AIR DISPERSION MODELING ASSESSMENT OF AIR TOXIC EMISSIONS FROM BNSF COMMERCE/MECHANICAL RAIL YARD

Submitted to:
California Air Resources Board

Prepared for:
BNSF Railway Company
Fort Worth, Texas

Prepared by:
ENVIRON International, Corporation
Emeryville, California

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ACRONYMS

ARB	Air Resources Board
BNSF	BNSF Railway Company
BPIP-PRIME	Building Profile Input Program - Plume RIse Model Enhancement
CalEPA	California Environmental Protection Agency
CalOSHA	California Occupational Safety and Health Administration
CAPCOA	California Air Pollution Control Officers Association
CARDS	Comprehensive Aerological Reference Dataset
DPM	Diesel particulate matter
ENVIRON	ENVIRON International Corporation
GE	General Electric
GIS	Graphical Information Systems
HD	Heavy-duty
HRA	Health Risk Assessment
I	Interstate
ISC	Industrial Source Complex
IGRA	Integrated Global Radiosonde Archive
LD	Light-duty
MATES	Multiple Air Toxics Exposure Study
MTBE	Methyl t butyl ether
NAS	Naval Air Station
NCDC	National Climactic Data Center
NLCD	National Land Cover Data
NRC	National Research Council
NWS	National Weather Service
OEHHA	Office of Environmental Health Hazard Assessment
PM	Particulate matter
PMI	Point of maximum impact
POLA	Port of Los Angeles
POLB	Port of Long Beach
RAAC	Risk Assessment Advisory Committee
SCAQMD	South Coast Air Quality Management District
SCRAM	Support Center for Regulatory Atmospheric Modeling
TAC	Toxic Air Contaminant
ULSD	Ultra low sulfur diesel
UPPR	Union Pacific Railroad Company

USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
VMT	Vehicle miles traveled
WBAN	Weather Bureau Army Navy

ABREVIATIONS

%	percent
AERMAP	AERMOD Terrain Processor
AERMET	AERMOD Meteorological Preprocessor
AERMOD	American Meteorological Society/Environmental Protection Agency Regulatory Model
COOP	Cooperative Station (NWS)
kg	kilogram
km	Kilometer
L	liter
m^3	cubic meter
µg	microgram

1.0 INTRODUCTION

In June 2005, BNSF Railway Company (BNSF) and Union Pacific Railroad Company (UPRR) entered into a mutual agreement (ARB/Railroad Statewide Agreement, 2005b or the "Agreement") with the California Air Resources Board (ARB) to reduce particulate emissions from their respective rail yards that are owned and operated within the State of California. Under provisions of the Agreement, ARB staff will be performing Health Risk Assessments (HRAs) at 17 rail yards ("Designated Rail Yards") within California. The HRAs will consider emissions of toxic air contaminants (TACs) from emission sources at each Designated Rail Yard including resident and transient locomotives, on- and off-road equipment, and stationary equipment.

Generally, an HRA consists of three major parts: (1) an air emissions inventory for TAC emission sources, (2) air dispersion modeling to evaluate off-site airborne concentrations due to TAC emissions from these sources, and (3) the assessment of risks associated with these predicted airborne concentrations. The UPRR and BNSF are required to complete the first two parts of the risk assessment process under the Agreement. Under the Agreement, ARB will conduct the assessment of risks part of the HRA process using the results of air dispersion exposure analyses conducted for each Designated Rail Yard. As noted in the Agreement, specific objectives of these risk assessments include developing a basis for risk mitigation and risk communication, including developing information to place the estimated risks in appropriate context. To aid in developing information for risk communication, ARB will also be conducting health risk assessments for other significant sources of TACs within the vicinity of each Designated Rail Yards.

BNSF has retained ENVIRON International Corporation (ENVIRON) to assist it with the development of TAC emissions inventories and in conducting the air dispersion modeling for each of their Designated Rail Yards. Under the current draft Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities (the "draft Guidelines", (ARB 2006a)), emission inventories and air dispersion modeling results for the following BNSF Designated Rail Yards are scheduled to be submitted by September 30, 2006: Commerce/Eastern Intermodal, Commerce/Mechanical, Los Angeles Intermodal (Hobart), Richmond, Stockton, and Watson/Wilmington (the "2006 BNSF Designated Rail Yards"). However, since the release of the draft Guidelines, ARB agreed to change the timeline for submission of the emissions and air dispersion modeling results to October 31, 2006 for Commerce/Mechanical and Richmond and November 30, 2006 for Commerce/Eastern, Hobart, Watson/Wilmington, and Stockton. These submission timelines were adjusted to accommodate ARB's request for changes to previously completed emission inventories to reflect previously unreleased ARB models. This report presents the methods and results of the air dispersion modeling analysis conducted to evaluate TAC emissions from operations at the Commerce/Mechanical rail yard located in Commerce, California ("Commerce/Mechanical").

1.1 Objectives

The purpose of this report is to summarize ENVIRON's methods used to conduct the air dispersion exposure assessment of TAC emissions from the Commerce/Mechanical Yard and to provide the results of this analysis to ARB for their completion of the HRA for this rail yard. As discussed in the draft Guidelines (ARB 2006a), the air dispersion modeling exposure assessment requires the selection of the dispersion model, the data that will be used in the dispersion model (pollutants to be modeled with appropriate averaging times, source characterization, building downwash, terrain, meteorology) and the identification of receptors whose potential exposure will be considered in ARB's HRA. ENVIRON previously provided to ARB, a report that described ENVIRON's model selection, meteorological data selection, and meteorological data processing methodologies for all the 2006 BNSF Designated Rail Yards (ENVIRON 2006). ARB approved these aspects of the air dispersion modeling analysis on August 3, 2006.[1] The remainder of this introduction section summarizes ENVIRON's selection of the air dispersion model to provide the modeling context for the methods discussed in the remainder of this report.

1.2 Methodologies

As discussed in the draft Guidelines, "air dispersion modeling uses mathematical formulations to characterize the atmospheric processes that disperse a pollutant emitted by a source" (ARB 2006a). The Agreement currently requires that air dispersion modeling be performed to estimate airborne concentrations from the dispersion of TAC and particulate matter emissions from relevant sources at each Designated Rail Yard. The emissions of diesel particulate matter (DPM) are separated from other particulate related TAC emission data in the model input and output (ARB 2006a). Air dispersion modeling requires the selection of an appropriate dispersion model and input data based on regulatory guidance, common industry standards/practice, and/or professional judgment. In general, ENVIRON performed air dispersion modeling for the BNSF Designated Rail Yards consistent with previous studies and/or guidance documents prepared by ARB (ARB 2004, 2005a, 2005c, 2006a) and the United States Environmental Protection Agency (USEPA 2000, 2004a, 2004b, 2005a, 2005b).

[1] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

ENVIRON used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD version 04300) to estimate airborne concentrations resulting from TAC emissions from the BNSF Commerce/Mechanical Yard. The AERMOD model was developed as a replacement for USEPA's Industrial Source Complex (ISC) air dispersion model to improve the accuracy of air dispersion model results for routine regulatory applications and to incorporate the progress in scientific knowledge of atmospheric turbulence and dispersion. Both models are near-field, steady-state Gaussian plume models, and use site-representative hourly surface and twice-daily upper air meteorological data to simulate the effects of dispersion of emissions from industrial-type releases (e.g., point, area, and volume) for distances of up to 50 kilometers (USEPA 2005b).

For the past 20 years, refined near-field air dispersion modeling has typically been conducted using USEPA's Industrial Source Complex (ISC) model. However, on November 9, 2005, the USEPA promulgated final revisions to the federal Guideline on Air Quality Models (USEPA 2005a). These revisions recommend that AERMOD, including the PRIME building downwash algorithms, be used for dispersion modeling evaluations of criteria air pollutant and toxic air pollutant emissions from typical industrial facilities. A one-year transition period commenced from the promulgation date of November 9, 2005. AERMOD provides better characterization of plume dispersion than does ISC, according to USEPA (USEPA 2003). AERMOD also is the model recommended by ARB in the draft Guidelines (ARB 2006a).

1.3 Report Organization

This report is divided into six sections as follows:

Section 1.0 - Introduction: describes the purpose and scope of this report and outlines the report organization.

Section 2.0 - Site Description: provides a brief description of the Commerce/Mechanical Facility and its operations.

Section 3.0 - Emission Inventory Summary: summarizes the TAC emission inventory results that were previously submitted to ARB under a separate report (included as Appendix A).

Section 4.0 - Air Dispersion Modeling: describes the air dispersion modeling methods used to estimate air chemical concentrations.

Section 5.0 -Uncertainties: summarizes the uncertainties resulting from various assumptions used in the air dispersion evaluation as well as from those used in the emission inventory development.

Section 6.0 – References: includes all references cited in this report.

The appendices include supporting information as follows:

Appendix A: provides ENVIRON's previous report to ARB on the emission estimation methodologies and results.

Appendix B: provides the tables of hourly, daily, and seasonal temporal information for source activities

Appendix C: discusses the sensitivity analyses performed to evaluate volume source spacing and configurations for locomotive movement sources

Appendix D: provides the electronic SCREEN3 input and output files for plume rise adjustments for locomotive movement activities

Appendix E: provides the electronic AERMOD-ready meteorological data files and raw surface and upper air meteorological data files

Appendix F: provides the electronic building downwash input and output files

Appendix G: discusses the sensitivity analyses performed to evaluate building downwash due to locomotives

Appendix H: provides the electronic digital elevation model (DEM) files

Appendix I: provides the electronic shapefiles containing census data for the Los Angeles area

Appendix J: discusses the sensitivity analysis used to determine the spacing and extent of the receptor grids

Appendix K: provides the electronic input and output files for AERMOD

Appendix L: provides the electronic air concentration tables in Microsoft Access database files

2.0 SITE DESCRIPTION

The Commerce/Mechanical site description incorporated in this evaluation is based primarily on information provided by BNSF and its contractors' staff. The following information is included to facilitate understanding of this site's operations as evaluated by this work.

2.1 Site Setting and Description

Commerce/Mechanical is located at 6300 East Sheila Street in Commerce, California and is approximately 10 kilometers east of Los Angeles. As shown in Figure 2-1, Commerce/Mechanical is located in a commercial and manufacturing area with several residential areas located within two kilometers. Commerce/Mechanical is bordered by Washington Boulevard to the north, Interstate-5 (I-5) to the east, the Adjacent Main Line to the south, and commercial properties to the west. Commerce/Mechanical is also located within five kilometers of three other major roadways, including: I-710 to the west, I-605 to the east, and Highway 60 located to the north. Figure 2-2 depicts available land use data from the United States Geological Survey's (USGS's) National Land Cover Dataset (USGS 2006) within 20 kilometers (km) of Commerce/Mechanical, as required by the draft Guidelines (ARB 2006a). Table 2-1 summarizes the percentage of each land use category within this 20-km radius.

