Dust

Fugitive dust from unpaved roads is a notable contributor to particulate matter emissions in rural Boulder, Larimer, and Weld counties where 50 percent to 80 percent of roads, or over 3,450 miles, are unpaved. Each of these counties employ dust suppressant programs utilizing magnesium chloride and/or other additives to prolong a hard surface to unpaved roadways, lowering the overall volumes of re-entrained dust into the atmosphere. The more urbanized areas, such as Boulder, Denver, Fort Collins and other municipalities, as well as CDOT, have instituted street sweeping programs after winter-storm sanding operations to minimize excess roadside sand available for re-entrainment. Winter liquid de-icing operations used by CDOT and local road departments for winter operations also help to reduce fugitive dust emissions throughout the regional study area.

### 3.2.4 Class I Federal Areas and Nitrogen Deposition

Class I Federal Areas include areas such as nationally protected forests, wilderness areas, and parks larger than 6,000 acres, designated for their natural environment and attributes. Rocky Mountain National Park is a Class I federal area of 267,370 acres, straddling the Continental Divide in the northern Front Range. The park was created to protect the scenic beauty and unique natural resources of the region and its ecosystems are managed to be as natural or unimpaired as possible. The park is 93 percent existing or proposed wilderness.

Metropolitan and agricultural areas along the eastern edge of the Colorado Front Range are important source areas for atmospheric pollutants that may impact Rocky Mountain National Park. The largest city is Denver, 40 miles to the southeast, but other, closer urban source areas include Boulder, Fort Collins, Longmont, and Loveland. Additional sources include the Yampa Valley west of the park and cattle feed lots and hog farms to the east in Greeley. Visibility in the park has decreased from a range of 140 miles in the 1970s to 35 to 90 miles today.

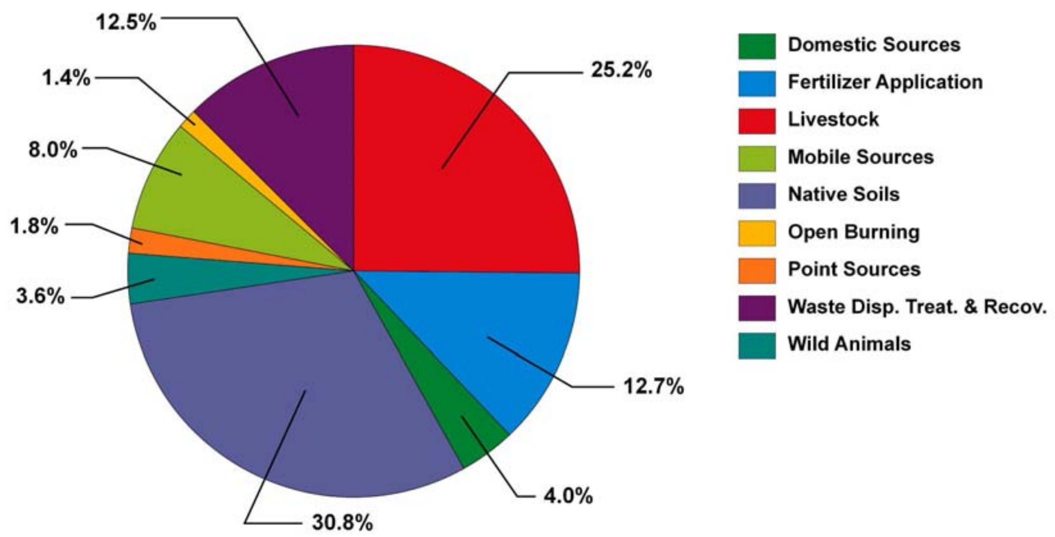
High-elevation ecosystems in Rocky Mountain National Park are vulnerable to atmospheric nitrogen deposition and have been affected by regional pollutants as evidenced by about a 2 percent per year increase in nitrogen deposition over the past 20 years. There is more nitrogen deposited in high-elevation ecosystems than plants can use, and excess nitrogen is leaching into park lakes and streams during certain times of the year. Pine and fir trees are experiencing excess nitrogen-derived disease. Experiments near the park show that nitrogen increases change the kind and diversity of plants that grow in the tundra. Grasses and sedges out-compete flowering plants, a change that could reduce habitat for some animals and diminish alpine flowers in the park. Potential consequences of nitrogen saturation on terrestrial systems include loss of species biodiversity, changes in forest species composition, and increased incursion by more nitrogen-tolerant invasive species.

Nitrogen-affected ecosystems and the accompanying changes in species composition, soil, water, and tree chemistry have been documented in eastern areas of Rocky Mountain National Park. Total annual wet and dry nitrogen depositions monitored in the park since the mid 1990s average around 21 pounds/acre/year. Pre-industrial or "natural" levels of nitrogen deposition are estimated to be about one pound/acre/year.

Nitrogen deposition is a growing concern not only in Rocky Mountain National Park but also in sensitive mountain environments all along the Front Range. $NO_x$ and ammonia ($NH_3$) can be transported long distances and eventually are deposited on land and water through precipitation in wet deposition or as gases and particles in dry deposition. This process is known as nitrogen deposition. Combustion of fossil fuels, such as petroleum and coal, generates emissions that form $NO_x$ in the atmosphere and is the major contributor to nitrogen deposition. Agricultural releases of nitrogen are primarily in the form of $NH_3$ from fertilizer manufacturing, livestock production activities, and cultivation of various crops. Ammonia is also emitted from vehicle catalytic converters. Over 3,254 tons of $NH_3$ were estimated along the Front Range in 2002. Regional studies indicate that Front Range $NH_3$ emissions due to mobile sources would grow to over 3,700 tons by 2018.

Unlike transportation and utility $NO_x$ emissions, agricultural $NH_3$ emissions are not regulated. Front Range sources of ammonia are graphically represented in **Figure 5**.

## Figure 5 2002 Ammonia Emissions for the Front Range Area




**The following 12 counties comprise the Front Range:**
**Adams, Arapahoe, Boulder, Denver, Douglas, El Paso, Jefferson, Larimer, Morgan, Pueblo and Weld.**

**Adapted fromTaipale, 2006; Colorado 2002 Ammonia Emissions Inventory,**
**Colorado Department of Public Health and Environment, Air Pollution Control Division.**

### 3.2.5 Transportation Conformity

Transportation conformity, as a provision of the Clean Air Act (as amended in 1990), helps to ensure that transportation funds go to projects that are consistent with local air quality goals outlined in the SIP. Conformity applies to federally funded or approved transportation plans, transportation improvement programs, and highway and transit projects. Conformity requires that these actions be included in a fiscally constrained Regional Transportation Plan and Transportation Improvement Program. This is required for areas that do not meet, or have not in the past met, air quality standards for CO, nitrogen dioxide, ozone, or particulate matter. A conformity determination estimates project-related emissions and demonstrates that those emissions are within the limits set by the SIP.

One of the first steps in the development of a SIP is the preparation of an emissions inventory, which is based on the actual or modeled emissions from all sources of air pollution within the non-attainment or attainment/maintenance area. The inventory of mobile source emissions is further categorized by on-road and non-road emissions. The emissions inventory helps define the extent of the pollution problem relative to air quality standards in current and future years. Emission estimates for on-road mobile sources are usually based on the combination of two fundamental measures: VMT and emissions rates (the rate of pollutants emitted in the course of travel based on vehicle speed and other factors).

The SIP identifies the allowable on-road emissions levels to attain the air quality standards as an emissions budget. These budgets act as a cap on emissions and represent the "holding capacity" of the area. The motor vehicle emissions budget that is explicitly identified in the six project area SIPs has been used in the transportation conformity process to cap the emissions allowed by motor vehicles on the corridor transportation network as planned.

Portions of the North I-25 project have been included in the long range plan for future CDOT projects; however, no portion of the project has yet been included within the fiscally constrained statewide Transportation Improvement Program or a Regional Transportation Plan, so no formal regional conformity findings have been made for any of the potential project actions. Transportation conformity must be demonstrated before a Record of Decision can be signed, and before improvements can be built.

Transportation control measures such as transit investments, HOV and managed lanes, reduction of vehicle use, and improved traffic flow (congestion reduction) are important planned pollution control measures incorporated in both Packages A and B.

# 4.0 ENVIRONMENTAL CONSEQUENCES

## 4.1 REGIONAL ANALYSIS

Emissions from mobile sources for various air pollutants within the entire regional study area were estimated for the existing condition (Year 2001), the No-Action Alternative, Package A, and Package B. Future emissions were based on anticipated traffic levels for each alternative for an interim year 2015 and the design year 2030 (see **Table 3**). Emissions levels included winter-summer seasonal influence, expected vehicle types, and traffic composition. Portions of all six SIP areas were included within this evaluation. Fugitive dust and construction generated emissions were not included in these analyses.

Travel demand forecasting completed for this Draft EIS generated a calculation of vehicle-miles traveled for the regional study area. The traffic network was evaluated by roadway linkages (Components A-H1 through A-H4; B-H1 through B-H4) and found an influence from proposed project changes on traffic volume of 5 percent or more around the primary travel corridors of US 287, I-25, and US 85.

Traffic-generated emissions for pollutants CO, $NO_x$, $PM_{10}$, VOC, and MSATs were estimated from an FHWA-modified interface to MOBILE 6.2 called EMIT. Roadway facility classifications included expressway, freeway, arterial, connector links, and ramps.

Bus-generated emissions were not considered to be regionally significant because the maximum daily circulation volume for either Package A commuter and feeder buses [A-T3 Component] or Package B BRT [B-T1 Component] and feeder buses [B-T2 Bus Component] would be less than 60 buses. No more than 6 idling buses (40 seconds per stop) and/or commuter rail units (60 seconds per stop) would be present at any one station, at any peak or non-peak traffic hour. Thus, analysis of transit station operations was also not included in the regional analysis. Rail-generated emissions for Package A [A-T1, A-T2 components] were calculated separately using emissions factors provided by RTD, and added to the calculated vehicle emissions burden totals (see **Table 3**). Larger parking lot generated emissions are addressed under project-level analyses.

Results tabulated in **Table 3** and **Figure 6** illustrates the trend of decreasing criteria pollutant emissions with increasing VMT in future years. The reason for this is increasing controls on the vehicle sources. Regional VMT measured over the regional study area would increase approximately 80 percent between 2001 and 2030. Regional analyses of total criteria pollutants show reductions in total emissions between 2001 and 2030: CO decreases 44 percent, VOC decreases 56 percent, $NO_x$ decreases 79 percent, and $PM_{10}$ decreases 32 percent. Package A and Package B 2030 criteria pollutant emissions would average about 1 percent higher than the 2030 No-Action emissions. Package B would generate fewer emissions of CO, and $NO_x$ than Package A. Package A would generate slightly fewer emissions of VOC. For $PM_{10}$ and MSAT's the emissions would be identical. The substantial reductions in pollutant concentrations between 2001 and 2030 are due primarily to future emissions controls and low-sulfur fuels, which will be in place by 2011.

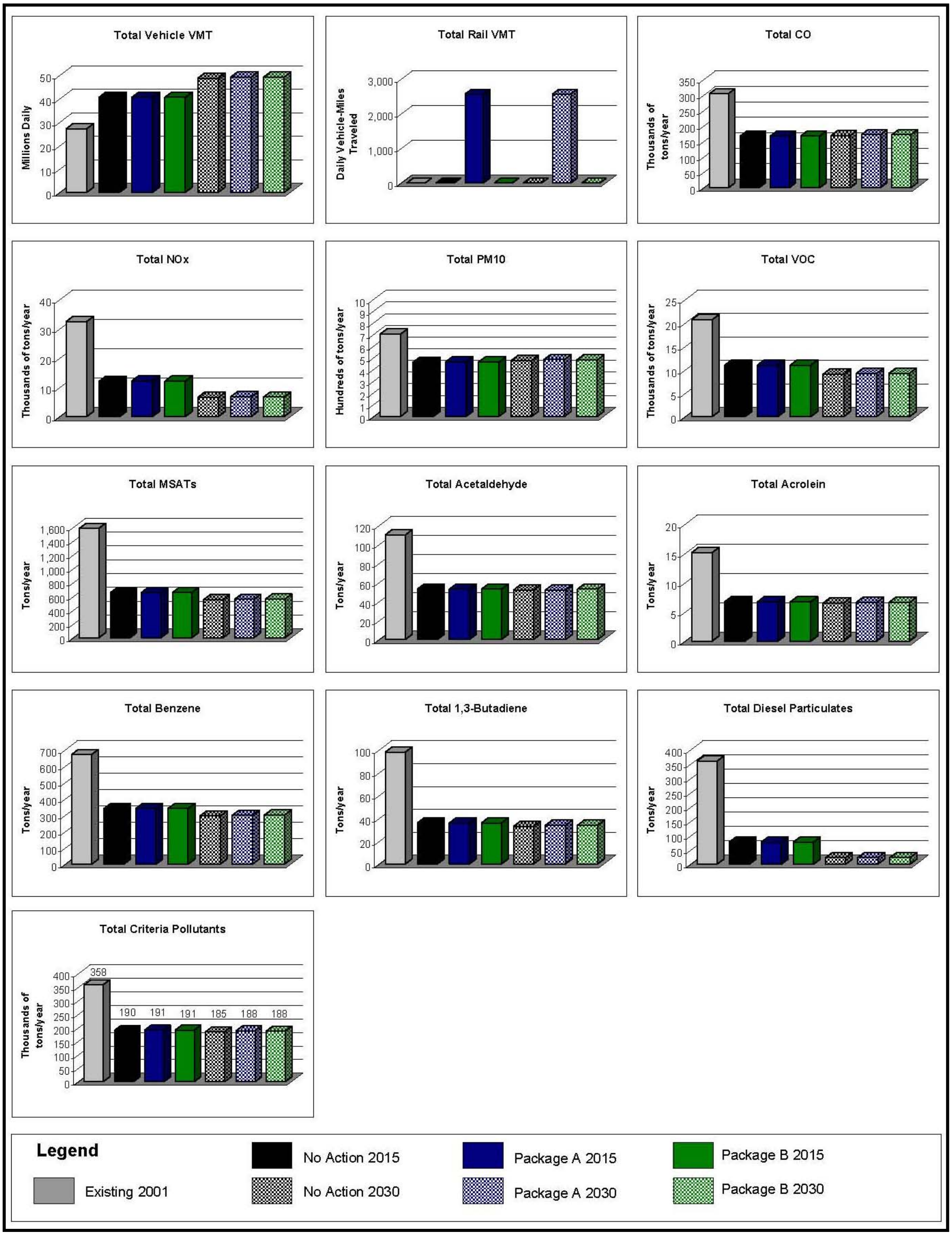
Although gross pollutant emissions tabulated in **Table 3** and **Figure 6** shows a reduction in emissions levels from 2001 to 2030, the individual declining pollutant emission trends are not consistently linear. The 2015 data for CO and $PM_{10}$ are the lowest emissions value among the modeled years of 2001, 2015, and 2030. Year 2030 CO emissions are on average 45 percent or 372 tons per day (tpd) lower than 2001 levels. However, 2030 CO emissions are 6.1 tpd higher than 2015 estimated CO emissions.