The Facility consists of a locomotive fueling platform, diesel engine repair facility (operated by General Electric [GE]), rail car repair building, storage areas, equipment service areas, and an administration building. The Adjacent Main Line located just south of Commerce/Mechanical is used for commuter rail (both AMTRAK and Metrolink) and freight services. The main railway line runs south and west to the classification yard and includes freight and commuter (AMTRAK and Metrolink) operations along the same lines. ENVIRON included this segment of the Adjacent Main Line in the air dispersion modeling analysis as per the draft Guidelines.

2.2 Facility Operations

Activities at Commerce/Mechanical include locomotive fueling, locomotive maintenance, locomotive line haul, passenger locomotives, track maintenance, portable engines, on-road fleet vehicles, and stationary source activities. The approximate locations of these activities at the Facility are shown in Figures 2-3 through 2-5.

The Facility locomotive activities can be divided into four operational areas as follows:

- **GE service facility**: performs basic service for operating locomotives in refueling, sanding, engine repair, and lubrication. The locomotive operations include idle modes, load testing, opacity testing, and low-notch, slow movements within the yard. Portable engines operate only in the GE service facility.
- **Car repair yard**: performs service for rail cars only. The locomotive activity for the rail car repair lot is sporadic and unpredictable, consisting of movements of empty cars in and out of the lot as needed. Locomotives are not assigned to the yard, and are called upon only when required.
- **Classification yard**: actually used as an empty car lot or siding track rather than a classification yard. The yard is adjacent to the south and west of the Facility, and is operated independently from the service operations. Except for its immediate proximity, it would be considered a separate facility. Locomotive activity is also sporadic and unpredictable.
- **Adjacent mainline**: used for BNSF freight and commuter traffic. The adjacent mainline is south of the small classification yard. The mainline activity may or may not be considered part of the Facility, but runs immediately adjacent to the classification yard.

Track maintenance activities occur over the same general areas as the locomotive activities. BNSF on-road fleet activities occur along travel routes from the gate at the northwest corner of the facility to the parking area north of the northern locomotive switching area, to the Administration Building, and to the parking area east of the Storage Unit in the central part of the Yard (as shown in Figure 2-5). Several stationary sources are located at the Facility, including a Wastewater Treatment Plant situated along the central western edge of the Facility, a Fire Suppressant System located in the northwest corner of the Facility, and an Emergency Generator and Gasoline Storage and Dispensing terminal located near the geographical center of the Facility.

3.0 EMISSION INVENTORY SUMMARY

ENVIRON estimated emissions for Commerce/Mechanical activities and provided this to ARB previously (Appendix A). The methodology used to calculate the DPM and gasoline TAC emission factors were described in this previous submission to ARB. Detailed calculation methodologies and the resulting emission factors are included as Appendix A. The remainder of this section provides a brief summary of the Commerce/Mechanical activities for which TAC emissions were estimated.

3.1 Locomotive DPM Emissions

ENVIRON described Commerce/Mechanical locomotive operations by dividing the activities into four main operational areas, defined as the GE Service Facility, Car Repair Yard, Classification Yard, and Adjacent Main Line traffic. ENVIRON further subdivided the main operational areas into activity categories to describe the emission modes and spatial allocation, such as locomotive movements and idle and load testing periods/positions. The activity categories thus established for the locomotive operational areas (designated as categories A through G in Appendix A and as indicated below) were as follows:

Facility Operational Areas

GE Service Facility

A. Basic Service
B. Basic Engine Inspection
C. Full Engine Service/Inspection
D. Movements of Cars to Car Repair Yard

Classification Yard

E. Movements in Adjacent Classification Yard

Non-Facility Operational Area

Adjacent Main Line

F. Freight Movements on Adjacent Main Line
G. Commuter Rail Operations on Adjacent Mainline

From data provided by BNSF and through discussions with BNSF and GE operations staff, ENVIRON determined the overall activity of locomotive operations. The locomotive operations data, detailed in Appendix A, included the number of engines serviced, and the typical time in notch setting for those engines receiving service. ENVIRON inferred locomotive movements and time in engine notch settings based on the type of service provided for each engine. For instance, full engine service included typical time in notch for diagnostic and post repair, load and opacity testing, and movements in and out of the service building. See Appendix A for a detailed description of the information and estimates used to define operations and resulting emissions within activity categories A through E. Temporal emission profiles were developed for each locomotive activity based on hourly locomotive counts. Variable hourly, daily, and seasonal emission factors were applied in the air dispersion modeling to approximate the temporal variations in emissions from locomotive activities, as discussed in Section 4.3. These temporal emission factors are presented in electronic tables in Appendix B.

The Adjacent Main Line could be considered a separate source to the Facility operational area because the Adjacent Main Line operates by and large independent of the Facility. ENVIRON considered separately the freight (designated as activity category F) and commuter traffic (including both AMTRAK and Metrolink activities, designated as activity category G in Appendix A). Appendix A also contains the details of the methods used to estimate emissions from these activity categories. Temporal emission profiles were developed for freight and commuter activities based on hourly locomotive counts for freight activities and schedule information and hourly passenger locomotive counts for AMTRAK and Metrolink activities. Variable hourly, daily, and seasonal emission factors were applied in the air dispersion modeling, as discussed in Section 4.3, to approximate the temporal variations in emissions from freight and passenger locomotive activities. These temporal emission factors are presented in electronic tables in Appendix B.

3.2 DPM and Gasoline TAC Emissions from Off-Road Equipment

ENVIRON categorized Off-Road Equipment at the Facility into two main types of equipment: track maintenance equipment and portable engines (designated as activity category K in Appendix A). Track maintenance equipment included equipment used to service tracks and included a variety of large and small engines and equipment. BNSF California track maintenance equipment can be used on any or all tracks within California to maintain the network. Therefore, DPM and gasoline TAC emissions for a given facility were estimated by apportioning the sum of emissions from all track maintenance equipment in California by site using the relative track mileage (including all tracks, main line and other tracks) at the site to the California total track mileage. Total exhaust emissions from track maintenance equipment were estimated using the draft version of the OFFROAD model (ARB 2006c). Additional details regarding the emission calculation methodologies are discussed in Appendix A.

Portable engines included forklifts, welders, leaf blowers, pressure washers, lawn and garden equipment, and other general industrial equipment. Emissions were estimated based on equipment specific emission factors from the draft OFFROAD model provided by ARB (2006c), annual hours of usage, and load factors. Appendix A presents additional details regarding the methods used to estimate emissions from these equipment types.

3.3 DPM and Gasoline TAC Emissions from On-Road Fleet Vehicles

On-road fleet vehicles (designated as activity category J in Appendix A) included employee vehicles owned by BNSF and road-legal vehicles owned by BNSF (i.e., passenger vehicles and small trucks) used for both on-site and off-site travel. DPM and gasoline TAC emissions due to on-road fleet vehicle activities were estimated using the emission factors from the draft EMFAC2005 model provided by ARB (2006c) and an average on-site travel distance. Appendix A presents additional details regarding the methods used to estimate emissions from these equipment types.

3.4 DPM and Gasoline TAC Emissions from Stationary Sources

Stationary Sources at the Facility included three diesel fuel storage tanks, a wastewater treatment plant, a gasoline dispensing and storage facility, a fire suppression system, and an emergency generator (designated as activity category L in Appendix A). The three diesel fuel storage tanks and wastewater treatment plant were assumed to have negligible DPM and TAC emissions, as discussed in the more detailed emission calculation methodologies and assumptions included in Appendix A.

TAC emissions from the gasoline dispensing and storage facility were estimated based upon the emissions methodology in the South Coast Air Quality Management District (SCAQMD) permit application (Application #319512) for this emissions source. The SCAQMD methodology contained emission factors and followed guidance from the Gasoline Service Station Industry-Wide Risk Assessment Guidelines (CAPCOA 1997) prepared by the Toxics Committee of the California Air Pollution Control Officers Association (CAPCOA). This methodology accounted for TAC emissions from filling/working, dispensing, spillage, and breathing. Additional details regarding the emission calculation methodologies are discussed in Appendix A.

DPM emissions from the fire suppression system and emergency generator were estimated based upon manufacturer PM certification levels and the estimated hours of usage from Facility records, permits, and permit applications. However, source parameter information was not available for either of these engines from BNSF personnel, Facility records, the engine manufacturers, or district permit applications and permits. Additionally, the fire suppression system and emergency generator accounted for only 0.07% and 0.06% of the total DPM emissions from the Facility, respectively. Due to the lack of source parameter information and the low levels of emissions from these sources, the fire suppression system and emergency generator were not included in the air dispersion modeling.

3.5 Emission Estimates Summary

Tables 3-1a and 3-1b summarize the total annual emissions, operating hours, and the emission rate (in grams per second or grams per square meter per second) for each emission source by activity subcategory for DPM and gasoline emission sources, respectively. ENVIRON performed the air dispersion modeling to estimate period-average DPM and gasoline concentrations using χ/Q emission rates (i.e., one gram per second per source for point and volume sources and one gram per second divided by the total surface area of the source group for each area source), resulting in period-average dispersion factors. Tables 3-1a and 3-1b include the emission rates (in grams per second) applied to the period-average dispersion factors from the air dispersion model to calculate period-average air concentrations. Table 3-1b also includes the maximum hourly TOG emission rates for gasoline sources used to estimate maximum one-hour TAC concentrations.

Table 3-2 outlines the annual DPM and TAC emissions estimated for each of the main source categories described in this section and their contribution to the total DPM and gasoline TOG and PM emissions. The emissions for each of the activities were distributed spatially and temporally over the range of operations as described in more detail in Section 4.

4.0 AIR DISPERSION MODELING

ENVIRON performed air dispersion modeling to estimate exposure concentrations from the dispersion of DPM and TAC emissions from routine operational sources at Commerce/Mechanical. ENVIRON evaluated DPM emissions from locomotive and on- and off-road diesel engines as well as TAC emissions from gasoline engines and on-site permitted stationary sources. Air dispersion modeling requires the selection of an appropriate dispersion model and input data based on regulatory guidance, common industry standards/practice, and/or professional judgment. As stated previously, ENVIRON performed air dispersion modeling generally consistent with previous studies and guidance documents (ARB 2004, 2005a, 2005c, 2006a and USEPA 2000, 2004a, 2004b, 2005a, 2005b) based on the information available at the time of the assessment. The type of air dispersion model and modeling inputs (i.e., pollutants to be modeled with appropriate averaging times, source characterization and parameters, meteorological data, building downwash, terrain, land use, and receptor locations) that were used in the air dispersion modeling for Commerce/Mechanical are discussed below.

4.1 Model Selection and Model Control Options

As discussed in the Introduction, ENVIRON used the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD version 04300) to estimate airborne concentrations resulting from DPM and TAC emissions from the BNSF Commerce/Mechanical Yard as recommended in the draft Guidelines (ARB 2006a) and USEPA air dispersion modeling guidelines (2005b). AERMOD was developed as a replacement for USEPA's Industrial Source Complex (ISC) air dispersion model to improve the accuracy of air dispersion model results for routine regulatory applications and to incorporate the progress in scientific knowledge of atmospheric turbulence and dispersion. This change was made in November 2005 (USEPA 2005a). After a one-year transition period for the change in model (i.e., as of November 9, 2006), ISC will no longer be considered a USEPA-approved model for certain regulatory applications. Both models are near-field, steady-state Gaussian plume models, and use site-representative hourly surface and twice-daily upper air meteorological data to simulate the effects of dispersion of emissions from industrial-type releases (e.g., point, area, and volume) for distances of up to 50 kilometers (USEPA 2005b).

AERMOD is appropriate for use in estimating ground-level short-term ambient air concentrations resulting from non-reactive buoyant emissions from sources located in simple and complex terrain. ENVIRON conducted the air dispersion analysis using AERMOD in the regulatory default mode, which includes the following modeling control options:

- adjusting stack heights for stack-tip downwash (except for building downwash cases),
- incorporating the effects of elevated terrain,
- employing the calms processing routine, and
- employing the missing data processing routine.

4.2 Modeled Pollutants and Averaging Periods

Calculation of chemical concentrations for use in exposure analysis requires the selection of appropriate concentration averaging times. ENVIRON based the selection of appropriate averaging times on the toxicity criteria data developed by the California Environmental Protection Agency (CalEPA).

For DPM, CalEPA has developed toxicity criteria for both carcinogenic and chronic non-carcinogenic effects (CalEPA 2005a, 2005b). Therefore, ENVIRON estimated the annual average DPM concentration over the span of the meteorological data for ARB's use in estimating cancer and chronic non-cancer risk. ENVIRON did not calculate maximum short-term concentrations (one-hour averages) for DPM as an acute toxicity criteria for DPM has not been developed by the CalEPA (i.e., no acute reference exposure level (REL) is listed) (CalEPA 2000).

ENVIRON evaluated a large number of non-DPM TACs in this assessment from non-DPM sources (mainly from gasoline engine emissions) as identified in the speciation profiles discussed in Appendix A. ENVIRON estimated both annual-average and maximum one-hour concentrations for each non-DPM TAC. In order to substantially reduce modeling complexity and run time, maximum one-hour TOG exhaust, TOG evaporative, and PM exhaust emission rates (as opposed to maximum one-hour individual TAC emission rates) were input into the air dispersion model. Speciation profiles containing the fractions of individual TACs for TOG exhaust, TOG evaporative, and PM exhaust emissions (discussed in Appendix A) were then applied to the TOG exhaust, TOG evaporative, and PM exhaust concentrations estimated by the dispersion model to calculate concentrations of individual TACs. This methodology resulted in conservative estimates (i.e., over-predictions) of the maximum one-hour concentrations for individual TACs.

4.3 Source Characterization and Parameters

Source characterization, location, and parameter information is necessary to model the dispersion of air emissions. ENVIRON modeled DPM and other TAC emissions from operational sources at Commerce/Mechanical, as described above. In general, we determined source locations from the activity information discussed in Section 2, facility plot plans, information provided by BNSF personnel and contractors, and/or recent aerial photographs of the facility and surrounding areas. ENVIRON accounted for temporal (i.e., hourly, daily, and/or seasonal) variations in activities and emissions from each source by using variable hourly, daily, and seasonal emission factors where available. ENVIRON represented emissions from locomotive sources, vehicular sources, mobile equipment sources, and stationary sources as one of the following source types, and generally consistent with the draft Guidelines (ARB 2006a), where possible:

- Point source (a source with emissions emanating from a known point, with buoyancy due to either thermal or mechanical momentum). A point source is characterized by a height, diameter, temperature, and exit velocity.
- Volume source (a source with emissions that have no buoyancy and are emanated from a diffuse area). A volume source is characterized by an initial lateral and vertical dimension (initial dispersion) and a release height.
- Area source (a source with emissions that have no buoyancy and are emanated from a diffuse plane or box). An initial vertical dimension and release height may also be specified for an area source.

ENVIRON used point sources to model emissions from stationary idling locomotive source activities and most other stationary permitted sources. We used volume sources to represent emissions from moving sources along specific pathways (e.g., moving locomotives, trucks, and cars). ENVIRON used area sources to represent emissions from mobile equipment and vehicles operating over large areas. Additional details regarding the characterization of sources, source locations, and modeling parameters for each source category discussed in Section 3.0 are described below.

4.3.1 Locomotives at the Facility and on the Adjacent Main Line

4.3.1.1 Stationary Idling Locomotives

ENVIRON represented DPM emissions from stationary idling locomotives by point sources spaced approximately every 50 meters similar to ARB's Roseville Study (ARB

2004). ENVIRON placed point sources along railway lines at Commerce Mechanical in areas where stationary idling activities occur, staggering point sources on adjacent parallel railway lines. The locations of point sources representing stationary locomotives are shown in Figures 4-1a and 4-1b. ENVIRON distributed emissions uniformly among the point sources comprising each stationary idling activity. Table 3-1a summarizes the emissions and operating hours for each stationary locomotive activity. Variable hourly, daily, and seasonal emission factors were also applied to approximate the temporal variations in emissions from these sources. These variable emission profiles are summarized in electronic tables in Appendix B.

Facility personnel provided source parameter information (i.e., release height, velocity, temperature, and diameter), which was based on the specific locomotive types and notch settings for each stationary locomotive activity (e.g., idling or load testing). ENVIRON performed fleet-averaging of locomotive source parameters as recommended by the draft Guidelines (ARB 2006a) to reduce the large number (from approximately 1180 to 160) of potential source parameter configurations related to the stationary locomotive activities at Commerce/Mechanical. Fleet-averaging of source parameters was performed by weighting the source parameters for each locomotive model type by the percentage of emissions from each locomotive model type for a given locomotive activity. Table 4-1 summarizes the fleet-average source parameters for stationary locomotive activities at Commerce/Mechanical.

4.3.1.2 Locomotive movement

ENVIRON represented moving locomotive DPM sources by individual volume sources spaced approximately every 50 meters similar to ARB's Roseville Study (ARB 2004). ENVIRON placed sources along railway lines at Commerce/Mechanical where movement activities occur and on the Adjacent Main Line paralleling the southern boundary of the Commerce/Mechanical Yard. Figure 4-2 shows the locations of modeled volume (movement) sources at the Facility and along the Adjacent Main Line. ENVIRON distributed emissions evenly among the volume sources comprising each movement activity. Table 3-1a summarizes the emissions and operating hours for each locomotive movement activity. Variable hourly, daily, and seasonal emission factors were also applied to approximate the temporal variations in emissions from these sources. These variable emission profiles are summarized in electronic tables in Appendix B.

For locomotive movement sources occurring along single rail lines, ENVIRON set the length of side for each volume source equal to the width of the fleet-average locomotive. In order to reduce modeling complexity and decrease model run-times, ENVIRON used larger volumes with the length of side equal to the combined width of the rail lines plus the width of a locomotive to represent multiple parallel rail lines. ENVIRON used a similar methodology (i.e., volumes with the length of side equal to the combined width of the rail lines plus the width of a locomotive) to represent converging or diverging rail lines, resulting in progressively smaller volumes as the rail lines converged and progressively larger volumes as rail lines diverged. ENVIRON performed sensitivity analyses to evaluate volume source spacing and the use of a single set of larger volume sources versus multiple sets of smaller volume sources along multiple parallel rail lines and converging/diverging rail lines. These sensitivity analyses demonstrated that the use of larger volume sources with 50-meter source spacing generally resulted in receptor concentrations within five percent of the receptor concentrations predicted by the multiple sets of smaller volume sources and smaller source spacing. The results of these sensitivity analyses are discussed in more detail in Appendix C. ENVIRON calculated the corresponding initial lateral dimension of each volume source from USEPA guidance (USEPA 2004b).

ARB accounted for buoyancy effects of exhaust from locomotive movement activities by calculating plume rise adjustments to the release height using USEPA's SCREEN3 model for all 11 different locomotive models considered in the study (ARB 2004). Due to variability in locomotive travel speeds, hourly wind speeds, and hourly stability class, a potentially large uncertainty is associated with these plume rise adjustments. ENVIRON also calculated plume rise adjustments to the release height using the SCREEN3 model and a methodology similar to that of ARB (ARB 2004). Due to the uncertainty associated with variable locomotive speeds, hourly wind speeds, and hourly stability class, plume rise adjustments were calculated based on fleet-average locomotive parameters for individual locomotive activities. For source activities with multiple notch settings (e.g., locomotive switching), ENVIRON selected plume rise predictions based on fleet-average source parameters for the single notch setting with the highest percentage of activity emissions. For movement activities with a range of locomotive speeds, the wind speed in SCREEN3 was set equal to the maximum locomotive speed, resulting in lower, more conservative plume rise adjustments. ENVIRON calculated the corresponding initial lateral dimension of each volume source from USEPA (USEPA 2004b) guidance. Tables 4-1 and 4-2 summarize the modeling source parameters, approximate travel speeds, and plume rise adjustments used for locomotive movement sources at

Commerce/Mechanical and on the Adjacent Main Line. Electronic SCREEN3 input and output files used to determine plume rise adjustments are attached in Appendix D.

4.3.2 Off-Road Equipment

4.3.2.1 Track Maintenance Equipment

As track maintenance equipment were used over large areas of the Facility, and as specific modeling source parameters were not available, ENVIRON conservatively represented DPM and gasoline TAC emissions from track maintenance equipment by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON placed area sources over railway lines at Commerce Mechanical in areas where track maintenance activities occur. The locations of area sources representing track maintenance equipment are shown in Figure 4-3. According to BNSF facility personnel, the majority (i.e., 90%) of track maintenance equipment activities occur in the southern section of the rail yard. Based on this information, ENVIRON apportioned 90% of the total track maintenance equipment emissions to the southern operating areas and 10% of the total emissions to the northern operating area shown in Figure 4-3. Emissions within the northern and southern operating areas were distributed uniformly. ENVIRON assumed that emissions from track maintenance activities occur weekdays (i.e., Monday through Friday) from 7 a.m. to 7 p.m. based on information from BNSF personnel. Tables 3-1a and 3-1b summarize the DPM and gasoline emissions, respectively, and operating hours for track maintenance equipment.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for track maintenance equipment was not available from BNSF personnel. Because track maintenance equipment generally appeared to be similar in height to locomotives and have vertical emissions releases, ENVIRON assumed an average release height corresponding to the lowest moving locomotive release height adjusted for plume rise (i.e., the lowest adjusted release height in Table 4-2). ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for track maintenance equipment activities at Commerce/Mechanical.