### Table 3 Daily Region-Wide Total Mobile Source Emissions Estimates

| Pollutant | Year 2001 | No-Action Alternative | | Package A | | Package B | |
|---|---|---|---|---|---|---|---|
| | | 2015 | 2030 | 2015 | 2030 | 2015 | 2030 |
| Vehicle VMT (daily) | 27,171,738 | 40,566,610 | 48,684,000 | 40,585,672 | 49,147,000 | 40,574,029 | 49,124,000 |
| Rail VMT [A-T1, A-T2] (daily) | NA | NA | NA | 2,567 | 2,567 | NA | NA |
| CO (tons/day) | 834.36 | 456.26 | 462.36 | 459.03 | 470.87 | 458.37 | 469.32 |
| VOC (tons/day) | 56.56 | 30.00 | 24.87 | 30.09 | 25.17 | 30.10 | 25.32 |
| $NO_x$ (tons/day) | 88.91 | 33.01 | 18.02 | 33.33 | 18.35 | 33.19 | 18.27 |
| $PM_{10}$ (tons/day) | 1.93 | 1.27 | 1.31 | 1.27 | 1.32 | 1.27 | 1.32 |
| Acetaldehyde (tons/day) | 0.30 | 0.15 | 0.14 | 0.15 | 0.14 | 0.15 | 0.15 |
| Acrolein (tons/day) | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Benzene (tons/day) | 1.84 | 0.93 | 0.81 | 0.93 | 0.82 | 0.93 | 0.82 |
| 1,3-butadiene (tons/day) | 0.26 | 0.10 | 0.09 | 0.10 | 0.09 | 0.10 | 0.09 |
| Diesel particulates (tons/day) | 0.98 | 0.21 | 0.06 | 0.21 | 0.06 | 0.21 | 0.06 |
| Formaldehyde (tons/day) | 0.90 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 | 0.39 |
| Total Emissions (tons/day) | 986.10 | 522.33 | 508.08 | 525.77 | 517.50 | 524.73 | 515.78 |

NA – Not Applicable

## Figure 6 Comparison of Regional Pollutant Emissions (tons per year)



A portion of the increased regional CO and $PM_{10}$ emissions from year 2015 to 2030 are related to changes in the vehicle composition and future emissions characteristics. The Tier 1 and Tier 2 regulations implemented by EPA beginning in 1994 and 2004, respectively, placed tighter controls on CO, VOC and NOx emissions from light duty motor vehicles. EPA has also adopted tighter emission standards for heavy duty highway vehicles beginning with the 2007 model year, more stringent Tier 3 and Tier 4 emission standards for heavy duty nonroad engines (e.g., locomotives), and lower limits on the sulfur content of gasoline and diesel fuel. The vehicle fleet used in transportation air quality modeling is projected 25 years into the future, allowing for increasingly stringent emissions controls and improved engine efficiency. Once fleet turnover is complete (e.g., all vehicles meet the most recent set of emissions standards), then emissions rates start to go back up primarily because of VMT increases.

## 4.2 Travel Modeling and Speed Sensitivity Analyses

Travel forecasts were prepared using the North I-25 EIS combined travel model for the years 2015 and 2030. The North I-25 DEIS combined model was developed from the NFRMPO travel model and DRCOG travel model, so that the North I-25 DEIS study area could be covered by one inter-regional, multi-modal model. The North I-25 model reflects the adopted 2030 Regional Transportation Plans of each of the respective MPO's. It should be noted the combined model uses the DRCOG mode choice and traffic assignment procedures (trip generation and trip distribution are run separately for each MPO area) on a combined regional network. The standard DRCOG assignment procedures are used (100 iterations, convergence 0.01, 6 iterations of speed balancing).

The travel model produces forecast of volume data for each link segment in the network. The links are categorized by facility type and area type. For processing by EMIT, the travel model link data results are summarized for five different geographic areas: Study Area, Fort Collins SIP, Greeley SIP, Longmont SIP, and Denver SIP.

Besides air quality parameters, EMIT has parameters for link speed. These are set to mimic the DRCOG speed-volume delay function. In other words, EMIT processes the link volumes and applies the DRCOG speed curves (categorized by facility type and area type). In this way the volume and speed of every link is specified for EMIT processing.

In the study area, the amount of VMT is about 25 million in 2001, 38 million in 2015, and 45 million in 2030. This represents about a 50% growth in total VMT for the study area between years 2001 and 2015; and continued growth in total VMT of about 20% between 2015 and 2030. Each SIP area has similar growth patterns. Amongst the alternatives, total VMT is slightly higher in Package A and Package B compared to No-Action for both 2015 and 2030 (less than 1%). This is due to the increased system capacity of the two packages, allowing for more mobility. About one third of the total VMT is on freeways. Another one third is on principal arterials, with the remainder on other facility types such as expressways, minor arterials, collectors and local roads. Package A draws slightly more (3%) traffic to the freeway than Package B, since the tolled express lanes of Package B restrict access to some users.

For pollutants CO and $PM_{10}$, emissions decrease from 2001 to 2015 but rise back up a little in 2030. This trend was not immediately intuitive, as typically total emissions drop into the future due to fleet turnover. To investigate this trend further a detailed analysis was performed. The analysis involved applying the speed curve to the link data, and tabulating the resulting VMT by three different speed categories for each of the facility type and area type combinations. The speed categories were based on the general points where emission rate curves "break" between higher rates and lower rates, as vehicle speed increases. In general emissions are higher less than 25 mph, and higher above 45 mph. Therefore, the VMT link data was divided for each facility and area type category into three speed classes:

- Less than 25mph (RED)
- 25 mph to 45 mph (GREEN)
- Greater than 45 mph (BLACK)

The amount of CO emitted is sensitive to the speed and composition of traffic. A comparison of the 2015 and 2030 roadway area and facility types to travel speed for Package A (see **Figure 7**) shows that much of the VMT attributed to 2015 regional roadway network travels at speeds below 25 mph on non-urban and suburban freeway and arterial facilities. As expected 2030 total VMT is greater than 2015 total VMT in each category. Because the totals are higher between 2015 and 2030, in general the VMT in each speed category is also proportionally higher. However, in the urban freeway as well as the urban and suburban arterial categories, the amount of 2030 VMT in the lower speed category is higher than expected, relative to 2015. Therefore, the emissions are higher in 2030 than 2015 because there is relatively more VMT at a lower speed, which has a higher emission rate. This supports the trend findings of EMIT emissions. For Package B comparisons shown in **Figure 8**, the comparison between 2015 and 2030 exhibits a similar pattern as Package A.

**Figure 7 Comparison of 2015 and 2030 VMT, Speed and Facility Type for Package A**

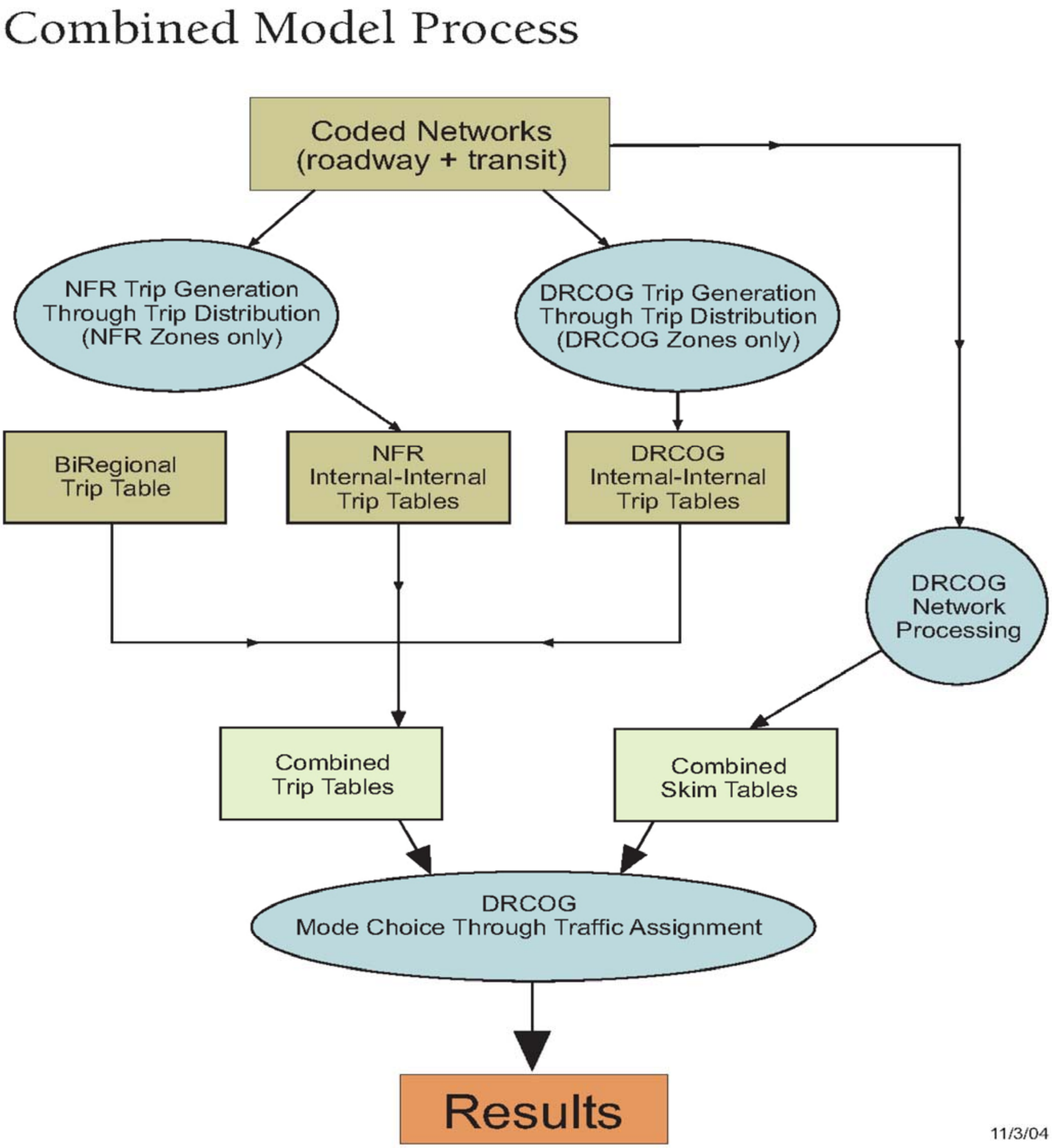


**Figure 8 Comparison of 2015 and 2030 VMT, Speed, and Facility Type for Package A**

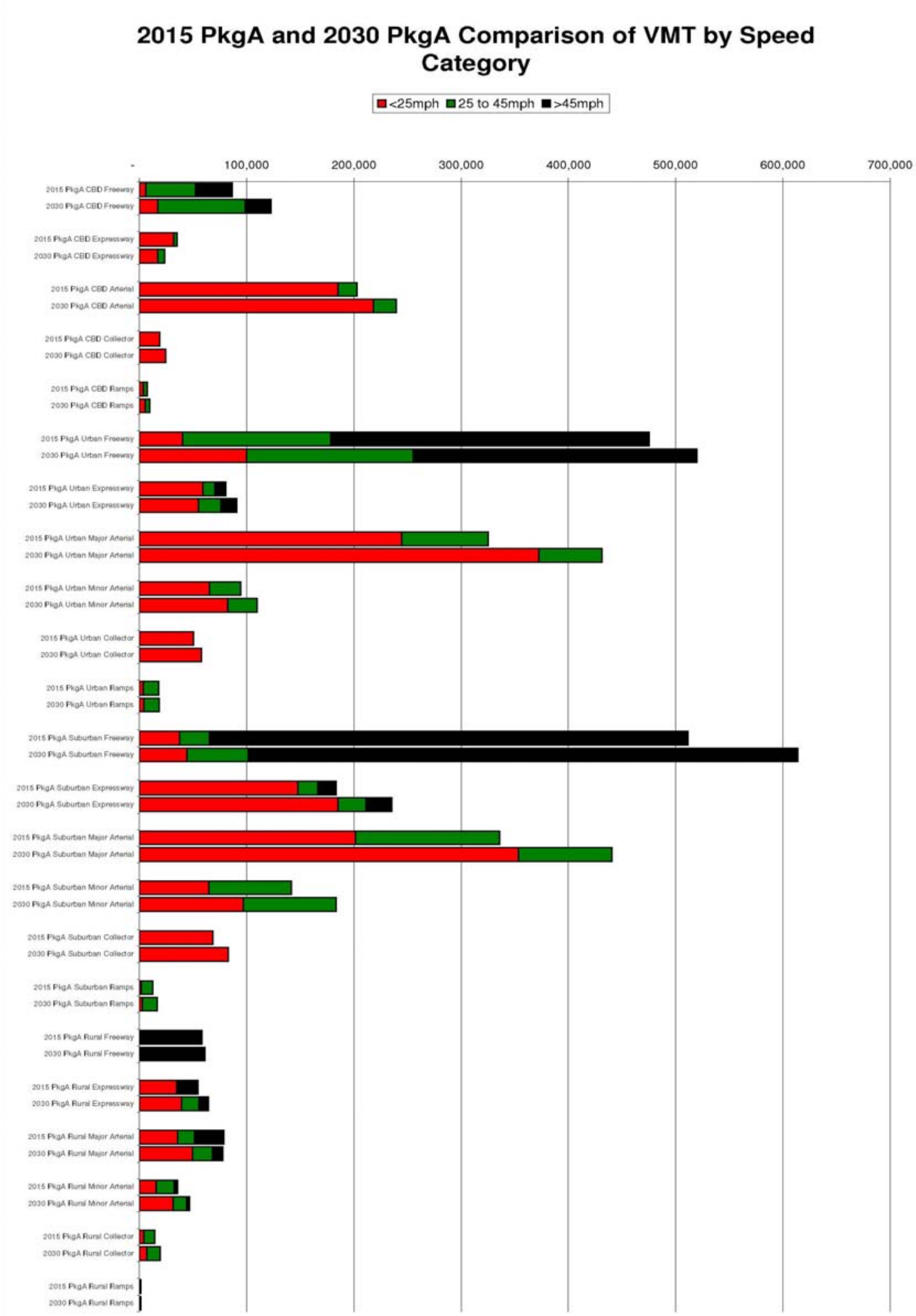


**Figure 9** compares VMT by speed category among the three packages. Because of Package A and Package B highway capacity improvements, high speed VMT on urban and suburban freeways increases slightly in the build alternatives compared to No-Action. Accordingly, the VMT in the 25mph to 45mph category is reduced compared to the No-Action alternative. The speed on major arterials decreased slightly in the Packages (less than 5%). Package A has more high speed VMT than Package B on suburban freeways, as the addition of general purpose lanes in Package A serves more traffic than the tolled express lanes of Package B.

The highest CO emissions generated by motor vehicles occur during idling and at speeds below 20 mph and above speeds of 50 to 55 mph. The 2030 packages (No-Action Alternative, Package A, Package B) would have a higher percentage of vehicles traveling at very slow speeds on all types of roadway facilities than the equivalent roadways in 2015. A higher percentage of highway speed (greater than 55 mph) traffic traveling on new facilities associated with Package A and Package B also would increase the CO emission-generating capacity of the year 2030 compared to the year 2015. This combination of high-emissions generating traffic patterns and volumes appears to be a factor in the slight increase in CO emissions for the year 2030.

Similarly, $PM_{10}$ tailpipe emissions for 2030 would be 32 percent lower than 2001 emissions, yet would be 15 tpy (3.2 percent) higher than estimated 2015 $PM_{10}$ emissions. The $PM_{10}$ emissions rate is not speed dependent, thus the slight increase in regional $PM_{10}$ emissions is associated with the increased volume of traffic and not the character of the roadway network.

The differences in annual regional total emissions between the 2030 No-Action and Package A and Package B is 9.4 tpd and 7.7 tpd, respectively. The total pollutant emissions increases are attributed primarily to the 1 percent higher year 2030 VMT (463,000 and 440,000 vehicles per day [vpd] respectively) for both Package A and Package B.

Total 2030 emissions for Package A would be 1.7 tpd more than total emissions for Package B. Approximately 0.28 tpd would be emissions from the commuter rail [A-H1 and A-H2] component exclusive to Package A. The remaining 1.4-tpd difference would be primarily CO emissions resulting from differences in traffic distribution and the speed-VMT relationship noted above.

**Figure 9 Comparison of 2015 and 2030 VMT, Speed, and Facility Type for Package B**

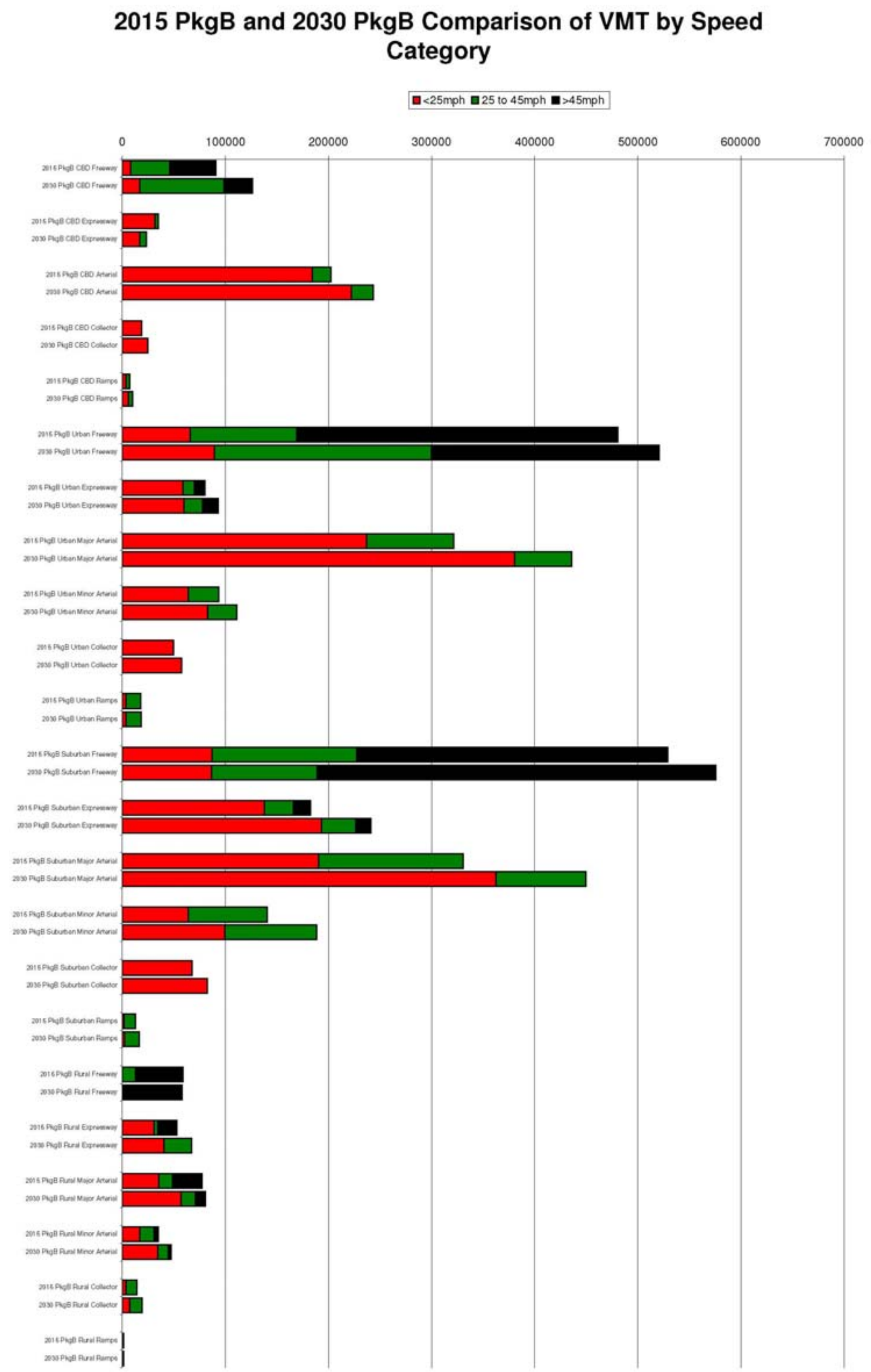
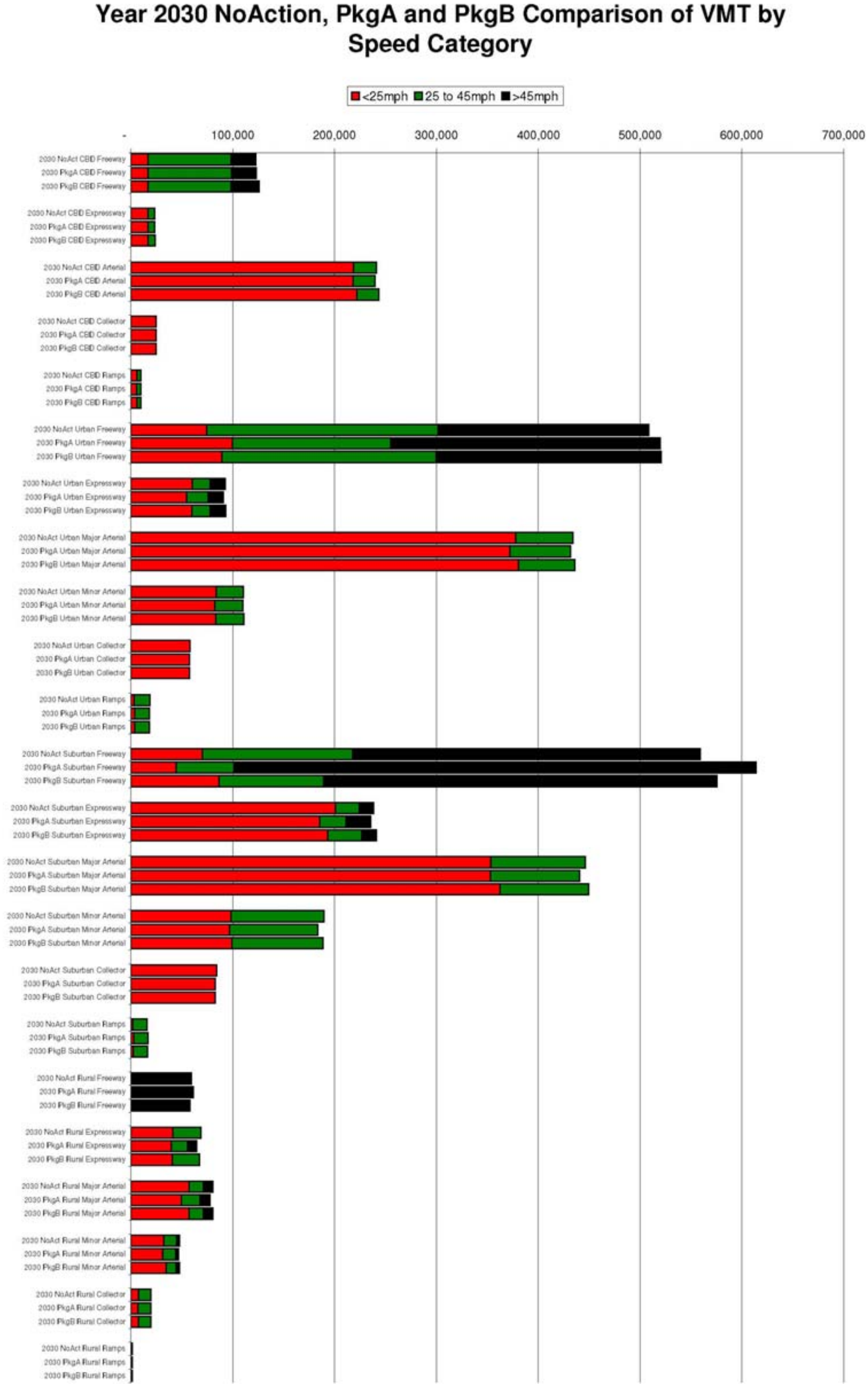


**Figure 10 Comparison of 2030 VMT, Speed and Facility Types for All Packages**



It takes a three-year average of the fourth-highest measured ozone level to be over 0.080 ppm (mathematically over 0.085 ppm) to create a violation similar to those that occurred in the 2003 season. The ozone situation in the summer of 2007 has led to a violation of the 8-hour ozone standard. EPA and APCD are currently evaluating how and when the non-attainment plan will be implemented. Because ozone emissions are a regional pollutant created from photochemical reactions between $NO_x$ and VOCs in the atmosphere, localized sources of these ozone precursors are not easily related to direct ozone effects within the regional study area. Ozone is also created from emissions from non-mobile sources such as lawn mowers, small engine equipment, and industrial sources. Ozone concentration is highly susceptible to weather conditions, such as local upslope winds or regional upper level wind patterns. FHWA has no approved methodology for analyzing impacts from ozone at the project level. However, the conforming TIP will likely not include regional ozone analyses that include Package A or Package B until after the 2035 Regional Transportation Plan has been issued.

MSAT emissions would be reduced between 53 percent and 66 percent for acetaldehyde, acrolein, benzene, 1,3-butadiene, and formaldehyde between 2001 and the 2030 No-Action Alternative. Diesel particulate matter (DPM) was reduced by over 93 percent during that same timeframe. $PM_{10}$ emissions reductions shown in **Table 3** are much less than reductions in DPM emissions because $PM_{10}$ is made up of more components than DPM, including gasoline and diesel engine exhaust and evaporative emissions, brake wear, tire wear and road dust.

All Package A and Package B 2030 MSAT emissions generally would be equal to or less than 1 tpy more than the No-Action levels, except for benzene, which would generate 4 tpy and 5 tpy respectively, more emissions than the No-Action Alternative. Formaldehyde emissions would be 2 tpy more than the No-Action Alternative.

## 4.3 Attainment/Maintenance Area Analysis

Emissions for various air pollutants within each attainment/maintenance area were estimated to provide a comparison against important mobile source air quality area pollutant emission burdens calculated by local planning and air quality agencies for each SIP area. These emission calculations are not representative of attainment/maintenance area conformity modeling and only include that portion of the attainment/maintenance area within the North I-25 regional study area. Comparisons are meant to compare emissions generated among project packages. The mobile source emissions burden estimated for the entire attainment/maintenance is shown in each of the following tables to provide a relative benchmark for package emissions.

Regional study area emission levels were estimated for the existing condition for 2001, and for years 2015 and 2030 for the No Action Alternative, Package A, and Package B. Future emissions were based on traffic distributions, speeds and volumes for each component located in each of the attainment/maintenance areas or located within an area influencing the attainment/maintenance area roadway network (½ mile from the attainment/maintenance area boundary). Emissions levels included seasonal influences, vehicle types and traffic composition.

The following tables show emissions levels for the criteria and MSAT pollutants by SIP (attainment/maintenance) area. In general, emissions from each SIP area mimic the regional trend of decreasing pollutant emissions from current 2001 levels to the year 2015 and to year 2030. Emissions budgets calculated by the various metropolitan planning organizations and published by APCD in the SIP maintenance plan revisions are projected to planning years in the future. Not all planning organizations have updated their plans to a consistent planning year, therefore; emissions budgets listed in the following SIP area data tables may be for different years.

### 4.3.1 Fort Collins Attainment/Maintenance Area For CO

Package A [A-H2, A-T1] and Package B [B-H2, B-T1] components within the Fort Collins SIP area would generate 33.6 percent and 33.9 percent fewer total emissions respectively than are estimated for the baseline condition in 2001. The 2030 design year total CO emissions for Package A and Package B would be 19.7 tons and 19.9 tons, respectively, less than the Fort Collins CO attainment/maintenance plan emissions budget attributed to mobile sources for 2015 (see **Table 4** and **Figure 10**). The regional trend of increasing CO emissions from 2015 to 2030 is not apparent within the Fort Collins SIP area.