4.3.2.2 Portable Engines

As portable engines were used over large areas of the Facility, and as specific modeling source parameters were not available for each engine, ENVIRON conservatively represented DPM and gasoline TAC emissions from portable engines by area sources as recommended by the draft Guidelines (ARB 2006a). ENVIRON placed area sources over areas where portable engine activities occur. The locations of area sources representing portable engines are shown in Figure 4-3. According to BNSF facility personnel, the majority (i.e., 95%) of portable engine activities occur in the area south and west of the GE Maintenance Buildings. Based on this information, ENVIRON apportioned 95% of the portable engine emissions to the area south and west of the GE Maintenance Buildings and 5% of the total emissions to the GE Maintenance Buildings shown in Figure 4-3. Emissions within each of these operating areas were distributed uniformly. ENVIRON assumed that emissions from portable engine activities occur 24 hours per day and seven days per week based on information from BNSF personnel. Tables 3-1a and 3-1b summarize the DPM and gasoline emissions, respectively, and operating hours for portable engines at the Facility.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for portable engines was not available from BNSF personnel. According to BNSF personnel, portable engines mainly consisted of forklifts and other engines mounted on small mobile platforms. Based on the physical description of portable engine equipment by BNSF personnel, ENVIRON assumed a release height of 0.6 meters, equal to the release height recommended by ARB (ARB 2000) for on-road fleet vehicles, for portable engines operating outdoors in the areas south and west of the GE Maintenance Buildings. ENVIRON assumed a release height equal to half the building height (i.e., a release height of 4.66 meters) for portable engines operating inside the GE Maintenance Building due to the large open doors on both ends of the building. ENVIRON calculated the corresponding initial vertical dimension of each area source from USEPA (USEPA 2004b) guidance. Table 4-3 summarizes the modeling source parameters for portable engine activities at Commerce/Mechanical.

4.3.3 On-Road Fleet

4.3.3.1 BNSF On-Road Fleet Vehicles

ENVIRON represented DPM and gasoline TAC emissions from BNSF on-road fleet vehicles by a combination of volume and area sources as recommended by the draft Guidelines (ARB 2006a) and in discussions with ARB staff.[2] ENVIRON represented on-

[2] Personal communication. Gavin Hoch of ENVIRON by telephone with Jing Yuan of ARB on August 24, 2006.

road fleet vehicle movements along specified travel pathways by individual volume sources spaced approximately every 50 meters, similar to locomotive movement activities. ENVIRON used areas sources to represent on-road fleet vehicle travel in areas of the Facility where the travel path(s) were not well-defined. The locations of volume and area sources representing on-road fleet vehicle travel paths/areas are shown in Figures 4-4a through 4-4d. Because Facility personnel did not have information specifying the approximate number of fleet vehicles or approximate percentage of emissions associated with any particular travel path and/or travel area, ENVIRON assumed that a similar number of fleet vehicles traveled over each travel path and within each travel area and apportioned total fleet vehicle emissions based on the length of each travel paths. For travel areas represented by area sources, an average path length within the area was assumed in order to apportion emissions. Emissions within each travel path or travel area were distributed uniformly. ENVIRON assumed that emissions from on-road fleet vehicle activities occur from 7 a.m. to 7 p.m. seven days per week based on information from BNSF personnel. Tables 3-1a and 3-1b summarize the DPM and gasoline emissions, respectively, and operating hours for BNSF on-road fleet vehicles.

Model-specific source parameter information (i.e., release height, velocity, temperature, and diameter) for BNSF on-road fleet vehicles was not available from BNSF personnel. Based on information from a previous ARB study (ARB 2000) and recommendations by ARB staff,[3] ENVIRON used a release height of 0.6 meters for on-road fleet vehicles. ENVIRON assumed that exhaust emissions from on-road fleet vehicles were released horizontally, and that plume rise due to differences in temperature between the vehicle exhaust and ambient air was negligible. ENVIRON calculated the corresponding initial vertical dimension of each volume and area source from USEPA (USEPA 2004b) guidance. Table 4-4 summarizes the modeling source parameters for BNSF on-road fleet vehicle activities at Commerce/Mechanical.

4.3.4 Permitted Stationary Sources

4.3.4.1 Fire Suppression System and Emergency Generator

Source parameter information (i.e., release height, velocity, temperature, and diameter) necessary to represent the Fire Suppression System and Emergency Generator was not available from BNSF personnel, the engine manufacturers, or district permit applications

[3] Personal communication. Gavin Hoch of ENVIRON by telephone with Pingkuan Di of ARB on August 31, 2006.

and permits. Additionally, the Fire Suppression System and Emergency Generator accounted for only 0.07% and 0.06% of the total DPM emissions from the Facility, respectively. Due to the lack of source parameter information, small emissions quantities, and low percentages of total emissions from these sources, the Fire Suppression System and Emergency Generator were not included in the air dispersion modeling.

4.3.4.2 Gasoline Dispensing and Storage Facility

ENVIRON represented gasoline TAC emissions from the Gasoline Dispensing and Storage Facility as an area source as recommended by the draft Guidelines (ARB 2006a). The locations of the area source representing the Gasoline Dispensing and Storage Facility is shown in Figure 4-5. ENVIRON assumed that emissions from the Gasoline Dispensing and Storage Facility (from fueling activities and breathing and working losses) occur 24 hours per day, seven days per week based on information from BNSF personnel. Table 3-1b summarizes the gasoline emissions and operating hours for the Gasoline Dispensing and Storage Facility.

Source parameter information (i.e., release height for evaporative losses from the storage tank and release height, velocity, temperature, and diameter for dispensing equipment) was not available for emission sources at the Gasoline Dispensing and Storage Facility. However, based on aerial photographs and discussions with BNSF personnel, the storage tank and dispensing equipment are both located above ground. In addition, the filling area and equipment is very similar to the equipment at a typical commercial filling station. Although evaporative emissions from the storage tank and dispensing equipment occur above ground level, the exact height of the release points for the emissions is unknown. Therefore, ENVIRON assumed a conservative release height of zero meters for emissions from the Gasoline Storage and Dispensing Facility. ENVIRON calculated the corresponding initial vertical dimension of the area source from USEPA (USEPA 2004b) guidance. Table 4-5 summarizes the modeling source parameters for the Gasoline Dispensing and Storage Facility at Commerce/Mechanical.

4.4 Meteorological Data

AERMOD requires a meteorological input file to characterize the transport and dispersion of pollutants in the atmosphere. Surface and upper air meteorological data inputs as well as surface parameter data describing the land use and surface characteristics near the site are first processed using AERMET, the meteorological preprocessor to AERMOD. The output file generated by AERMET is the meteorological input file required by AERMOD. Details of AERMET and AERMOD meteorological data needs are described in USEPA guidance documents (USEPA 2004a, 2004b). As ENVIRON previous received ARB approval of meteorological data selection and processing methods (ENVIRON 2006), the remainder of this section only briefly describes the following two key aspects of the AERMET analysis: the surface and upper air meteorological data selected and the surface parameter evaluation for Commerce/Mechanical. ENVIRON has provided the raw meteorological data and the AERMOD model-ready meteorological data file as an electronic attachment in Appendix E.

4.4.1 Surface and Upper Air Meteorological Data

The focus of the HRA to be conducted by ARB is the characterization of risk in the areas immediately surrounding Commerce/Mechanical. As such, ENVIRON selected meteorological data for air dispersion modeling based upon their spatial and temporal representativeness of conditions in the immediate vicinity of the rail yard. As described in ENVIRON's report on meteorological data selection and processing methods previous approved by ARB (ENVIRON 2006), ENVIRON selected the wind speed and wind direction data from the Lynwood station for the four years from 2002 to 2005 as the most representative available wind speed and wind direction data for use in the air dispersion analysis of the BNSF Commerce and Hobart Rail Yards. ENVIRON used cloud cover, temperature and pressure data (as Lynwood did not have a complete record of temperature or pressure measurements for 2002 to 2005) from the National Weather Service's (NWS's) Los Angeles Downtown USC station from 2002 to 2005. Upper air data from the San Diego Miramar Naval Air Station (NAS) was used in AERMET processing for Commerce/Mechanical (ENVIRON 2006).

4.4.2 Surface Parameters

Prior to running AERMET, it is necessary to specify the surface characteristics for the meteorological monitoring site and/or the project area. The surface parameters include surface roughness, Albedo, and Bowen ratio, and are used to compute fluxes and stability of the atmosphere (USEPA 2004a) and require the evaluation of nearby land use and temporal impacts on these surface parameters. Surface parameters supplied to the model were specified for the area surrounding the meteorological monitoring site, rather than the project area (rail yard), as recommended by USEPA (USEPA 2005a) and ARB[4]. Because the selected meteorological station is in very close proximity to the Commerce/Mechanical and the land use surrounding the

[4] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

meteorological station is very similar to the land use surrounding Commerce/Mechanical, surface parameters calculated for the meteorological station should be representative of Commerce/Mechanical.

In general, ENVIRON determined land-use sectors around the meteorological monitoring site using USGS land cover maps in conjunction with recent aerial photographs. ENVIRON then specified surface parameters for each using default seasonal values adjusted for the local climate. When a land-use sector consists of multiple land use types, ENVIORN used an area-weighted average of each surface parameter as recommended by USEPA (2004a). The locale-specific surface parameters used in this evaluation were described in ENVIRON's previous report to ARB (ENVIRON 2006). Figure 4-6 shows the sectors ENVIRON selected around the meteorological monitoring site for use in the AERMET processing and the USEPA land-use types within each sector. Table 4-6 summarizes the sector-specific surface parameters (surface roughness, Albedo, and Bowen ratio) determined for each of these sectors.

4.5 Building Downwash

Building downwash is the effect of structures on the dispersion of emissions from nearby point (stack) sources. As several point sources at Commerce/Mechanical were identified as adjacent to buildings, ENVIRON considered building downwash in this assessment. ENVIRON estimated building dimensions (i.e., location of building corners and heights of buildings) based on information provided by BNSF personnel and contractors. Figure 4-7 shows the buildings evaluated as part of the building downwash analysis at Commerce/Mechanical. ENVIRON input building dimension information, summarized in Table 4-7, into USEPA's Building Profile Input Program - Plume Rise Model Enhancements (BPIP-PRIME) to account for potential building-induced aerodynamic downwash effects. The electronic input and output files for BPIP are provided in Appendix F. A sensitivity analysis was conducted to estimate the impact of building downwash from locomotive engines on stationary locomotive sources. This sensitivity analysis indicated that, at receptor distances close to the sources (i.e., within 100 meters), building downwash may have a large impact on the modeled concentrations. However, at distances further away from the sources (i.e., 400 to 700 meters), receptor concentrations for model runs with and without building downwash were similar (i.e., within 10% of each other). Based on the results of the sensitivity analysis, and the uncertainty in placing structures corresponding to stationary locomotives in areas where stationary locomotives occur, and the inherent uncertainty in concentration predictions near to stationary and mobile sources, as discussed in Section 5.0, building downwash effects from stationary locomotives were not considered in this assessment. The results of the sensitivity analysis are discussed in more detail in Appendix G.

4.6 Terrain

Another important consideration in an air dispersion modeling analysis is whether the terrain in the modeling area is simple or complex (i.e., terrain above the effective height of the emission point). ENVIRON used the following USGS 7.5 Minute digital elevation model (DEMs) information to identify terrain heights within the modeling domain:

- Hollywood
- Los Angeles
- El Monte
- Inglewood
- Southgate
- Whittier

The electronic DEM files in the North American Datum (NAD) 1983 projection are provided in Appendix H. ENVIRON provided terrain elevation data to the AERMOD model using version 04300 of AERMAP, AERMOD's terrain preprocessor. Due to discontinuities at the boundaries between some of the DEMs, AERMAP was not able to estimate the terrain elevations for five receptor locations. Using the known terrain elevation at adjacent receptors, ENVIRON estimated the terrain elevations at these six receptors using a linear interpolation methodology.