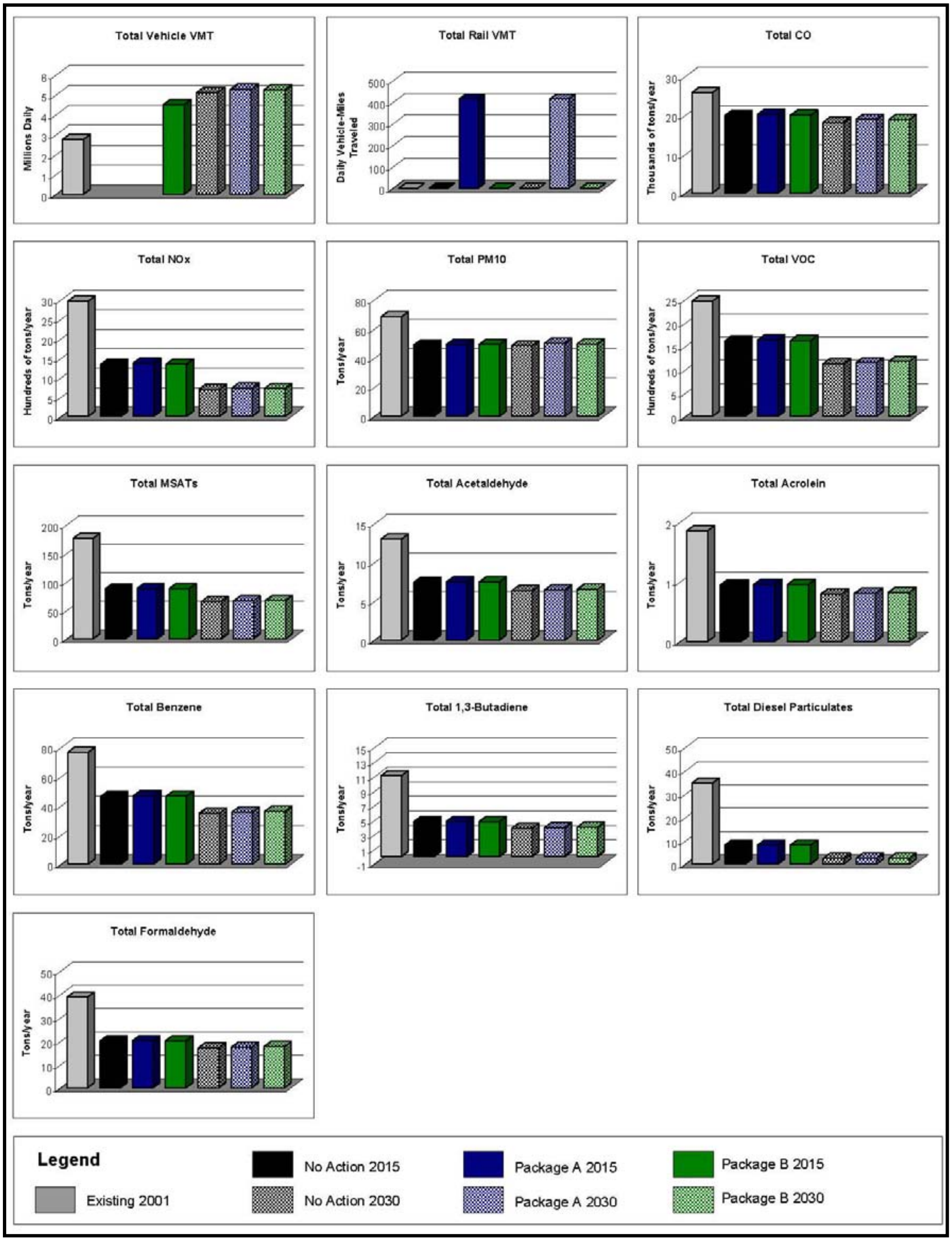
Package A 2030 total emissions would be 87 tons or about 0.4 percent more than those for 2030 in Package B. The largest contributing emissions would come from higher CO and $NO_x$ emissions. This increase would be attributed in part to the commuter rail component [A-T1]. Package B would have lower CO and $NO_x$ emissions, resulting from lower emission rates associated with less congestion (lower emissions rates) and with more freeway traffic (VMT) distribution.

**Table 4 Daily Fort Collins Attainment/Maintenance Area Emissions Estimates**

| Pollutant | Area Mobile Emissions Budget | Year 2001 | No-Action Alternative | | Package A | | Package B | |
|---|---|---|---|---|---|---|---|---|
| | 2015 | | 2015 | 2030 | 2015 | 2030 | 2015 | 2030 |
| Vehicle VMT(daily) | NA | 2,757,650 | 4,491,311 | 5,117,000 | 4,522,375 | 5,269,000 | 4,496,119 | 5,234,000 |
| Rail VMT[A-T1] (daily) | NA | NA | NA | NA | 415 | 415 | NA | NA |
| CO (tons/day) | 71 | 70.70 | 54.35 | 49.75 | 55.36 | 51.75 | 54.72 | 51.47 |
| VOC (tons/day) | NA | 6.74 | 4.41 | 3.08 | 4.47 | 3.14 | 4.44 | 3.22 |
| NOx (tons/day) | NA | 8.09 | 3.65 | 1.90 | 3.74 | 1.98 | 3.67 | 1.96 |
| $PM_{10}$ (tons/day) | NA | 0.19 | 0.13 | 0.13 | 0.13 | 0.14 | 0.13 | 0.14 |
| Acetaldehyde (tons/day) | NA | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| Acrolein (tons/day) | NA | 0.01 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Benzene (tons/day) | NA | 0.21 | 0.13 | 0.10 | 0.13 | 0.10 | 0.13 | 0.10 |
| 1,3-butadiene (tons/day) | NA | 0.03 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Diesel particulates (tons/day) | NA | 0.10 | 0.02 | 0.01 | 0.02 | 0.01 | 0.02 | 0.01 |
| Formaldehyde (tons/day) | NA | 0.11 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 | 0.05 |
| **Total Emissions (tons/day)** | **NA** | 86.20 | 62.78 | 55.04 | 63.96 | 57.20 | 63.19 | 56.97 |

NA – Not Applicable

**Figure 11 Comparison of Fort Collins Attainment/Maintenance Pollutant Emissions (tons per year)**



### 4.3.2 Greeley Attainment/Maintenance Area For CO

Package A [A-T3] and Package B [B-T2] components within the Greeley SIP would generate 29.3 percent and 28.8 percent respectively fewer total emissions than are estimated for the baseline condition in 2001. The 2030 design year total CO emissions for Package A and Package B would be 36.4 tons and 36.2 tons, respectively, less than the estimated Greeley CO attainment/maintenance plan emissions budget attributed to mobile sources for 2030 (see **Table 5** and **Figure 11**).

A comparison shows that Package B within the Greeley SIP area would contribute 0.17 tpd of CO and 0.003 tpd more $PM_{10}$ emissions than Package A. The higher emissions would be due to corresponding higher VMT.

### 4.3.3 Longmont Attainment/Maintenance Area For CO

Package A (A-T2) and Package B (B-T2) components within the Longmont SIP would generate 43.1 percent and 42.2 percent respectively fewer total emissions than are estimated for the baseline condition in 2001. The 2030 design year total CO emissions for Package A and Package B would be 22.6 tons and 22.3 tons, respectively, less than the Longmont CO attainment/maintenance plan emissions budget attributed to mobile sources for 2020 (see **Table 6** and **Figure 12**).

Similar to Greeley, CO and $PM_{10}$ emissions would be subject to emissions controls. Over time, emissions rates would start to go up.

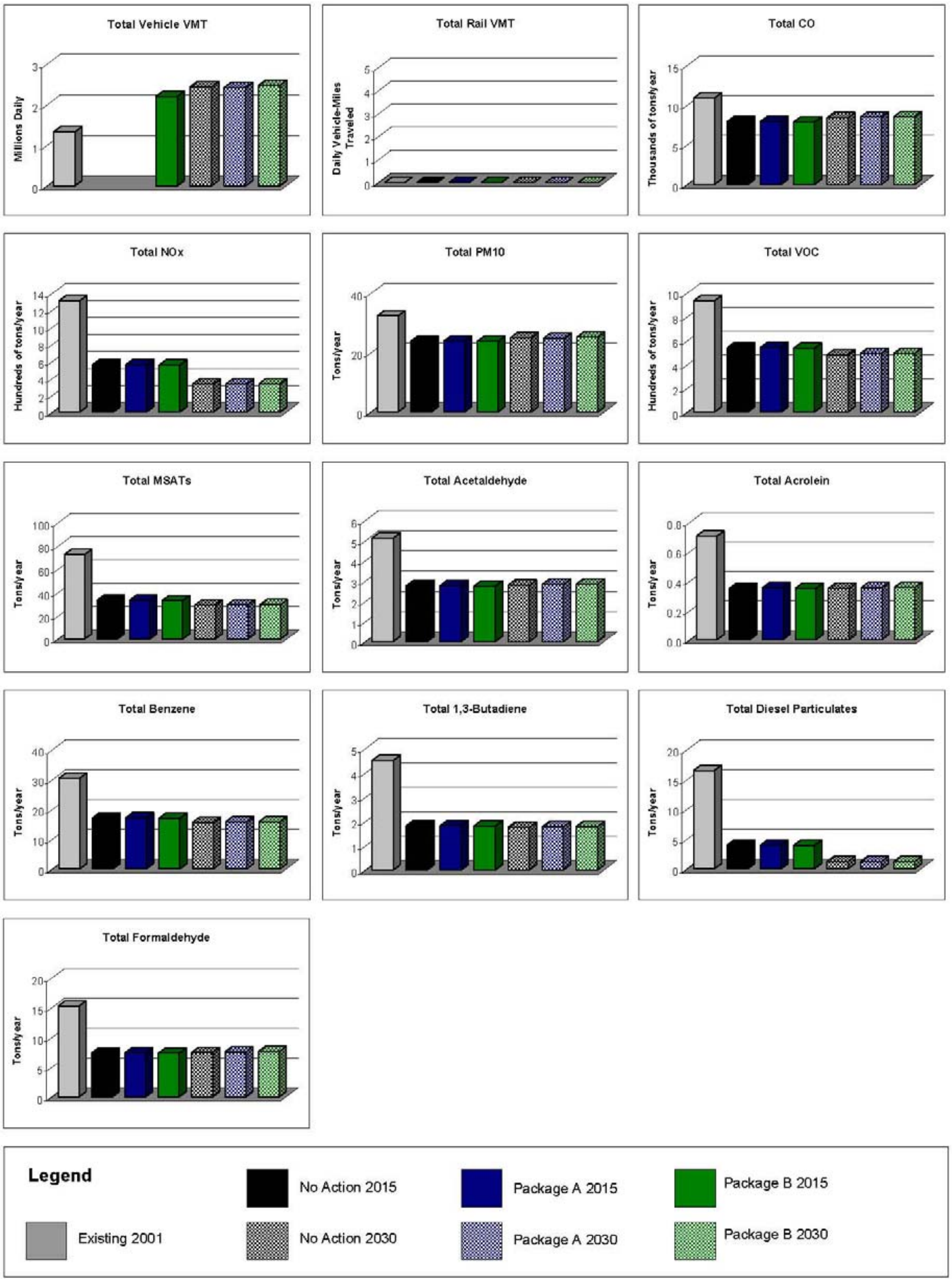
A comparison shows that Package B within the Longmont SIP area would contribute 0.34 tpd more of criteria and MSAT emissions than Package A. The higher emissions would be due to corresponding higher VMT associated with Package B.

## Table 5 Daily Greeley Attainment/Maintenance Area Emissions Estimates

| Pollutant | Area Mobile Emissions Budget | Year 2001 | No-Action Alternative | | Package A | | Package B | |
|---|---|---|---|---|---|---|---|---|
| | 2030 | | 2015 | 2030 | 2015 | 2030 | 2015 | 2030 |
| Vehicle VMT(daily) | NA | 1,324,159 | 2,205,951 | 2,435,000 | 2,211,572 | 2,420,000 | 2,200,730 | 2,470,000 |
| Rail VMT (daily) | NA | NA | NA | NA | 0 | 0 | NA | NA |
| CO (tons/day) | 59.60 | 29.82 | 21.60 | 23.05 | 21.68 | 23.22 | 21.54 | 23.39 |
| VOC (tons/day) | NA | 2.56 | 1.47 | 1.32 | 1.48 | 1.35 | 1.47 | 1.35 |
| $NO_x$ (tons/day) | NA | 3.58 | 1.52 | 0.90 | 1.53 | 0.90 | 1.52 | 0.91 |
| $PM_{10}$ (tons/day) | NA | 0.09 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| Acetaldehyde (tons/day) | NA | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Acrolein (tons/day) | NA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Benzene (tons/day) | NA | 0.08 | 0.05 | 0.04 | 0.05 | 0.04 | 0.05 | 0.04 |
| 1,3-butadiene (tons/day) | NA | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Diesel particulates (tons/day) | NA | 0.04 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 |
| Formaldehyde (tons/day) | NA | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| **Total Emissions (tons/day)** | **NA** | 36.24 | 24.75 | 25.41 | 24.85 | 25.62 | 24.68 | 25.80 |