4.7 Land Use

AERMOD can evaluate heat island effects from urban areas to atmospheric transport and dispersion using an urban boundary layer option. ENVIRON used Auer's method of classifying land-use as either rural or urban to analyze the urban nature of the region in which the primary project area is located (Auer 1978). This method calls for analysis of the land within a three-kilometer radius from the primary project area to determine if the majority of the land can be classified as either rural (i.e. undeveloped) or urban. If more than fifty percent of the area circumscribed by this three-kilometer radius circle consists of Auer land-use industrial, commercial or residential urban land types, then the urban boundary layer option is used in modeling. ENVIRON used both the USGS National Land Cover Data and the most recent USGS aerial photograph of the area surrounding the facility to determine that more than fifty percent of the area within three-kilometers of Commerce/Mechanical is urban, see Figure 4-8. Therefore, ENVIRON selected the urban boundary layer option for this analysis.

Selection of the urban boundary layer option in AERMOD requires also requires an estimate of the population of the urban area in order to make adjustments to the urban boundary layer. ENVIRON used published census data for the City of Los Angeles to determine population values as recommended by USEPA (USEPA 2005a). ENVIRON also provides electronic census data for the modeling domain (described in the next section) as an electronic attachment in Appendix I, as required in the draft Guidelines.

4.8 Receptor Locations

ENVIRON used gridded receptor points surrounding the BNSF Commerce/Mechanical Yard in the air dispersion analysis. These gridded receptor points represent the general population in the vicinity of the BNFS Commerce/Mechanical Yard, which includes both residential and commercial populations. However, these receptors do not necessarily represent the specific locations of the residential and commercial populations in the vicinity of the BNSF Commerce/Mechanical Yard. ENVIRON used three sets of discrete Cartesian receptor grid points around the Facility in the air dispersion modeling. The spacing and sizes of the Cartesian receptor grids were determined based on a screening sensitivity analysis, discussed in more detail in Appendix J. The Cartesian receptors included a fine receptor grid with spacing of 50 meters out to a distance of approximately 500 meters from the Facility boundary, a medium receptor grid with spacing of 250 meters out to a distance of approximately 1200 meters from the Facility boundary, and a coarse receptor grid with spacing of 500 meters out to eight kilometers from the Facility boundary. ENVIRON used Facility plot plans and other information provided by BNSF facility personnel to locate the Facility boundary. Receptors inside the facility boundary were removed prior to the air dispersion modeling analysis. The locations of the coarse, medium, and fine receptor grid points are shown in Figures 4-9a, 4-9b, and 4-9c, respectively. Discrete receptor points were generated from each of the grids shown in Figures 4-9a, 4-9b, and 4-9c. The air dispersion modeling analysis did not include receptors at the Facility boundary.

In accordance with the draft Guidelines (ARB 2006a), ENVIRON also evaluated individual receptor points at off-site locations within one mile of the Facility corresponding to sensitive receptors, including schools, hospitals, and daycare centers. Sensitive receptor locations were identified from searches of the following sources:

- California Department of Education, California School Directory http://www.cde.ca.gov/re/sd/
- The Automated Licensing Information and Report Tracking System (Hospitals and Licensed Care Facilities)

http://alirts.oshpd.ca.gov/AdvSearch.aspx

- Yellow Pages
  http://yp.yahoo.com

These on-line databases were searched for the following zip codes in the cities of Commerce, East Los Angeles, Los Angeles, Maywood, and Montebello:

90022	90023	90040	90270	90640

The sensitive receptor locations identified from the search of these data sources and within one mile of the Facility are listed in Table 4-8.

Electronic census data was provided for the modeling domain in accordance with the draft Guidelines (ARB 2006a). These data, provided on a census-block level, were obtained from the GeoLytics CensusCD 2000 (GeoLytics 2001), and provided in electronic shapefile format in Appendix I.

4.9 Air Dispersion Modeling Results

ENVIRON calculated the air concentration of each TAC at each of the receptor locations discussed in Section 4.8. ENVIRON modeled DPM and TAC sources using unit emission rates (i.e., one gram per second) to estimate period-average dispersion factors for DPM and TACs corresponding to meteorological years 2002 through 2005. These period-average dispersion factors for DPM and TACs were combined with source-specific emission rates to generate period-average concentrations for the meteorological period 2002 through 2005.

ENVIRON modeled all non-DPM TAC sources using hourly-maximum evaporative TOG, exhaust TOG, and exhaust PM emission rates in order to estimate one-hour maximum evaporative TOG, exhaust TOG, and exhaust PM concentrations for the meteorological period 2002 through 2005. ARB speciation profiles for evaporative TOG, exhaust TOG, and exhaust PM were applied to estimate chemical-specific one-hour maximum concentrations at each receptor. It should be noted that this method results in an over-prediction of maximum one-hour concentrations of individual constituents at each receptor, as discussed in the uncertainty section below. Electronic AERMOD input and output modeling files are included in Appendix K. Electronic database tables containing DPM and gasoline TAC period-average concentrations at each receptor and one-hour maximum gasoline TAC concentrations at each receptor for the meteorological period modeled are contained in Appendix L.

5.0 UNCERTAINTIES

Understanding the degree of uncertainty associated with each component of a risk assessment is critical to interpreting the results of the risk assessment. As recommended by the National Research Council (NRC 1994), [a risk assessment should include] "a full and open discussion of uncertainties in the body of each EPA risk assessment, including prominent display of critical uncertainties in the risk characterization." The NRC (1994) further states that "when EPA reports estimates of risk to decision-makers and the public, it should present not only point estimates of risk, but also the sources and magnitude of uncertainty associated with these estimates." Similarly, recommendations to CalEPA on risk assessment practices and uncertainty analysis from the Risk Assessment Advisory Committee (RAAC) were adapted from NRC recommendations (RAAC 1996). Thus, to ensure an objective and balanced characterization of risk and to place the risk assessment results in the proper perspective, the results of a risk assessment should always be accompanied by a description of the uncertainties and critical assumptions that influence the key findings of the risk assessment.

In accordance with the recommendations described above and as required in the draft Guidelines (ARB 2006a), ENVIRON has evaluated the uncertainties associated with the first two steps of an HRA: (1) emissions estimation and (2) air dispersion modeling. The uncertainties and critical assumptions associated with these steps are described below. Consistent with the Agreement, ARB will complete the third major part of the HRA which consists of estimating the risks for each of the designated rail yards and evaluating the uncertainties associated with the risk characterization component of the HRA (ARB 2005b). As noted in the Agreement, specific objectives of the HRAs to be conducted by ARB include developing a basis for risk communication, including describing the uncertainties associated with the key findings of the risk assessment. At the request of ARB, ENVIRON will assist ARB in identifying the critical assumptions and uncertainties associated with the risk characterization step of the HRA. This uncertainty evaluation will be conducted concurrent with the ARB risk characterization activities and will be provided to ARB in a separate submittal.

The following section summarizes the critical uncertainties associated with the emissions estimation and air dispersion modeling components of the risk assessment.

5.1 Estimation of Emissions

The uncertainties associated with emissions estimates and projections include uncertainties in activity and emission rates for the base year as well as projected future years. Although future year emissions were not evaluated in this assessment, the residential and worker risk scenarios will be evaluated for 70-year and 40-year periods, respectively, at a minimum by ARB. Thus, uncertainty due to future changes in activity and emission rates will be generally discussed. The uncertainty in activity and emissions estimates applies to both locomotive and non-locomotive sources.

For locomotive sources, the activity rates include primarily the number of engines operating and time in modes. The number of engines operating in the facility on the mainline are accurately measured and counted at readers, but the readers are not necessarily located exactly at the site under study, and can under certain circumstances produce erroneous duplicate readings that could only be accounted for via rough approximation. A separate, and less accurate dataset was used to estimate the number of engines arriving and departing from a site. These data, however, often do not produce matching arrivals and departures. ENVIRON adopted a conservative approach based on using the higher of the arrival or departure numbers, which may have resulted in overestimates of the number of engines arriving.

Uncertainties also exist in estimates of the engine time in mode. Idling is typically the most significant operational mode, but locomotive event recorder data could not distinguish between idling with the engine on and idling with the engine off. As a result, ENVIRON used professional judgment to distinguish between these two modes. In addition, no idle time reduction was assumed in the future year scenarios, despite the fact that BNSF has initiated programs to reduce idling through installation of automatic start/stop devices and other operational changes to reduce idling. So while the current operations may not be precisely known, control measures already being implemented are expected to result in reduced activity levels and lower emissions than are estimated here for future years.

The most significant non-locomotive sources at the rail yards are on-road trucks, cargo handling equipment, and transport refrigeration units used at intermodal facilities. Activity levels of these vehicles and equipment are estimated relatively accurately, however the duty cycles (engine load demanded) are less well characterized. Default estimates of the duty cycle may not accurately reflect the typical duty demanded from these vehicles and equipment at any particular site. New emissions models for these sources have recently been provided for use in this study by ARB. In many cases, these revised models reflect a dramatic change in emission factors from previous versions of the models and it is therefore reasonable to expect that future revisions to these models may result in further changes to emission estimates for on-road and off-road engines. In addition, national and state regulations have targeted these sources for emission reductions. Implementation of these rules and fleet turnover to newer engines meeting more strict standards should significantly reduce emissions at these rail sites in future years. The effects of these regulations have, for the most part, not been incorporated in the emission estimates, and so estimated emissions are greater than those expected for future years at the same activity level.

5.2 Estimation of Exposure Concentrations

5.2.1 Estimates from Air Dispersion Models

As discussed in Section 4.0, USEPA-recommended dispersion model AERMOD was used to estimate annual average off-site chemical exposure concentrations at the various off-site receptor locations. This model uses the Gaussian plume equation to calculate ambient air concentrations from emission sources. For this model, the magnitude of error for the maximum concentration is estimated to range from 10 to 40% (USEPA 2005b). Therefore, off-site exposure concentrations used in this assessment represent approximate off-site exposure concentrations.

5.2.2 Source Placement

Uncertainty exists in the placement of emission sources at the Facility. As a large amount of locomotive and on- and off-road engine activity at a rail yard is engaged in movement, the distribution of emissions during movement in the yards is an important source of uncertainty. Unlike fixed stationary sources, emissions from movement would occur over a continuum rather than as discrete points. However, regulatory approved models were originally developed for the evaluation of fixed stationary sources and the use of a continuum of source locations to model emissions during movement of sources results in an unacceptably large number (in the tens of thousands) of sources that would result in unwieldy post-processing data needs and unacceptable modeling run times (on the order of months rather than hours or days).

In this assessment, point and volume sources were spaced evenly at approximately 50-meter intervals similar to ARB's Roseville Study (ARB 2004) over rail locations where locomotive and on- and off-road activities occurred. Closer spacing between point and volume sources may impact the predicted concentrations at receptor locations near the Facility boundary. Sensitivity analyses performed to determine the potential impact of source placement on predicted concentrations at receptors near the Facility boundary (see Appendix C) indicated that concentrations at receptors nearest to the specific emission sources could be over-predicted by at least 10 percent.

5.2.3 Source Representation

The source parameters (i.e., release velocity and release temperature) used to model stationary locomotive activities are sources of uncertainty. Following ARB guidance (ARB 2006a), fleet-average source parameters were calculated to reduce the large number of potential source parameter configurations related to stationary locomotive activities at Commerce/Mechanical. The specific methodology used for calculating fleet-averaged source parameters is presented in Section 4.3.1.1. The use of fleet-average source parameters for stationary locomotive activities resulted in approximate predictions for these sources.

The release heights and vertical dimensions used for movement sources at the Facility are also sources of uncertainty. ARB calculated adjustments to the release height and vertical dimension for movement sources for individual engine models based on locomotive notch settings (i.e., locomotive travel speeds) and using two different stability classes for their Roseville study (ARB 2004). This methodology resulted in several uncertainties. ARB's methodology assumed that the wind speed was equal to the locomotive speed and did not account for variability in either the locomotive speed or hourly wind speeds. In addition, ARB's methodology assumed only two stability classes (i.e., class "D" for daytime and class "F" for nighttime), and did not account for potential variability in stability class during these time periods based local meteorological data. Nevertheless, ENVIRON calculated plume rise adjustments using a methodology similar to ARB's, described in more detail in Section 4.3.1.2, for locomotive movement activities and on-road diesel and gasoline vehicle movement sources at the Facility. Thus, the use of plume rise adjustments resulted in approximate predictions of receptor concentrations for these sources.

The use of area sources to represent emissions sources operating in areas where travel paths are not well defined or equipment usage may occur over the entire operating area are additional sources of uncertainty related to source representation. At the Commerce/Mechanical Rail Yard, area sources were used to represent on-road fleet vehicle movement activities in and around parking areas, track maintenance equipment, and portable engines, which account for almost 16 percent of total DPM emissions from the Rail Yard. Based on guidance in the draft Guidelines (ARB 2006a), these source activities may be modeled as either area or volume sources. The AERMOD model uses very different methodologies to estimate dispersion from area and volume sources (USEPA 2004c), and the use of area sources generally results in higher (more conservative) concentration estimates. Thus, the use of area sources to represent on-road fleet, track maintenance, and portable engine activities at Commerce/Mechanical generally resulted in over-predictions of receptor concentrations for these source activities.

5.2.4 Meteorological Data Selection

Uncertainty also exists in the meteorological data used in the AERMOD air dispersion model. These uncertainties are related to the use of meteorological data that is not site-specific, combination of surface data from two meteorological stations, substitution of missing meteorological data, and use of surface parameters for the meteorological station as opposed to the rail yard.

ENVIRON selected meteorological data for air dispersion modeling based upon their spatial and temporal representativeness of conditions in the immediate vicinity of the rail yard. On-site meteorological data was not available for the rail yard. Therefore, the meteorological data used in this analysis was based on surface meteorological data from ARB's Lynwood station (approximately nine kilometers from the rail yard) and the NCDC/NWS station at Los Angeles-Downtown USC (approximately eleven kilometers from the rail yard) and upper air data from San Diego-Miramar Naval Air Station. A complete set of surface meteorological data was not available at either Lynwood or Los Angeles-Downtown USC, therefore wind speed and wind direction data from Lynwood were combined with temperature, pressure, and cloud cover data from Los Angeles-Downtown USC. Meteorological surface measurements from the Lynwood and Los Angeles-Downtown USC stations were not 100% complete for all modeled years, therefore missing data were substituted using procedures outlined in Atkinson & Lee (1992). Surface parameters supplied to AERMET, the meteorological preprocessor to AERMOD, were specified for the area surrounding the meteorological monitoring site (Lynwood station), rather than the project area (rail yard), as recommended by USEPA (USEPA 2005a) and ARB.[5] However, because the selected meteorological station is in very close proximity to the Commerce/Mechanical and the land use surrounding the meteorological station is very similar to the land use surrounding Commerce/Mechanical, surface parameters calculated for the meteorological station should be representative of Commerce/Mechanical. The uncertainties due to the use of non-site-specific meteorological data, combination of surface data from different stations, substitution of missing surface data, and use of surface parameters for the meteorological station resulted in approximate exposure concentrations.

5.2.5 Building Downwash

The spacing and placement of point sources relative to buildings or structures results in impacts to building downwash parameters and resulting modeling concentrations. Based on the results of ENVIRON's sensitivity analyses discussed in Appendix G, the uncertainty in placing locomotive

[5] Personal communication, J. Yuan of ARB by e-mail to D. Daugherty of ENVIRON on August 3, 2006.

structures in areas where stationary locomotives occur, and the fact that many of the stationary locomotive activities occur in the interior of the rail yard, ENVIRON did not include building downwash effects due to locomotives in this assessment. Also, because specific locations for most stationary locomotive activities were not available, point sources representing these activities were distributed evenly over the areas where these operations occurred, as described in Section 4.3.1.1. These assumptions and modeling techniques resulted in approximate predictions of receptor concentrations near the facility boundary, as described in further detail below.

5.2.6 Uncertainty in Points of Maximum Impact

Receptor concentration estimates in close proximity to the facility, such as any potential point of maximum impact (PMI), are highly dependent on air dispersion modeling assumptions. That is, different modeling assumptions regarding the spatial and temporal distributions of the emission sources can greatly influence the resulting concentration estimates in proximity to the emission sources, including the magnitude and location of the PMI. As discussed in Section 5.2.2, there is significant uncertainty associated with identification of and estimation of impacts at locations near to a mobile source facility due to the complexity associated with modeling sources that can move (i.e., volume or line sources representing mobile sources). To illustrate the potential influence of modeling techniques used in this assessment, sensitivity analyses were performed for two different movement activities at Commerce/Mechanical (presented in Appendix C). The first sensitivity analysis in Appendix C considered locomotive movement along a single segment of rail. The results of this analysis indicated that the PMIs predicted by the two configurations are in different locations. In addition, the PMI predicted by the set of volume sources spaced 50 meters apart is approximately 21% higher (more conservative) than the PMI predicted using the line source. The second sensitivity analysis in Appendix C considered locomotive movement along four parallel segments of rail. Although the location of the PMI was the same for both configurations in this analysis, the volume sources placed over all four rail lines and spaced 50 meters apart predicted a PMI approximately 17% higher (more conservative) than the line source configuration. These two analyses illustrated the particular sensitivities in assessment of receptors near a rail yard's boundary to source representation (i.e., source spacing, and source sizing for approximation of mobile sources) in the modeling and how source simplification assumptions generally result in over-prediction of concentrations near to the rail yards. Other modeling techniques and assumptions used in this assessment, including fleet-averaging of stationary locomotive activity source parameters, plume rise adjustments to locomotive and on-road diesel and gasoline vehicle movement sources, the use of area sources to represent emissions sources operating in areas where travel paths are not well defined or equipment usage may occur over the entire area, as described above, also contribute to uncertainty to modeling predictions for receptors near the boundary of the rail yard.

Focusing on receptor locations at a greater distance (i.e., one to two kilometers) from the facility reduces the overall influence on the proximity to specific site operations. The two sensitivity analyses discussed above, and presented in more detail in Appendix C, indicated that concentrations were over-predicted by 21% and 17% at the PMI. However, at distances one to two kilometers from the facility, receptor concentrations for the two source configurations were all within one to five percent of each other, as shown in Figures C-1 and C-2 of Appendix C. Thus, the results of these two sensitivity analyses indicated that concentrations at receptors further from the sources are much less sensitive to air dispersion assumptions regarding the spatial and temporal distributions of emission sources.

5.2.7 Estimation of Maximum One-Hour TAC Concentrations

ENVIRON evaluated a large number of non-DPM TACs in this assessment from non-DPM sources (mainly from gasoline engine emissions) as identified in the speciation profiles discussed in Appendix A. In order to substantially reduce modeling complexity and run time, maximum one-hour TOG exhaust, TOG evaporative, and PM exhaust emission rates (as opposed to maximum one-hour individual TAC emission rates) were input into the air dispersion model. Speciation profiles containing the fractions of individual TACs for TOG exhaust, TOG evaporative, and PM exhaust emissions (discussed in Appendix A) were then applied to the TOG exhaust, TOG evaporative, and PM exhaust concentrations estimated by the dispersion model to calculate concentrations of individual TACs. This methodology resulted in conservative estimates (i.e., over-predictions) of the maximum one-hour concentrations for individual TACs.

5.3 Risk Characterization

As stated previously, ARB will conduct the risk characterization part of the HRA based on the results of the emissions estimation and air dispersion modeling provided by ENVIRON. Consistent with the Agreement and draft Guidelines (ARB 2005b, 2006a), the risk characterization activities conducted by ARB will include evaluating and reporting the uncertainties associated with the estimated risks for each designated rail yard. As discussed in detail above, there are many uncertainties associated with the estimation of emissions and exposure point concentrations from rail yard emission sources that would be in addition to the uncertainties associated with the exposure assumptions and toxicity information to be used in ARB's estimation of risks. Many of these uncertainties lead to an over-prediction of the estimated offsite impacts. At the request of ARB, ENVIRON will assist ARB in identifying the critical assumptions and uncertainties associated with the risk characterization step of the HRA. This evaluation will be conducted concurrent with the ARB risk characterization activities and will be provided to ARB in a separate submittal.