NA – Not Applicable

**Figure 12 Comparison of Greeley Attainment/Maintenance Area Pollutant Levels (tons per year)**

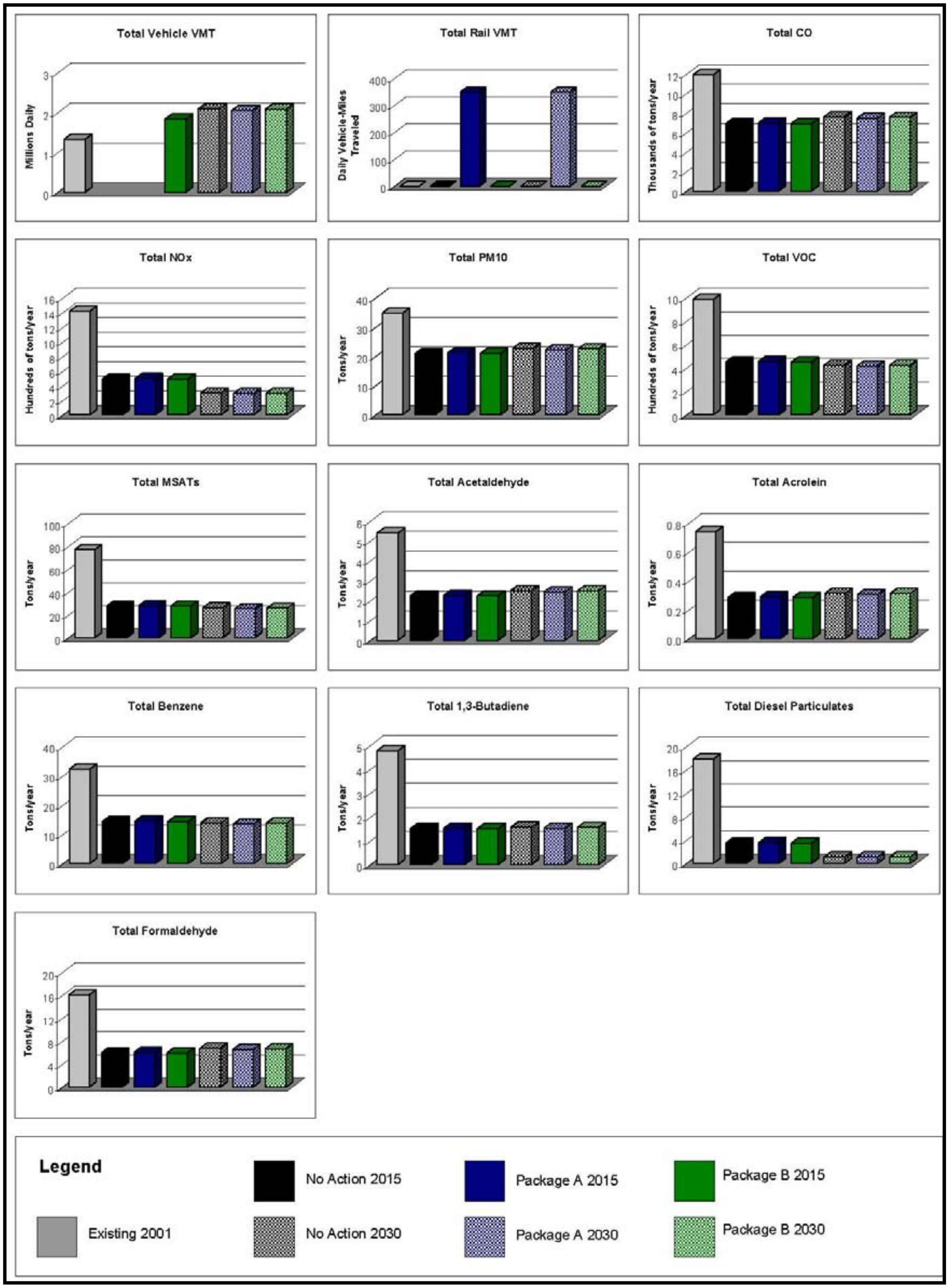


## Table 6 Daily Longmont Attainment/Maintenance Area Emissions Estimates

| Pollutant | Area Mobile Emissions Budget | Year 2001 | No-Action Alternative | | Package A | | Package B | |
|---|---|---|---|---|---|---|---|---|
| | 2020 | | 2015 | 2030 | 2015 | 2030 | 2015 | 2030 |
| Vehicle VMT(daily) | NA | 1,331,417 | 1,823,737 | 2,090,000 | 1,843,839 | 2,050,000 | 1,830,951 | 2,082,000 |
| Rail VMT [A-T2](daily) | NA | NA | NA | NA | 350 | 350 | NA | NA |
| CO (tons/day) | 43.00 | 32.61 | 18.91 | 20.85 | 19.16 | 20.39 | 18.94 | 20.71 |
| VOC (tons/day) | NA | 2.70 | 1.23 | 1.16 | 1.25 | 1.14 | 1.23 | 1.15 |
| $NO_x$ (tons/day) | NA | 3.88 | 1.34 | 0.81 | 1.36 | 0.79 | 1.34 | 0.81 |
| $PM_{10}$ (tons/day) | NA | 0.10 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 | 0.06 |
| Acetaldehyde (tons/day) | NA | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Acrolein (tons/day) | NA | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 |
| Benzene (tons/day) | NA | 0.09 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| 1,3-butadiene (tons/day) | NA | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Diesel particulates (tons/day) | NA | 0.05 | 0.01 | 0.00 | 0.01 | 0.00 | 0.01 | 0.00 |
| Formaldehyde (tons/day) | NA | 0.04 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 | 0.02 |
| **Total Emissions (tons/day)** | **NA** | 39.49 | 21.61 | 22.96 | 21.91 | 22.46 | 21.65 | 22.81 |

NA – Not Applicable

## Figure 13 Comparison of Longmont Attainment/ Maintenance Pollutant Levels



### 4.3.4 Denver Attainment/Maintenance Areas For CO, $PM_{10}$ and Ozone

Package A (A-H3, A-H4, A-T2) and Package B (B-H3, B-H4, B-T2) components within the Denver SIPs would generate 46.7 percent and 46.4 percent fewer total emissions than are estimated for the baseline condition in 2001. The 2030 design year total CO emissions for Package A and Package B would be well below the Denver CO attainment/maintenance plan emissions budget attributed to mobile sources for 2025 (see **Table 7** and **Figure 13**).

Similar to Greeley, CO and $PM_{10}$ emissions would be subject to emissions controls. Over time, emissions rates would start to go up.

A comparison shows that Package B within the Denver SIP area would contribute more overall criteria pollutant and MSAT emissions than Package A. The higher emissions would be due to corresponding higher VMT (93,570 vehicle-miles per day) associated with Package B.

### 4.3.5 Project-Level CO Analysis

Carbon monoxide emissions rates have been steadily declining over the past 10 years due to improvements in vehicle engine emission controls, motor efficiency, and fuel composition. However, traffic volumes due to increasing population and travel trips are continuing to rise over time. Ambient monitoring levels for CO concentrations within the regional study area have remained below 5 ppm since 2000. The highest 2005 readings for 8-hour CO in the regional study area were 3.2 ppm, 3.0 ppm, and 2.9 ppm for monitors located in Fort Collins, Greeley, and Denver CAMP, respectively.

Pollutant levels from CO emissions were estimated using CAL3QHC air quality dispersion modeling. This model is used to estimate CO concentrations at poorly operating signalized intersections to simulate worst-case localized air pollutant emissions at points where vehicles congregate, incorporating idling emissions and start-stop traffic conditions. High volume intersections and interchanges within the regional study area affected by Package A and Package B traffic conditions, and operating with unacceptable levels of congestion (LOS D or worse) were selected through consultation with CDPHE-APCD, EPA, and FHWA for project-level "hot spot" analysis. The following locations were identified for CO hot spot analysis:

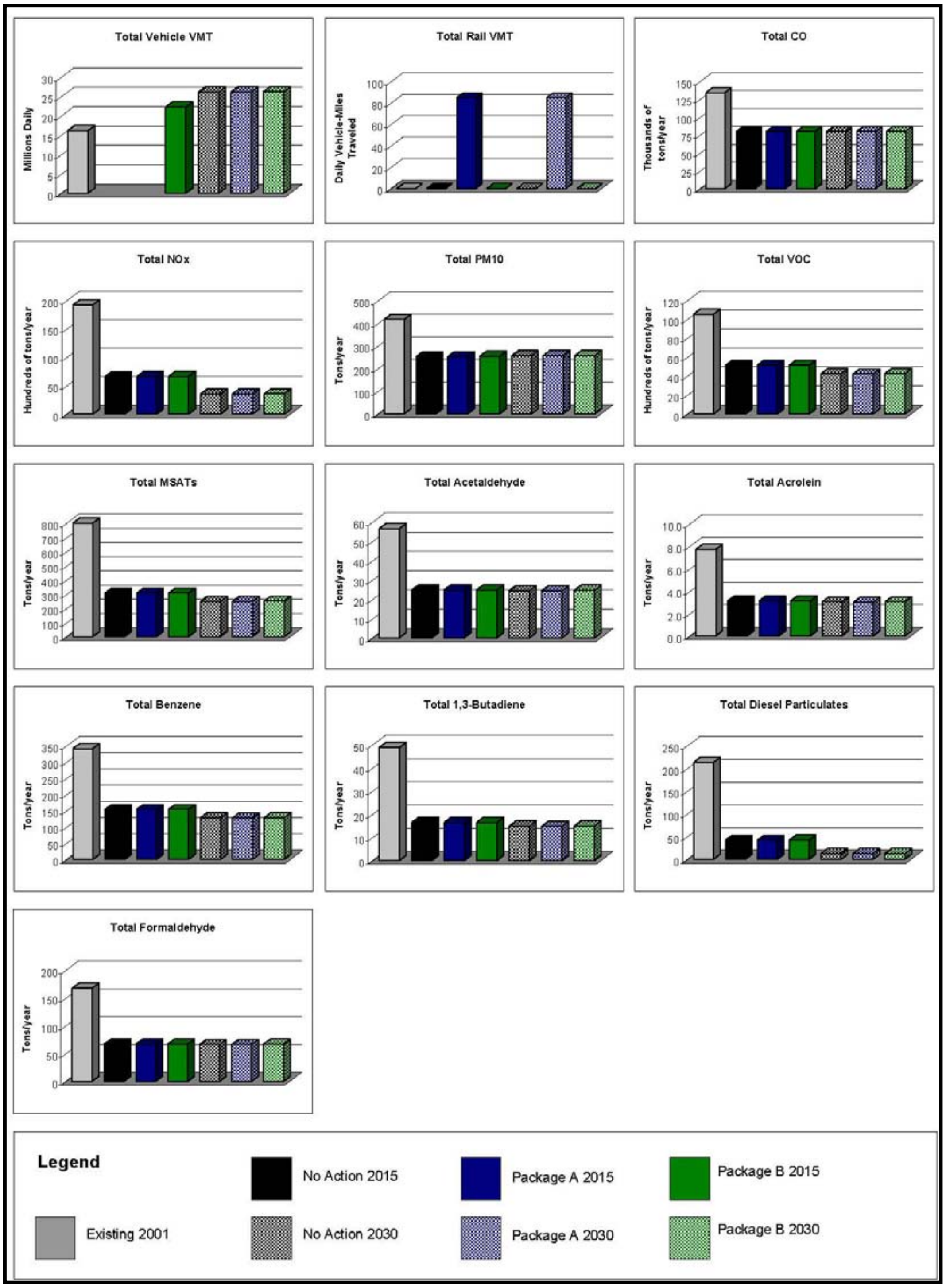
- Harmony Road and I-25 [A-H2] (Fort Collins SIP)
- Evans Bus Station at 31st Street and US 85 [A-T3, B-T1, B-T2] (Greeley SIP)
- Sugar Mill Transit Station at SH 119 and County Line Road [A-T2] (Longmont SIP)
- SH 7 and I 25 [A-H3] (Denver SIP)
- Thornton Parkway and I-25 [A-H4] (Denver SIP)

## Table 7 Daily Denver Attainment/Maintenance Area Emissions Estimates

| Pollutant | Area Mobile Emissions Budget | Year 2001 | No-Action Alternative | | Package A | | Package B | |
|---|---|---|---|---|---|---|---|---|
| | 2025 | | 2015 | 2030 | 2015 | 2030 | 2015 | 2030 |
| Vehicle VMT(daily) | NA | 16,154,443 | 22,171,981 | 26,085,179 | 22,163,596 | 26,131,341 | 22,240,082 | 26,224,911 |
| Rail VMT (daily) [A-T2] | NA | NA | NA | NA | 85 | 85 | NA | NA |
| CO (tons/day) | 1,410.00 | 368.01 | 218.29 | 218.54 | 218.72 | 218.59 | 219.64 | 219.97 |
| VOC (tons/day) | 56.00 | 28.86 | 14.03 | 11.63 | 14.08 | 11.55 | 14.08 | 11.69 |
| NOx (tons/day) | 55.00 | 52.67 | 17.98 | 9.68 | 18.02 | 9.69 | 18.12 | 9.74 |
| $PM_{10}$ (tons/day) | NA | 1.14 | 0.69 | 0.70 | 0.69 | 0.70 | 0.70 | 0.71 |
| Acetaldehyde (tons/day) | NA | 0.15 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 | 0.07 |
| Acrolein (tons/day) | NA | 0.02 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 | 0.01 |
| Benzene (tons/day) | NA | 0.93 | 0.42 | 0.35 | 0.42 | 0.35 | 0.42 | 0.35 |
| 1,3-butadiene (tons/day) | NA | 0.13 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 | 0.04 |
| Diesel particulates (tons/day) | NA | 0.58 | 0.12 | 0.03 | 0.12 | 0.03 | 0.12 | 0.03 |
| Formaldehyde (tons/day) | NA | 0.46 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 | 0.18 |
| **Total Emissions (tons/day)** | **NA** | 452.96 | 251.83 | 241.22 | 252.35 | 241.21 | 253.37 | 242.79 |

NA – Not Applicable

## Figure 14 Comparison of Denver Attainment/Maintenance Pollutant Levels



Traffic volumes at these intersections are among the highest in their respective corridors and SIP areas. All of the above intersections experience current congestion at peak hours. These intersections and interchanges would continue to experience congestion in the future under the No-Action Alternative, Package A, or Package B. Each location was modeled for the proposed 2030 traffic volumes, number of through lanes, turning lanes, and signalization.

Motor vehicle emissions rates for 2001 were combined with projected 2030 peak-hour traffic volumes at each intersection to utilize the highest emissions rate with the highest traffic volumes, to represent the worst-case modeling conditions for future years (see **Table 8**). Modeled receptors are located approximately 10 feet from the edge of roadways.

The project-level CO analyses resulted in no exceedances of the NAAQS at any of the identified interchanges and intersections representing the highest volume and worst operations within the regional study area. The highest modeled 8–hour average concentration was 6.9 ppm associated with Site E of the Sugar Mill Transit Station [A-T2] at the poorly operating intersection of SH119 and County Line Road in Longmont. This value is below the federal 8–hour CO NAAQS of 9 ppm. Carbon monoxide concentrations 100 feet from the Sugar Mill intersection would be 3 ppm. Lower concentrations would be expected at greater distance from the roadway due to dispersion of the pollutions by wind and air turbulence.

## Table 8 Results of Hot Spot Analyses for Carbon Monoxide

| Location | Alternative | 2030 Traffic Volume (vpd) | 1-hour Background CO Concentration | NAAQS 1-hour Standard CO[2] | Maximum 1-Hour CO Concentration[2] | 8-hour background CO concentration | NAAQS 8-hour Standard CO[2] | Maximum 8-Hour CO Concentration[2] |
|---|---|---|---|---|---|---|---|---|
| Harmony Road and I-25 | No Action | 53,700 | 4 ppm | 35 ppm | 8.7 ppm | 2.4 ppm | 9 ppm | 5.1 ppm |
| Harmony Road and I-25[1][A-H2 Component] | Package A | 57,700 | 4 ppm | 35 ppm | 9.3 ppm | 2.4 ppm | 9 ppm | 5.5 ppm |
| Harmony Road and I-25[1] [B-T1 Component] | Package B | 55,650 | 4 ppm | 35 ppm | 9.3 ppm | 2.4 ppm | 9 ppm | 5.5 ppm |
| Evans Bus Station, 31st and US 85 | No Action | 51,650 | 3.6 ppm | 35 ppm | 8.4 ppm | 2.5 ppm | 9 ppm | 5.3 ppm |
| Evans Bus Station, 31st and US 85 [A-T3 only] | Package A | 48,900 | 3.6 ppm | 35 ppm | 8.4 ppm | 2.5 ppm | 9 ppm | 5.3 ppm |
| Sugar Mill Rail Station Site E | No Action | 20,400 | 3.4 ppm | 35 ppm | 7.7 ppm | 2.6 ppm | 9 ppm | 5.1 ppm |
| Sugar Mill Rail Station Site E[1] [A-T2] | Package A | 40,750 | 3.4 ppm | 35 ppm | 10.8 ppm | 2.6 ppm | 9 ppm | 6.9 ppm |
| SH 7 and I-25 | No Action | 61,500 | 3.3 ppm | 35 ppm | 7.3 ppm | 2.2 ppm | 9 ppm | 4.4 ppm |
| SH 7 and I-25[1] [A-H3 Component] | Package A | 62,150 | 3.3 ppm | 35 ppm | 7.3 ppm | 2.2 ppm | 9 ppm | 4.5 ppm |
| SH 7 and I-25[1] [B-T1 Component] | Package B | 63,250 | 3.3 ppm | 35 ppm | 7.3 ppm | 2.2 ppm | 9 ppm | 4.5 ppm |
| Thornton Parkway and I-25 | No Action | 42,850 | 3.1 ppm | 35 ppm | 5.8 ppm | 1.8 ppm | 9 ppm | 3.5 ppm |
| Thornton Parkway and I-25 [A-H4 Component] | Package A | 42,850 | 3.1 ppm | 35 ppm | 5.8 ppm | 1.8 ppm | 9 ppm | 3.5 ppm |
| Thornton Parkway and I-25 [B-T2 Component] | Package B | 44,350 | 3.1 ppm | 35 ppm | 5.8 ppm | 1.8 ppm | 9 ppm | 3.5 ppm |

[1] Includes traffic operations associated with egress/ingress at transit stations.
[2] Parts per million concentration

### 4.3.6 Project-Level $PM_{10}$ Analysis

$PM_{10}$ is one of the air quality criteria pollutants outlined in the Clean Air Act that is generated, in part, by motor vehicles. $PM_{10}$ is a pollutant of concern in the Denver attainment/maintenance area. Although this analysis addresses emissions generated by mobile sources, area and point source $PM_{10}$ emissions in the Denver area include the Denver International Airport, Buckley Air Force Base, a large oil refinery complex, four power generation plants, and other industrial sources.

Some $PM_{10}$ particles are formed by eroded natural surface rock and soil material and enter the air through a variety of actions including "entrainment" into the atmosphere by wind-blown dust. This is particularly important to the Denver Metro Area because it is situated within a low-lying basin where atmospheric temperature inversions trap entrained dust and other pollutants underneath a ceiling of overriding cold air. This frequent condition creates stagnant air within the Denver Metro Area and acts to concentrate pollutants. Counteracting this condition, Denver also experiences very strong westerly winds that effectively disperse pollutants. These same winds act to accelerate entrainment of exposed dust and sand.

Particles from winter road sanding, brake and tire wear, pavement wear, and other vehicle degenerative processes contribute to $PM_{10}$. Fugitive dust is one of the major contributors of $PM_{10}$ in the regional study area. Fugitive dust is mainly dust from roads, fields and construction sites. Mobile sources of fugitive dust includes road dust generated from vehicle entrainment of excess roadside sand, as ell as non-roadway vehicle dust contributed from motorized vehicles that typically operate off-road, such as farming equipment, recreational vehicles, construction equipment, and airport vehicles. The primary vehicular emissions source of $PM_{10}$ comes from diesel engines which are critical to both the transit and transportation freight industries.

The CDPHE-APCD enforces several regulations through the auspices of the Air Quality Control Commission (AQCC) to reduce particulate emissions from mobile sources as control strategies and contingency measures for non-attainment areas, including gas and diesel motor vehicle inspections and maintenance programs (Regulations 11 and 12) and street-sanding and sweeping standards to clean up winter sanding operations and excess roadside sand accumulations (Regulation 16).

There is currently no FHWA-approved quantitative dispersion modeling methodology for assessing $PM_{10}$, therefore a qualitative analysis was performed following the guidelines presented in the *Transportation Conformity Guidance for Qualitative Hot-Spot Analyses in* $PM_{2.5}$ *and* $PM_{10}$ *Non-attainment and Maintenance Areas* (2006).

A survey of $PM_{10}$ levels recorded from monitoring stations within the regional study area for the years 2001 to 2006 shows that there have not been any exceedances of the annual or 24-hour NAAQS from monitoring stations within the Denver and northern Front Range areas. Although the annual average $PM_{10}$ standard was revoked by the EPA in December 2006, maximum concentrations recorded at area monitoring stations have been listed in **Table 9** for comparison purposes.

## Table 9 Maximum Annual Mean and 24-Hour Particulate Matter Concentrations

| Monitoring Station | $PM_{10}$ | | | |
|---|---|---|---|---|
| | Average Annual[1] | | 24-Hour | |
| | Std | Max | Std | Max |
| Brighton | 50 | 27.6 | 150 | 102 |
| Commerce City | 50 | 38.9 | 150 | 142 |
| Welby | 50 | 35 | 150 | 140 |
| Boulder 2440 Pearl Street | 50 | 24 | 150 | 75 |
| Longmont | 50 | 22 | 150 | 75 |
| Denver CAMP | 50 | 39 | 150 | 103 |
| Denver Gates | 50 | 39.3 | 150 | 84 |
| Denver Visitors Center | 50 | 37 | 150 | 119 |
| Fort Collins | 50 | 21 | 150 | 130 |
| Greeley | 50 | 22 | 150 | 96 |

Only the southernmost segment of the 45-mile long regional study area, including Package A commuter rail [A-T1, A-T2], Package B new BRT-express lanes [B-T1], and station facilities associated with each package, is located in the Denver attainment/maintenance area for $PM_{10}$. Consultation with CDPHE-APCD, EPA, and FHWA determined that the project-level hot spot analysis would be conducted at a worst-case transit station parking facility within the regional study area and a comparative analysis for each of the four proposed bus and rail maintenance facilities located outside of the Denver $PM_{10}$ attainment/maintenance area. The intention of these project-level qualitative analyses is to assess whether the project would be likely to cause or contribute to any new localized $PM_{10}$ violations or increase the frequency or severity of any existing violations (40 CFR 93.116).

The project-level analysis did not include fugitive dust or construction generated emissions. Road re-entrained dust emission is a function of road silt content average weight of vehicles, and VMT. Because only VMT would change as a result of Package A or B, fugitive dust from roads would be proportionate to VMT. Package A would therefore increase road re-entrained dust by approximately 0.95% over the No-Action Alternative and 80% over existing levels. Package B would increase road re-entrained dust by approximately 0.90% over the No-Action Alternative and 81% over existing levels.

## North Fort Collins Commuter Rail Maintenance Yard

The commuter rail operations and maintenance facility [A-T1] located off East Vine Street and North Timberline Road in Fort Collins would accommodate end-of-the-line storage, repair and inspection of train components, including locomotive and coach units. The expected fleet would consist of six EPA Tier 2 motorized units: either diesel multiple units (DMU) or locomotive hauling coaches (LHC). The choice of operating units would be compatible with the FasTracks North Metro commuter rail connecting Denver Union Station with the Package A Fort Collins—Longmont commuter rail terminus.

The site is estimated to be 76 acres of track, open yard and service buildings housing administration, employee services and parts storage, parking, water quality facilities, on-site fueling centers, areas for vehicle cleaning, equipment repair, paint and body shops, yard utilities, track sanding facilities, repair bays, and docks. Yard run-around and bypass tracks, double end access, layover track, and lead tracks to the main line would form the ground facilities.

Currently, the site at East Vine and North Timberline is surrounded by undeveloped and agricultural land. A small construction yard is located south of Vine Street near the site. A developing residential area and apartment complex are located northeast of the site. A mobile home park, as well as industrial and commercial development, occupies land west of Timberline near the site.

## Berthoud Commuter Rail Maintenance Yard

The proposed 61.6 acre maintenance yard [A-T2], located at CR 46 and US 287 in Berthoud, would have the same functions and operations as the Fort Collins Commuter Rail Yard.

Existing railroad tracks flank the west side of the Berthoud site. Single and multi-family residences lie scattered to the west and southwest of the tracks. The surrounding land is mostly undeveloped with some active crop farming to the northwest. An industrial and manufacturing complex is located south of the proposed site.

## Rail Hot Spot Analysis

A comparative analysis of $PM_{10}$ emissions was used to evaluate the potential for causing or contributing to any new localized $PM_{10}$ violations or increase the frequency or severity of any existing violations (40 CFR 93.116).

Qualitatively, the proposed rail maintenance yards were compared to an existing air quality analysis completed for an early, un-adopted version of the *US 36 Corridor Draft EIS* (dated August 4, 2006) at Rennick Rail Maintenance Yard located in Boulder County. Both North I-25 corridor commuter rail maintenance yards were delineated to a conceptual level of design. Although yard site functions and general operational capacities have been identified, site specific track layout and rail operations and repair schedules have not yet been defined. Therefore, project-level $PM_{10}$ emissions would be compared to the US 36 corridor site under one set of parameters and the results related to each site. For the US 36 analysis, a worst-case LHC technology was assumed because it is more maintenance intensive and requires accommodating longer train lengths compared to DMU technology.

Air quality $PM_{10}$ effects from the US 36 Rennick Rail Maintenance Yard were estimated for the US *36 Corridor Draft EIS* by calculating the emissions from LHC engine traffic and modeling those emissions using an EPA-approved Industrial Source Complex Short-Term (ISCST3) dispersion model. Emissions factors acquired from RTD for EPA Tier 2 commuter rail units were used in the analysis. Emission factors approved by CDPHE-APCD for diesel multiple units are substantially lower than these, so this analysis represents a worst case.

The results of the *US 36 Draft EIS* rail maintenance yard modeling indicate that the maximum predicted concentration for 24-hour $PM_{10}$ was 5.6 micrograms per cubic meter (ug/$m^3$), which is above the 5 ug/$m^3$ 24-hour $PM_{10}$ significance level standard used in evaluation of plume source dispersion modeling. The maximum impact was determined to occur at a receptor located downwind from and at the boundary of the rail yard facility located directly in line with the emission sources representing two rows of three idling LHC engines situated in the center of the facility. All other receptors modeled around the periphery of the facility were below the designated significance level. The highest annual $PM_{10}$ concentration was 1.6 ug/$m^3$ and exceeded the annual $PM_{10}$ significance level of 1 ug/$m^3$ at several receptors modeled around the facility boundary.

Although the predicted impacts exceed the plume modeling significance levels, they are well below the NAAQS. To provide a conservative evaluation of emissions levels in and around the yard, background levels from one of the highest reading $PM_{10}$ ambient monitoring stations within the area were added to the calculated emissions. The Denver CAMP monitoring station located in downtown Denver was selected because it represented the highest background levels of $PM_{10}$ during the years 1999 to 2003. The maximum second-highest 24-hour value measured during that period was 75 ug/$m^3$. This value represents a conservative background concentration that would include influences from other mobile, industrial, and natural sources in the Denver area. Adding this background to the maximum 24-hour value for the maintenance yard, the total predicted impact is 80.6 ug/$m^3$, which is well below the NAAQS of 150 ug/$m^3$. Likewise, adding the highest annual measured value from Denver CAMP of 38 ug/$m^3$ to the modeled maintenance yard annual maximum value of 1.6 ug/$m^3$ would total 39.6 ug/$m^3$, below the NAAQS annual $PM_{10}$ value of 50 ug/$m^3$. Thus, there would be no exceedances of air quality standards for such a facility.

Comparison of the North Fort Collins and Berthoud Rail Yards to the US 36 Rennick Rail Yard shows similar function, similar yard size, and a smaller operating engine fleet as tabulated in **Table 10**. The emissions generated at the Rennick facility are well below the $PM_{10}$ NAAQS for the maximum predicted 24-hour and annual emissions levels. Additionally, if lower polluting DMU engines are selected as operating units on the North I-25 corridor rail package, emissions would be expected to be lower than those predicted at the US 36 Rennick Yard. Therefore, emissions generated at each of the proposed North Fort Collins and Berthoud Yards would be less than the NAAQS and would be unlikely to cause or contribute to any new localized $PM_{10}$ violations or increase the frequency or severity of any existing violations.

**Table 10 Comparisons of Commuter Rail Maintenance Yards North I-25 to US 36 Corridor Rennick Rail Maintenance Yard**

| Rail Yard | Rail Type | Engine Fleet Size | Yard Ground Size (acre) | Functions and Operations | Conclusion |
|---|---|---|---|---|---|
| US 36 Rennick | LHC | 11 | 58.0 | Similar | Emissions are below 24-hour and annual NAAQS levels for $PM_{10}$ |
| North Fort Collins [A-T1] | DMU or LHC | 6-8 | 76.1 | Similar | Emissions would be similar to the Rennick Yard |
| Berthoud [A-T2] | DMU or LHC | 6-8 | 61.6 | Similar | Emissions would be less than Rennick Yard |

## Greeley Commuter Bus /BRT Maintenance Facility

The proposed commuter bus operations and maintenance facility at 31st Street and 1st Avenue in Greeley would accommodate covered storage, repair and inspection the bus fleet consisting of 38 buses for Package A US 85 commuter service and a portion of 43 total buses for Package B Bus Rapid Transit and feeder bus service. This facility would be deployed for either Package A or Package B.