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Table 2-1

Percentages of Land Use Categories Within Twenty Kilometers of Facility

BNSF Commerce Mechanical

Commerce, California

Land Use Category [1]	**Percentage (%)**
Open water	0.25%
Low Intensity Residential	39.47%
High Intensity Residential	17.65%
Commercial/Industrial/Transportation	22.07%
Bare Rock/Sand/Clay	1.48%
Quarries/Strip Mines/Gravel Pits	0.01%
Transitional	0.00%
Deciduous Forest	0.14%
Evergreen Forest	0.79%
Mixed Forest	2.16%
Shrubland	10.29%
Orchards/Vineyards/Other	0.01%
Grasslands/Herbaceous	3.27%
Pasture/Hay	0.13%
Row Crops	0.05%
Small Grains	0.03%
Fallow	0.00%
Urban/Recreational Grasses	2.18%
Woody Wetlands	0.01%
Emergent Herbaceous Wetlands	0.01%

Notes:

1. Land use data are based on National Land Cover Data 1992 from US Geological Survey.

Table 3-1a
Summary of Emissions and Operating Hours for Modeled PM Emission Sources[1]
BNSF Commerce Mechanical
Commerce, California

Emission Source	Activity Category	Activity Category Description	Activity Sub-Category	Activity Subcategory Description	Modeling Source Type	Operation Mode	Modeling Source Group[2]	Total Emissions (g)	Days of Operation Per Week	Hours of Operation Per Day	Modeled Area (m^2)	Total Emission Rate[3,4] (g/s) or ($g/m^2/s$)	Number of Modeled Sources	Emission Rate Applied to Period-Average Dispersion Factors[5] (g/s)
Locomotives	A	Basic Locomotive Service	A1	Movement into yard	Volume	Notch 1	A1	24,750	7	24	-	7.85E-04	13	6.04E-05
			A2	Idling while refueling	Point	Idle	A2	445,128	7	24	-	1.41E-02	8	1.76E-03
			A3	In-consist	Point	Idle	A3	222,564	7	24	-	7.06E-03	29	2.43E-04
			A4	Lead engine load test	Point	Notch 8	A4	523,583	7	24	-	1.66E-02	30	5.53E-04
			A5	Movement out of yard	Volume	Notch 2	A5	54,079	7	24	-	1.71E-03	13	1.32E-04
	B	Basic Engine Inspection	B1	Movement into engine shop	Volume	Notch 1	B1	838	7	24	-	2.66E-05	17	1.56E-06
			B2	Preloaded test	Point	Notch 8	B2	82,585	7	24	-	2.62E-03	3	8.73E-04
			B3	After service load test	Point	Notch 8	B3	167,672	7	24	-	5.32E-03	2	2.66E-03
			B4	Movement out to service	Volume	Notch 1	B4	838	7	24	-	2.66E-05	10	2.66E-06
	C	Full Engine Service/ Inspection	C1	Movement into engine shop	Volume	Notch 1	C1	972	7	24	-	3.08E-05	17	1.81E-06
			C2	Preloaded test	Point	Notch 8	C2	93,687	7	24	-	2.97E-03	3	9.90E-04
			C3	Opacity test	Point	Idle	C3I	481	7	24	-	1.53E-05	2	7.63E-06
					Point	Notch 1	C31	1,040	7	24	-	3.30E-05	2	1.65E-05
					Point	Notch 2	C32	2,163	7	24	-	6.86E-05	2	3.43E-05
					Point	Notch 3	C33	3,992	7	24	-	1.27E-04	2	6.33E-05
					Point	Notch .4	C34	4,901	7	24	-	1.55E-04	2	7.77E-05
					Point	Notch 5	C35	7,957	7	24	-	2.52E-04	2	1.26E-04
					Point	Notch 6	C36	8,028	7	24	-	2.55E-04	2	1.27E-04
					Point	Notch 7	C37	7,903	7	24	-	2.51E-04	2	1.25E-04
					Point	Notch 8	C38	9,109	7	24	-	2.89E-04	2	1.44E-04
			C4	Final load test	Point	Notch 8	C4	190,214	7	24	-	6.03E-03	2	3.02E-03
			C5	Movement out to service	Volume	Notch 1	C5	972	7	24	-	3.08E-05	10	3.08E-06
	D	Switching	D	Switching	Point	Idle	D	16,249	5	11	-	1.57E-03	52	3.03E-05
					Volume	Dynamic Brake	DD	17	5	11	-	1.65E-06	19	8.67E-08
					Volume	Notch 1	D1	2,782	5	11	-	2.69E-04	19	1.42E-05
					Volume	Notch 2	D2	11,572	5	11	-	1.12E-03	19	5.90E-05
					Volume	Notch 3	D3	8,990	5	11	-	8.71E-04	19	4.58E-05
					Volume	Notch .4	D4	5,336	5	11	-	5.17E-04	19	2.72E-05
					Volume	Notch 5	D5	1,449	5	11	-	1.40E-04	19	7.39E-06
					Volume	Notch 6	D6	852	5	11	-	8.25E-05	19	4.34E-06
					Volume	Notch 7	D7	558	5	11	-	5.41E-05	19	2.85E-06
					Volume	Notch 8	D8	1,014	5	11	-	9.82E-05	19	5.17E-06
	E	Non-BNSF Passing Line Haul	E	Non-BNSF Passing Line Haul	Volume	Dynamic Brake	ED	138	7	24	-	4.38E-06	17	2.57E-07
					Volume	Notch 1	E1	17	7	24	-	5.51E-07	17	3.24E-08
					Volume	Notch 2	E2	77	7	24	-	2.43E-06	17	1.43E-07
					Volume	Notch 3	E3	178	7	24	-	5.66E-06	17	3.33E-07
	F	BNSF Passing Line Haul	F	BNSF Passing Line Haul	Volume	Dynamic Brake	FD	35,446	7	24	-	1.12E-03	17	6.61E-05
					Volume	Notch 1	F1	4,456	7	24	-	1.41E-04	17	8.31E-06
					Volume	Notch 2	F2	19,655	7	24	-	6.23E-04	17	3.67E-05
					Volume	Notch 3	F3	45,787	7	24	-	1.45E-03	17	8.54E-05
	G	Passenger locomotives	G	Passenger locomotives	Volume	Dynamic Brake	GD	8,630	7	24	-	2.74E-04	17	1.61E-05
					Volume	Notch 1	G1	831	7	24	-	2.64E-05	17	1.55E-06
					Volume	Notch 2	G2	5,551	7	24	-	1.76E-04	17	1.04E-05
					Volume	Notch 3	G3	11,649	7	24	-	3.69E-04	17	2.17E-05
On-Road Fleet	J	On Road Fleet	J	On-Road Fleet	Volume	-	29 Vol	914	7	12	-	5.80E-05	24	2.41E-06
					Area	-	AR29	82	7	12	6,971	7.46E-10	4	5.20E-06
Off-Road Equipment	K	Off Road Equipment	K2[6]	Track Maintenance Equipment (North Area)	Area	-	AR27_N	1,430	5	12	12,374	1.03E-08	2	1.27E-04
				Track Maintenance Equipment (South Area)	Area	-	AR27_S	12,874	5	12	57,602	1.98E-08	6	1.14E-03
			K3[7]	Portable Engines (Inside GE Building)	Area	-	AR28_1	18,301	7	24	2,748	2.11E-07	1	5.80E-04
				Portable Engines (Outside GE Building)	Area	-	AR28_2	347,724	7	24	12,374	8.91E-07	2	1.10E-02

Notes:
1. "Stationary Permitted Sources" (designated as activity category L in Appendix A) of DPM were not modeled due to negligible emissions and lack of source parameter information for modeling.
2. "Modeling Source Group" corresponds to the modeling source group name in the AERMOD input and output files.
3. The "Total Emission Rate" is calculated based on the "Total Emissions" divided by the "Days of Operation Per Week" divided by the "Hours of Operation Per Day".
4. The "Total Emission Rate" units are "grams per second" for point and volume sources and "grams per meter squared per second" for area sources.
5. The "Emission Rate Applied to Period-Average Dispersion Factors" is the emission rate applied to the modeled period average dispersion factors for each source group to estimate air concentrations.
For point and volume sources the "Emission Rate Applied to Period-Average Dispersion Factors" is equal to the "Total Emission Rate" divided by the "Number of Modeled Emission Sources".
For area sources the "Emission Rate Applied to Period-Average Dispersion Factors" is equal to the "Total Emission Rate" multiplied by the modeled area.
6. Track Maintenance activities divided into North and South areas due to emissions density. According to BNSF personnel, 10% of emissions occur in the North operating area and 90% of emissions occur in the South operating area.
7. Portable engine activities divided up into two areas due to differences in modeling source parameters and emissions density. According to BNSF personnel, 5% of emissions occur in the GE Maintenace Building and 95% of emissions occur in the areas outside the GE Maintenance Building.

Table 3-1b

Summary of Emissions and O erating Ho rs For Modeled Gasoline Emission So rce[1]s BNSF Commerce Mechanical

Commerce, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type	Modeling Source Group[2]	Total Emissions (g)	Days of Operation Per Week	Hours of Operation Per Day	Modeled Area (m^2)	Total Emission Rate[3,4] (g/s) or ($g/m^2/s$)	Number of Modeled Sources	Emission Rate Applied to Period-Average Dispersion Factors[5] (g/s)	Hourly Maximum Emission Rate (g/s) or ($g/m^2/s$)
Gasoline PM (ARB Speciate Profile #400)											
J[7]	On-Road Fleet	Volume	GPM	400	7	12	-	2.54E-05	24	1.06E-06	1.06E-06
	On-Road Fleet	Area		36	7	12	6,971	3.27E-10	4	2.28E-06	3.27E-10
K2[8]	Track Maintenance (North Area)	Area		1	5	12	12,374	8.03E-12	2	9.94E-08	8.03E-12
	Track Maintenance (South Area)	Area		10	5	12	57,602	1.55E-11	6	8.94E-07	1.55E-11
K3[9]	Portable Engines (Inside GE Building)	Area		177	7	24	2,748	2.05E-09	1	5.62E-06	2.05E-09
	Portable Engines (Outside GE Building)	Area		3,367	7	24	12,374	8.63E-09	2	1.07E-04	8.63E-09
TOG Evaporative (ARB Speciate Profile #422)											
J[7]	On-Road Fleet	Volume	EVAP	28,489	7	12	-	1.81E-03	24	7.53E-05	7.53E-05
	On-Road Fleet	Area		2,557	7	12	6,971	2.33E-08	4	1.62E-04	2.33E-08
K2[8]	Track Maintenance (North Area)	Area		7	5	12	12,374	4.89E-11	2	6.05E-07	4.89E-11
	Track Maintenance (South Area)	Area		61	5	12	57,602	9.46E-11	6	5.45E-06	9.46E-11
K3[9]	Portable Engines (Inside GE Building)	Area		1,892	7	24	2,748	2.18E-08	1	6.00E-05	2.18E-08
	Portable Engines (Outside GE Building)	Area		35,957	7	24	12,374	9.21E-08	2	1.14E-03	9.21E-08
L	Gasoline Dispensing Facility	Area		75,718	7	24	243	9.89E-06	1	2.40E-03	9.89E-06
TOG Exhaust (ARB Speciate Profile #2105)											
J[7]	On-Road Fleet	Volume	EXH	53,298	7	12	-	3.38E-03	24	1.41E-04	1.41E-04
	On-Road Fleet	Area		4,784	7	12	6,971	4.35E-08	4	3.03E-04	4.35E-08
K2[8]	Track Maintenance (North Area)	Area		39	5	12	12,374	2.78E-10	2	3.44E-06	2.78E-10
	Track Maintenance (South Area)	Area		349	5	12	57,602	5.37E-10	6	3.10E-05	5.37E-10
K3[9]	Portable Engines (Inside GE Building)	Area		9,588	7	24	2,748	1.11E-07	1	3.04E-04	1.11E-07
	Portable Engines (Outside GE Building)	Area		182,169	7	24	12,374	4.67E-07	2	5.78E-03	4.67E-07

Notes:

1. Stationary Permitted Sources (designated as activity category L in Appendix A) of DPM were not modeled due to negligible emissions and lack of source parameter information for modeling.
2. "Modeling Source Group" corresponds to the modeling source group name in the AERMOD input and output files.
3. The "Total Emission Rate" is calculated based on the "Total Emissions" divided by the "Days of Operation Per Week" divided by the "Hours of Operation Per Day".
4. The "Total Emission Rate" units are "grams per second" for point and volume sources and "grams per meter squared per second" for area sources.
5. The "Emission Rate Applied to Period-Average Dispersion Factors" is the emission rate applied to the modeled period average dispersion factors for each source group to estimate air concentrations.
For point and volume sources, the "Emission Rate Applied to Period-Average Dispersion Factors" is equal to the "Total Emission Rate" divided by the "Number of Modeled Emission Sources";
For area sources, the "Emission Rate Applied to Period-Average Dispersion Factors" is equal to the "Total Emission Rate" multiplied by the modeled area.
6. The "Hourly Maximum Emission Rate" is the emission rate used to in the air dispersion model. For point and volume sources, the "Hourly Maximum Emission Rate"
is equal to the "Emission Rate Applied to Period-Average Dispersion Factors). For area sources, the "Hourly Maximum Emission Rate" is equal to the "Total Emission Rate."
7. On-Road Fleet modeled as volume sources along distinguishable travel paths and area sources for travel in larger areas without distinguishable paths.
8. Track Maintenance activities divided into North and South areas due to emissions density. According to BNSF personnel, 5% of emissions occur in the North operating area and 95% of emissions occur
in the South operating area.
9. Portable engine activities divided up into two areas due to differences in modeling source parameters and emissions density. According to BNSF personnel, 5% of emissions occur
in the GE Maintenace Building and 95% of emissions occur in the areas outside the GE Maintenance Building.