The site is estimated to be 4.6 acres of service buildings, administration offices, employee services, tire and parts storage, parking, water quality facilities, on-site fueling centers, areas for vehicle cleaning, paint and body shops, and repair bays. The entire 2 acre open yard area would be paved and have multiple access points.

The area surrounding the proposed 31st and 1st Avenue bus maintenance yard is commercial and undeveloped land.

## Fort Collins BRT Maintenance Facility

This proposed facility at Portner and Trilby Roads in Fort Collins would be a second option for a facility deployed for Package B to provide facilities for feeder bus line and BRT fleets. The BRT operations and maintenance facility would accommodate covered storage, repair and inspection a portion of the total bus fleet of 43 buses. The new facility augments an existing bus maintenance and storage facility operated by the City of Fort Collins. The 7.4 acre site would have the same functions, facilities and operations as the Greeley Commuter Bus Maintenance Facility.

The site is located in an area of commercial and undeveloped land, while outlying areas are surrounded by increasingly urbanized development including low density to medium density residential areas and remnant agricultural properties.

## Commuter Bus and BRT Hot Spot Analysis

A comparative analysis of $PM_{10}$ emissions was used to evaluate the potential for either bus maintenance facility causing or contributing to any new localized $PM_{10}$ violations or increase the frequency or severity of any existing violations (40CFR93.116).

The $PM_{10}$ monitoring stations located near the proposed Greeley and Fort Collins maintenance facilities recorded maximum 24-hour $PM_{10}$ concentrations of 96 ug/$m^3$ and 130 ug/$m^3$ respectively in the past 10 years.

Both North I-25 Corridor commuter bus and BRT maintenance yards were delineated to a conceptual level of design. Although yard site functions and general operational capacities have been identified, site specific circulation, storage and repair schedules have not yet been defined. A relative comparison of facility bus fleet and site size at each facility was used to indicate whether the proposed maintenance facilities would be likely to generate more or less emissions than a similarly functioning bus maintenance facility located at Commerce City within the Denver $PM_{10}$ attainment/maintenance area (see **Table 11**).

The **Colorado State Implementation Plan for $PM_{10}$ Revised 2005 Summary of Dispersion Model Results** was used to formulate a comparison using total emissions model grid cell data for area of the Commerce City maintenance facility (Grid Cell No.96). The modeled grid data is used to establish emissions concentrations associated with a larger, modeled bus maintenance facility within the $PM_{10}$ attainment/ maintenance area. The Commerce City site is located in a highly industrialized area. The regional $PM_{10}$ modeling grid point includes emissions generated from other sources than vehicular mobile sources, such as industrial and urban area generators, and therefore provides a more conservative reference to compare among the Greeley and Fort Collins sites.

**Table 11 Comparisons of Physical Attributes of the Commuter Bus Maintenance Facility in Commerce City to North I-25 Bus and BRT Maintenance Facilities**

| Maintenance Facility | Bus Type | Bus Fleet Size | Yard Ground Size | Functions and Operations | Comparative Emissions Estimate |
|---|---|---|---|---|---|
| Commerce City (Commuter and Regional Bus Service) | Standard Diesel Commuter Bus and Diesel Coach | 118 | 14 acres | Similar | Emissions are some of the highest within the conformity modeling area. |
| Greeley [A-T2] or [B-T1] | Standard Diesel Commuter or Diesel Coach | 38-43 | 4.6 acres | Similar | Emissions are estimated to be 68% less than the Commerce City facility |
| North Fort Collins [B-T1] | Standard Diesel Commuter Bus and Diesel Coach | 43 | 7.4 acres | Similar | Emissions are estimated to be 64% less than the Commerce City facility |

As shown in **Table 12**, expected increase in 98 percentile maximum $PM_{10}$ concentrations are all remain below the NAAQS of 150 ug/$m^3$ in the interim year 2015 and design year 2030 at the proposed North I-25 Corridor facilities. This suggests that for these scenarios, no emissions violation or increase in frequency or severity of violation are anticipated due to operations at the Greeley or Fort Collins Bus or BRT maintenance facilities.

**Table 12 Comparison of Commerce City, Greeley and Fort Collins Maintenance Facilities**

| Location Description | Grid Cell Number | NAAQS $PM_{10}$ (ug/$m^3$) | Total $PM_{10}$ Emissions (98 percentile) (ug/$m^3$) | |
|---|---|---|---|---|
| | | | 2015 | 2030 |
| Commerce City Maintenance Facility | 96 | 150 | 150.86 | 175.45 |
| Greeley Bus Maintenance Facility (Proportional emissions) | NA | 150 | 48.28 | 56.15 |
| Fort Collins BRT Maintenance Facility (Proportional emissions) | NA | 150 | 54.31 | 63.16 |

## Worst-Case Transit and Parking Station

The predicted highest-volume transit station with the largest associated parking lot occurs at the SH 7 BRT station in the morning peak hours. This site is expected to have a maximum idling congregation of four buses at any one peak hour. The site would accommodate 180 parked vehicles under Package A [A-H3 Component] as a commuter parking lot with feeder bus service and 469 parked vehicles under the BRT station parking in Package B (B-T1 Component). Average individual bus idling times are approximately 40 seconds per stop. The maximum number of buses coincident to one parking station at any one peak hour occurs in the peak hours when feeder and mainline US 85 bus headways are shortest. Transit headway refers to the frequency of circulating buses in any one direction on a transit route. A 30-minute headway would be equivalent to two buses per hour. The analyses did not include fugitive dust pollution. Only tailpipe emissions were analyzed.

Traffic accessing the parking facility is expected to operate at an acceptable level of service during peak morning hours. Level of service (LOS) in the afternoon peak hours is expected to operate less adequately (LOS D). Passing and parking traffic volumes are listed in **Table 13** and **Table 14**.

**Table 13 Characteristics of SH 7 BRT Station and Parking Facility**

| Peak Hour | 2030 No-Action | 2030 Package A [A-H3] | 2030 Package B [B-T1] |
|---|---|---|---|
| Idling BRT volume | NA | NA | 4 |
| Idling commuter bus | 0 | 4 | 4 |
| Parked vehicles | 0 | 180 | 469 |
| Internal parking travel (VMT) | 0 | 74 | 266 |
| Parking access and pass-by vehicles (VMT) | 5,685 | 5,715 | 5720 |

**Table 14 Daily Peak-Hour $PM_{10}$ Emissions from SH 7 BRT Station and Parking Facility**

| Pollutant | 2030 | | |
|---|---|---|---|
| | No-Action Pass-by Traffic Only | Package A [A-H3] | Package B [B-T1] |
| $PM_{10}$ (tons/year) | 0.06 | 0.07 | 0.08 |

Actual vehicle travel within the parking lot was estimated as requiring each vehicle to traverse two row lengths of the lot to successfully locate and park the vehicle and one row length to exit the lot. A speed of 15 mph was used to calculate an emissions factor for this increment of travel. Emission factors for vehicles were estimated from MOBILE 6.2 look-up tables for typical Denver vehicle compositions utilized in conformity modeling. Future low-sulfur and alternate fuel operating buses would produce less overall emissions; however, idling emissions were not calculated for this analysis.

There are no $PM_{10}$ monitoring stations located near the SH 7 BRT station and parking lot. The **Colorado SIP for $PM_{10}$ Revised 2005 Summary of Dispersion Model Results** was used to formulate a comparison between total emissions model grid cell data at the SH 7 BRT station and parking site [B-T1 Component] (Grid Cell No.155) and at a known similar RTD commuter park-n-Ride facility at the Thornton Parkway (Grid Cell No.125) for purposes of assessing whether the new facility would be likely to cause or contribute to any new localized $PM_{10}$ violations or increase the frequency or severity of any existing violations (40 CFR 93.116) over the project timeline (see **Table 15**). The Denver area $PM_{10}$ maintenance plan dispersion modeling incorporates both area-wide analysis and hot spot analyses to determine regional $PM_{10}$ concentrations. Grid cells at the northern periphery of the modeling domain evaluate an area approximately one kilometer by one kilometer in size and include many more emissions than just the featured sites.

Neither Package A nor Package B are included in the most recent DRCOG and NFRMPO conformity models. VMT comparisons for the two sites show that, in the years 2015 and 2030, the total VMT would only increase 0.009 percent and 0.007 percent respectively due to the new SH 7 facility. This percentage increase has been applied to the 98 percentile $PM_{10}$ values for the SH 7 BRT and Parking Facility and the Thornton Parkway RTD Facility. The result is that expected increases in emissions would all remain below the NAAQS of 150 ug/$m^3$ in the interim year 2015 and design year 2030, suggesting that for these scenarios, no emissions violation or increase in frequency or severity of violation would be anticipated due to installation of the SH 7 BRT and Parking Facility.

**Table 15 Comparison of $PM_{10}$ Dispersion Model Data at SH 7 BRT Station and Parking Lot [B-T1 Component] and Thornton Parkway RTD Facility**

| Location Description | Grid Cell Number | NAAQS ($ug/m^3$) | Total Emissions (98 percentile) ($ug/m^3$) | |
|---|---|---|---|---|
| | | | 2015 | 2030 |
| I-25 and Thornton Parkway RTD Facility without added VMT influence | 125 | 150 | 119.92 | 133.60 |
| I-25 and Thornton Parkway RTD Facility with added VMT influence | 125 | 150 | 119.93 | 133.61 |
| I-25 and SH 7 BRT Station and Parking Facility without added VMT influence | 155 | 150 | 113.28 | 126.59 |
| I-25 and SH 7 BRT Station and Parking Facility with added VMT influence | 155 | 150 | 113.29 | 126.60 |

Results from regional and project level pollutant emissions analyses support that neither Package A nor Package B would be likely to cause or contribute to any new localized $PM_{10}$ violations or increase the frequency or severity of any existing violations (40CFR 93.116). This conclusion would be the same even when read re-entrained dust is included because the increase between either of the two packages and the No Action Alternative is less than one percent.

### 4.3.7 Project-Level MSAT Analysis

A basic quantitative analysis of the mass of air toxic emissions from the regional study area of the proposed project was completed using the latest version of the EPA's mobile emission factor model (MOBILE 6.2) as discussed in **3.5.3.1 Regional Analysis**. The local study area used for this traffic analysis includes all major roadways potentially affected by the proposed new transportation facility.

**Table 16** describes the mass of MSAT emissions associated with the No-Action Alternative, Package A, and Package B. Package A and Package B would generate 1.1% and 1.6% higher emissions, respectively, than the No Action Package in the year 2030. The MSAT emissions in the year 2001 base case was much higher than either the build or no-build cases in the year 2030**.** This is reflective of the overall national trend in MSATs as previously described.

**Table 16 2030 MSAT Emissions (tons per year) by Package**

| Pollutant | 2030 | | |
|---|---|---|---|
| | No-Action | Package A | Package B |
| Vehicle VMT (Daily) | 48,684,000 | 49,147,000 | 49,124,000 |
| Acetaldehyde | 52 | 52 | 53 |
| Acrolein | 7 | 7 | 7 |
| Benzene | 295 | 299 | 300 |
| 1,3-Butadiene | 33 | 34 | 34 |
| Diesel Particulates | 23 | 23 | 23 |
| Formaldehyde | 141 | 142 | 143 |
| **Total Emissions (Tons/year)** | **551** | **557** | **560** |

Regardless of the alternative chosen, MSAT emissions would likely be lower than present levels in the future year as a result of EPA's national control programs that are projected to reduce MSAT emissions by 57 to 87 percent between 2000 and 2020. Local conditions may differ from these national projections in terms of fleet mix and turnover, VMT growth rates, and local control measures. However, the magnitude of the EPA-projected reductions is so great that MSAT emissions in the regional study area would be likely to be lower in the future in nearly all cases.

When evaluating the future options for upgrading a transportation corridor, the major mitigating factor in reducing MSAT emissions is the implementation of the EPA's new motor vehicle emission control standards. Substantial decreases in MSAT emissions would be realized from a current base year (2001) through an estimated time of completion for a planned project and its design year. Accounting for anticipated increases in VMT and varying degrees of efficiency of vehicle operation, total MSAT emissions were predicted to decline more than 65 percent from 2001 to 2025.

The MSATs from mobile sources, especially benzene, have dropped dramatically since 1995, and are expected to continue dropping. In addition, Tier 2 automobiles introduced in model year 2004 would continue to help reduce MSATs. Diesel exhaust emissions have been falling since the early 1990s with the passage of the Clean Air Act amendments. The Clean Air Act amendments provided for improvement in diesel fuel through reductions in sulfur and other components.

The Urban Air Toxics Pilot Program in Denver monitored three locations, all of which are within the regional study area: the downtown Denver CAMP, Swansea Station located at 4650 Columbine Street in metro Denver, and Welby Station located near 78$^{th}$ Avenue and Steele Street in the heart of the Platte River industrial district. Although not all MSATs were monitored at these sites, acetaldehyde, benzene, 1,3-butadiene, and formaldehyde were sampled during the period of May 2002 through April 2003 and were detected 90 percent or more of the time at all three monitoring locations.

Calculated regional MSAT emissions associated with Package A and Package B would be 3.13 tons per year (tpy) and 4.75 tpy, respectively, more than the No-Action Alternative by the design year of 2030. Decreases from the base year are substantial even with the associated increase in VMT in the regional travel study area. Some sensitive receptors do exist but their exposure would decrease from the interim 2015 year to the 2030 design year and beyond. These receptors include schools, churches and community centers.

**Summary of MSAT Analysis:**

**<u>Package A</u>**

The air quality effect from Package A commuter rail and bus service is incrementally neutral. Diesel emissions generated by rail locomotion (DMU or LHC) and diesel-operated transit bus engines are anticipated to be less than current operating levels due to introduction of Tier 3 and 4 low-sulfur fuels and diesel engine emission controls. Transit service would remove an estimated 6,700 to 7,800 individual vehicles daily from the roadway network in the year 2030. The commuter bus and feeder systems would provide roughly 1,600 daily riders with service between various northern Front Range sites to Denver and DIA. This translates to an average of 1,100 vehicles removed from the roadways. However, the reduction associated with vehicles removed from the roadways by Package A transit options would account for only 0.11 percent of total area VMT.

Specific emissions levels for each transit station along these rail and bus routes were not evaluated in this study. However, a worst-case scenario of the largest bus and parking facility within the regional study area generated 6 tpy more MSAT pollutants than the No-Action background traffic scenario. This increase over background levels could affect residential and sensitive receivers, such as schools and hospitals located within immediate proximity of the transit facility. Weather conditions, such as wind or atmospheric inversions, would act to either disperse local pollutants or concentrate pollutants within stagnant air.

**Summary of MSAT Analysis:**

**<u>Package B</u>**

The air quality effect from Package B BRT and feeder bus service would be affected by diesel emissions generated by buses running in the dedicated transit lane. Diesel emission levels would be anticipated to be less than those currently experienced on buses in use in the regional study area, due to introduction of Tier 3 and 4 low-sulfur fuels and diesel engine emission controls. Transit service would remove an estimated 3,900 individual vehicles daily from the roadway network in the year 2030. However, the reduction associated with vehicles removed from the roadways by Package A transit options would account for only 0.39 percent of total area VMT.

Specific emissions levels for each transit station along these rail and bus routes were not evaluated in this study. However, a worst-case scenario of the largest bus and parking facility within the regional study area generated 9 tpy more MSAT pollutants than the No-Action background traffic scenario. This increase over background levels could affect residential and sensitive receivers, such as schools and hospitals located within immediate proximity of the transit facility. Weather conditions, such as wind or atmospheric inversions, would act to either disperse local pollutants or concentrate pollutants within stagnant air.

## Greeley Commuter Bus [A-T3]/BRT Maintenance Facility[B-T1]

A quantitative analysis of MSATs addressed localized emissions associated with the proposed bus maintenance facilities proposed in Packages A [A-T3] and B [B-T1]. Both proposed feeder bus and BRT maintenance yards have been delineated to a conceptual level of design. Although site functions and general operational capacities have been identified, site specific storage, circulation, and repair schedules have not yet been defined. Therefore, project-level MSAT emissions would be calculated under one set of parameters and the results related to each site.

The proposed commuter bus operations and maintenance facility at 31st Street and 1st Avenue in Greeley would accommodate covered storage, repair and inspection, and the bus fleet consisting of 38 buses for Package A US 85 commuter service and a portion of 43 total buses for Package B BRT and feeder bus service. This facility would be deployed for either Package A or Package B.

The site is estimated to be 4.6 acres of service buildings, administration offices, employee services, tire and parts storage, parking, water quality facilities, on-site fueling centers, areas for vehicle cleaning, paint and body shops, and repair bays. The entire 2-acre open yard area would be paved and have multiple access points.

The area surrounding the proposed 31st Street and 1st Avenue bus maintenance yard is commercial and undeveloped land.

## Fort Collins BRT Maintenance Facility[B-T1]

This proposed facility, located at Portner and Trilby Roads in Fort Collins, would be a second facility deployed for Package B to provide facilities from feeder bus line and BRT fleets. The BRT operations and maintenance facility would accommodate covered storage, repair and inspection for a portion of the total bus fleet of 43 buses. The 7.4 acre site would have the same functions, facilities, and operations as the Greeley Commuter Bus Maintenance Facility.

The site is located in an area of commercial and undeveloped land, while outlying areas are surrounded by increasingly urbanized development, including low-density to medium-density residential areas and remnant agricultural properties.

## Greeley Commuter Bus and BRT Hot Spot Analysis

Air quality effects from the proposed bus maintenance areas were estimated by calculating the running and idling emissions from diesel traffic to establish a peak-hour maximum parking and transit operations generated emissions for that facility. A .5 mile travel distance was assumed for each vehicle to enter, exit, and park per day. The resultant total MSAT emissions would be less than 0.01 tpy or 13.8 pounds per year for either size facility. MSAT emissions factors derived from California Air Resources Board research data published for late-model diesel buses (Ayala et al., 2003a) were used in the analysis. Emissions factors for diesel fuel operated buses are limited to diesel particulates (119.0 milligrams per mile) and benzene (1.6 milligrams per mile). Reliable emission rates for diesel fuel operated buses are not available for acetaldehyde and formaldehyde. No acrolein or butadiene is emitted in start-up and steady state late-model diesel bus exhaust. The limited travel distance and idle times associated with bus and BRT facilities of this size are estimated to be negligible.

**Summary of MSAT Analysis:**

The localized increases in MSAT concentrations would likely be most pronounced along the roadway sections that would be built along highly developed residential areas and major intersections. In summary, when a highway is widened and as a result moves closer to receptors, the localized level of MSAT emissions for the build package could be higher relative to the No-Action Alternative, but this could be offset due to short-term reductions in congestion, which are associated with lower MSAT emissions for some pollutants. However, on a regional basis, EPA's vehicle and fuel regulations, coupled with fleet turnover, would over time cause substantial reductions that, in almost all cases, would cause region-wide MSAT levels to be substantially lower than today.

### 4.3.8 Localized Effects of Commuter Rail and BRT Stations

Commuter rail and BRT stations would result in local increases of some pollutants due to increasing emissions from transit vehicles themselves and from automobile, truck and bus traffic accessing the stations. These emissions would be greater than with the No-Action Alternative at these particular locations, but in no cases would there be exceedances of the NAAQS.

**Table 17** and **Table 18** show the stations with residential or other sensitive land uses that could be affected by these localized increases in emissions.

## Table 17 Sensitive Land Uses Affected by Package A

| Transit Station Location | Sensitive Land Uses in the Vicinity |
|---|---|
| Fort Collins Downtown Transit Center Rail Station: Mason and Cherry Streets | Residential, church and educational land uses within 600 feet. |
| CSU Commuter Rail Station: South Mason Street between West Laurel Street and Old Main Drive. | Church and college residential and uses within 600 feet of the commuter rail. |
| South Fort Collins Transit Center Commuter Rail Station [A-H2 Component]: US 287 and Harmony Road | Commuter rail station would be 500 feet from residential areas. |
| North Loveland Commuter Rail Station: 29th Street and US 287 | Commuter rail station would be 100 feet from residential development and 600 feet from school and church facilities. |
| Downtown Loveland Commuter Rail Station: North 4th Street and Cleveland Avenue (US 287) | Commuter rail station would be 700 feet from residential, school, community health, and church facilities. |
| Berthoud Commuter Rail Station: US 287 and Mountain Avenue (SH 56) | Commuter rail station would be 100 feet from residential land uses. |
| North Longmont Commuter Rail Station: SH 66, between US 287 and North 115th Street | Commuter rail station would be 100 feet from residential land uses. |
| Longmont at Sugar Mill Commuter Rail Station: Three sites are under consideration: The first site is south of Sugar Mill Road, north of Ken Pratt Boulevard, and west of North 119th Street. The second site is on north side of Sugar Mill Road. The third site is at County Line Road and SH 119. | Commuter rail station would be 600 feet, 1,000 feet and less than 100 feet respectively, from residential land uses. |
| I-25 and WCR 8 Commuter Rail Station: I-25 and WCR 8 | No sensitive land uses in close proximity. Nearest sensitive land use is 2,300 feet from site. |
| Fort Collins Commuter Rail Maintenance Facility: Vine Drive and Timberline Road | Commuter rail facilities would be within 500 feet from residential, church and health facilities. |
| Berthoud Commuter Rail Maintenance Facility: CR 46 and US 287 | Scattered residential land use within 100 feet of the maintenance facility. No other sensitive land uses in area. |
| Greeley Commuter Bus Station: US 85 and D Street A | Commuter bus facilities would be 300 feet from residential area and community facility. |
| South Greeley Commuter Bus Station: US 85 and US 34 interchange on the southwest corner of 26th Street and 9th Avenue | Commuter bus facilities would be 1,00 feet from closest residential land use. Most sensitive land use areas are located more than 1,100 feet from site. |
| Evans Commuter Bus Station: US 85 and 42nd Street | Commuter bus facilities would be 100 feet from residential areas and church facilities. |
| Platteville Commuter Bus Station: US 85 and SH 66 | Commuter bus facilities would be 300 feet from sensitive land use areas. |
| Fort Lupton Commuter Bus Station: US 85 just south of 14th Street | Commuter bus facilities would be 850 feet from sensitive land use areas. |
| Greeley Bus Maintenance Facility: 31st Street and 1st Avenue | Commuter bus facilities would be 700 feet from residential areas and church facilities. |

## Table 18 Sensitive Land Uses Affected by Package B

| BRT Station Location | Air Quality Indirect Effects |
|---|---|
| South Fort Collins Transit Center BRT Station [B-H2]: US 287 and Harmony Road | Commuter BRT facilities would be 500 feet from residential areas. |
| Harmony Road and Timberline BRT Station [B-H2]: Harmony Road and Timberline | Commuter BRT facilities would be 300 feet from closest residential areas. |
| I-25 and Harmony Road BRT Station [B-T1]: I-25 and Harmony Road | No sensitive land use areas in close proximity. Nearest residential development 2,000 feet from site. |
| Windsor BRT Station [B-T1]: I-25 and SH 392 | Commuter BRT facilities would be 300 feet from residential areas. |
| Crossroads BRT Station [B-T1]: There are two sites: Site O is northeast of I-25 and Crossroads Boulevard. Site M is located southwest of I-25 and Crossroads Boulevard | No sensitive land use areas within a .5 mile proximity. |
| US 34 and SH 257 BRT Station [B-T1]: US 34 and SH 257 | No residential areas in close proximity. |
| West Greeley BRT Station [B-T1]: US 34 (Business Loop) and 83rd Avenue | Commuter BRT facilities would be 100 feet from residential areas. |
| Greeley Downtown Transfer Center BRT Station: Downtown Greeley between 9th Avenue and 8th Avenue on 7th Street | Commuter BRT facilities would be greater than 1,000 feet from residential areas. |
| Berthoud BRT Station [B-T1]: I-25 and SH 56. | Commuter BRT facilities would be 600 feet from residential areas. |
| Firestone BRT Station [B-T1]: I-25, south of SH 119. | Commuter BRT facilities would be less than 300 feet from residential areas. |
| Frederick/Dacono BRT Station [B-T1]: I-25, .5 mile north of SH 52 | No sensitive land use areas in close proximity. |
| I-25 and SH 7 BRT Station [B-T1]: Two sites: Site E Is east of I-25 and .5 mile north of SH 7  Site C is located on the southwest corner of the I-25 and SH 7 interchange | Both commuter BRT facilities would be less than 300 feet from the closest sensitive land use. |
| Fort Collins BRT Maintenance Facility [B-T1]: Portner Road, just north of Trilby Road | Commuter BRT facilities would be less than 100 feet from residential areas. |

### 4.3.9 Indirect Effects

Indirect effects are reasonably foreseeable and can be linked together and extended to estimate further consequences. The most apparent link to air quality is incremental population growth, land use, and development changes caused as a result of the North I-25 corridor project. These growth and development changes would affect traffic and traffic patterns which would then affect air quality. In areas of anticipated transit oriented development, air quality would be anticipated to improve due to more efficient travel patterns. This improvement would be more noticeable with Package A then Package B.

**Nitrogen Deposition**

Another indirect air quality effect could be the continued conversion of agricultural land use which is the dominant source of ammonia along the Front Range (see **Figure 7**). This land is being connected to residential and commercial uses which would lessen agricultural sources of nitrogen deposition effects to the Rocky Mountain National Park and other sensitive environments in the future.

Nitrogen deposition is an important issue to the integrity of the natural setting of the Rocky Mountain National Park (RMNP), where upslope wind conditions transport agricultural, industrial, and transportation generated NOx and ammonia into the sensitive environments of the park. Long-term exposure of nitrogen on undisturbed ecosystems creates nitrogen saturation, a state where deposited nitrogen not utilized by the ecosystem may leach into groundwater and streams. High-elevation sites receive greater amounts of dry deposition and cloud-water deposition of nitrogen. Research supports that NOx emissions are much more widely dispersed than NH3.

Current baseline and future 2030 No Action and averaged Package A and B projections of these nitrogen emissions from transportation would decrease 79 percent, or roughly 25,700 tons per year (see **Table 3**, for all 2030 alternatives.  Ammonia emissions, however; would increase 151 percent or 226 tons per year.  Overall, the gross nitrogen anticipated from mobile on-road sources is expected to decrease 67% and 65% for the No Action and averaged Package A and B by 2030. These emissions do not include any benefit from regional transit improvements planned by RTD and the Packages A and B, nor do these emissions assume any market penetration of hybrid vehicles or other advanced technologies between now and 2030. Non-road sources of nitrogen are predicted to decrease an average 61 percent or over 12,000 tons per year NOx and 11 tons per year ammonia, over this same time period (Houk, 2007).

The overall decrease in total nitrogen emissions would contribute to the RMNP goal of reducing nitrogen deposition rates by the year 2012, although the transportation emissions of ammonia are increasing in the future.

## 5.0 MITIGATION MEASURES

Regional and local agency strategies that could be used to reduce criteria pollutant and MSAT emissions, especially diesel particulate matter from existing diesel engines, include but are not limited to: tailpipe retrofits, closed crankcase filtration systems, cleaner fuels, engine rebuild and replacement requirements, contract requirements, anti-idling ordinances and legislation, truck stop electrification programs, and aggressive fleet turnover policies.

The follow mitigation measures are recommended to mitigate potential project impacts from commuter rail:

- New rail vehicles will be required to meet Tier 3 and Tier 4 standards (see **Section 4.1**).

The following mitigation measures are recommended for construction activities associated with either of the build packages:

- Project proponents must prepare an air quality mitigation plan that describes all feasible measures to reduce air quality impacts from their project. CDOT staff must review and endorse construction mitigation plans prior to work on a project site.
- Acceptable options for reducing emissions could include use of late model engines, low-emission diesel products, alternative fuels, engine retrofit technology, and after-treatment products.
- The contractor will ensure that all construction equipment is properly tuned and maintained.
- Idling time will be minimized to 10 minutes – to save fuel and reduce emissions.
- An operational water truck should be on site at all times. Water will be applied to control dust as needed to prevent dust impacts off site.
- There will be no open burning of removed vegetation. Vegetation should be chipped or delivered to waste energy facilities.
- Existing power sources or clean fuel generators will be utilized rather than temporary power generators.
- A traffic plan will be developed to minimize traffic flow interference from construction equipment movement and activities. The plan may include advance public notice of routing, use of public transportation, and satellite parking areas with a shuttle service. Operations affecting traffic for off-peak hours will be scheduled whenever reasonable.
- Obstructions of through-traffic lanes will be minimized. A flag person will be provided to guide traffic properly minimizing congestion and to ensure safety at construction sites.

These mitigation measures would be enacted along with the project phases (see **Chapter 2** of DEIS) for which the measures are relevant.

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