Table 3-2
Summary of Activity Category Total Annual DPM and TOG Emissions at the Facility
BNSF Commerce Mechanical
Commerce, California

Activity Category	Activity Category Description	Diesel			Gasoline								
		PM Emissions			PM Emissions			TOG Evaporative Emissions			TOG Exhaust Emissions		
		Grams	Metric Tons	Percentage (%)	Grams	Metric Tons	Percentage (%)	Grams	Metric Tons	Percentage (%)	Grams	Metric Tons	Percentage (%)
A	Basic Services	1,270,104	1.27	52.5%	-	-	-	-	-	-	-	-	-
B	Basic Engine Inspections	251,932	0.25	10.4%	-	-	-	-	-	-	-	-	-
C	Full Engine Service/Inspection	331,417	0.33	13.7%	-	-	-	-	-	-	-	-	-
D	Switching	48,819	0.05	2.0%	-	-	-	-	-	-	-	-	-
E/F	Adjacent Freight Movements	105,754	0.11	4.4%	-	-	-	-	-	-	-	-	-
G	Passenger Locomotives	26,661	0.03	1.1%	-	-	-	-	-	-	-	-	-
J	On-Road Fleet Vehicle	996	0.00	0.04%	436	4.36E-04	10.9%	31,046	3.10E-02	21.5%	58,082	5.81E-02	23.2%
K	Other Off-Road Track maintenance	14,304	0.01	0.6%	11	1.12E-05	0.3%	68	6.82E-05	0.05%	387	3.87E-04	0.2%
K	Other Off-Road Portable Engines	366,025	0.37	15.1%	3,544	3.54E-03	88.8%	37,850	3.78E-02	26.2%	191,757	1.92E-01	76.6%
L	Stationary Sources[1]	3,225	0.003	0.13%	-	-	-	75,718	7.57E-02	52.3%	-	-	-
	TOT L	2,419,238	2.42	100.0%	3,992	3.99E-03	100%	144,682	1.45E-01	100%	250,226	2.50E-01	100%

Notes:
1. Stationary Permitted Sources (designated as activity category L in Appendix A) of DPM were not modeled due to negligible emissions and lack of source parameter information for modeling.

Table 4-1
Fleet-Average Source Parameters for Locomotive Activities
BNSF Commerce Mechanical
Commerce, California

									Day		Night	
Activity Subcategory	**Activity Subcategory Description**	**Modeling Source Type**	**Operation Mode**	**Stack Height (m)**	**Exit Temperature (K)**	**Exit Velocity (m/s)**	**Exit Diameter (m)**	**Initial Lateral Dimension (m)**	**Release Height (m)**	**Initial Vertical Dimension (m)**	**Release Height (m)**	**Initial Vertical Dimension (m)**
A1	Movement into yard	Volume	Notch 1	-	-	-	-	0.5 - 5.68	10.05	2.34	18.31	4.26
A2	Idling while refueling	Point	Idle	4.52	392	3.70	0.587	-	-	-	-	-
A3	In-consist	Point	Idle	4.52	392	3.70	0.587	-	-	-	-	-
A4	Lead engine load test	Point	Notch 8	4.52	675	46.7	0.591	-	-	-	-	-
A5	Movement out of yard	Volume	Notch 2	-	-	-	-	0.5 - 5.68	19.34	4.50	25.02	5.82
B1	Movement into engine shop	Volume	Notch 1	-	-	-	-	0.5 - 4.04	9.68	2.25	17.96	4.18
B2	Preloaded test	Point	Notch 8	4.52	694	48.6	0.585	-	-	-	-	-
B3	After service load test	Point	Notch 8	4.52	694	48.6	0.585	-	-	-	-	-
B4	Movement out to service	Volume	Notch 1	-	-	-	-	0.50	9.68	2.25	17.96	4.18
C1	Movement into engine shop	Volume	Notch 1	-	-	-	-	0.5 - 4.04	8.84	2.06	17.14	3.99
C2	Preloaded test	Point	Notch 8	4.52	691	44.0	0.606	-	-	-	-	-
C3	Opacity test	Point	Idle	4.52	402	2.25	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 1	4.52	470	3.04	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 2	4.52	566	5.30	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 3	4.52	647	10.84	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch .4	4.52	697	13.95	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 5	4.52	700	21.93	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 6	4.52	690	27.77	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 7	4.52	685	34.86	0.606	-	-	-	-	-
C3	Opacity test	Point	Notch 8	4.52	691	43.98	0.606	-	-	-	-	-
C4	Final load test	Point	Notch 8	4.52	691	43.98	0.606	-	-	-	-	-
C5	Movement out to service	Volume	Notch 1	-	-	-	-	0.50	8.84	2.06	17.14	3.99
D	Switching	Point	Idle	4.52	362	15.56	0.288	-	-	-	-	-
	Switching	Volume	Dynamic Brake	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch 1	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch 2	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch 3	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch .4	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch 5	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch 6	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
	Switching	Volume	Notch 7	-	-	-	-	0.5 - 4.61	15 1	3.51	24.51	5.70
	Switching	Volume	Notch 8	-	-	-	-	0.5 - 4.61	15.1	3.51	24.51	5.70
E	Non-BNSF Passing Line Haul	Volume	Dynamic Brake	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
	Non-BNSF Passing Line Haul	Volume	Notch 1	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
	Non-BNSF Passing Line Haul	Volume	Notch 2	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
	Non-BNSF Passing Line Haul	Volume	Notch 3	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
F	BNSF Passing Line Haul	Volume	Dynamic Brake	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
	BNSF Passing Line Haul	Volume	Notch 1	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
	BNSF Passing Line Haul	Volume	Notch 2	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
	BNSF Passing Line Haul	Volume	Notch 3	-	-	-	-	2.72 - 3.63	5.52	1.28	13.86	3.22
G	Passenger locomotives	Volume	Dynamic Brake	-	-	-	-	1.19	5.25	1.22	8.84	2.06
	Passenger locomotives	Volume	Notch 1	-	-	-	-	1.19	5.25	1.22	8.84	2.06
	Passenger locomotives	Volume	Notch 2	-	-	-	-	1.19	5.25	1.22	8.84	2.06
	Passenger locomotives	Volume	Notch 3	-	-	-	-	1.19	5.25	1.22	8.84	2.06

Table 4-2

Plume Rise Adjustments for Locomotive Movement Sources[1]
BNSF Commerce Mechanical
Commerce, California

Activity Subcategory	Activity Subcategory Description	Modeled Notch Setting[2]	Locomotive Speed mph	Locomotive Speed m/s	Modeled Locomotive Type	Plume Height[3] m			Initial Vertical Dimension m		
						Stability D	Stability F	Adjusted F[4]	Stability D	Stability F	Adjusted F[4]
A1	Maintenance: Movement into the Yard	1	5	2.24	Fleet-Average	10.05	18.31	-	2.34	4.26	-
A5	Maintenance: Movement out of Yard	2	5	2.24		19.34	25.02	-	4.50	5.82	-
B1	Movement into Engine Shop	1	5	2.24		9.68	17.96	-	2.25	4.18	-
B4	Movement out to Service	1	5	2.24		9.68	17.96	-	2.25	4.18	-
C1	Movement into Engine Shop	1	5	2.24		8.84	17.14	-	2.06	3.99	-
C5	Movement out to Service	1	5	2.24		8.84	17.14	-	2.06	3.99	-
D	Switching	2	5	2.24		15.1	24.51	-	3.51	5.70	-
E	Non-BNSF Line Haul	3	30	13.4		5.52	26.7	13.86	1.28	6.21	3.22
F	BNSF Line Haul	3	30	13.4		5.52	26.7	13.86	1.28	6.21	3.22
G	Passenger Locomotives	3	30	13.4		5.25	25.52	8.84	1.22	5.93	2.06

Notes:
1. Plume rise calculated using USEPA's SCREEN3 model using methodology in ARB's Roseville Study (ARB 2004).
2. Due to sensitivity of plume rise to wind speed and locomotive speed, plume rise adjustments calculated for only one notch setting per source subactivity.
For source subactivities with multiple notch settings, the source parameters for the notch setting with the greatest percentage of activity emission were selected.
3. Plume Height = physical height of locomotive plus plume rise.
4. The maximum wind speed for stability category F in SCREEN3 is 4.0 m/s. For locomotive speeds (i.e., effective wind speeds) greater than 4.0 m/s, the plume rise for stability category F was adjusted according to the methodology in the ARB Roseville Study (ARB 2004): adjusted plume rise = plume rise x(1/locomotive speed) 1/3

Source:
1. Air Resources Board. ARB 2004. Roseville Rail Yard Study. October 2004

Table 4-3
Source Parameters for Off-Road Equipment
BNSF Commerce Mechanical
Commerce, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type	Release Height[1] (m)	Initial Vertical Dimension[2] (m)
K2	Track Maintenance Equipment	Area	5.25	1.22
K3	Portable Engines (Inside GE Building)	Area	7.20	3.35
	Portable Engines (Outside GE Building)	Area	0.60	0.14

Notes:
1. Assumed release height for track maintenance equipment equal to the lowest plume height from plume rise adjustments for locomotive sources; assumed release height for portable engines in the GE Maintenance Building equal to half the height of the GE Locomotive Maintenance Building, for portable engines operated outdoors assumed 0.6 meter release height.
2. Initial vertical dimension for Portable Engines Inside GE Building calculated as release height divided by 2.15 based on USEPA guidance (USEPA 2004) for volume sources on or adjacent to a building.

Source:
1. United States Environmental Protection Agency (USEPA). 2004. User's Guide for AMS/EPA Regulatory Model - AERMOD. Office of Air Quality Planning and Standards. Emissions Monitoring and Analysis Division. Research Triangle Park, North Carolina. EPA-454/B-03-001. September.

Table 4-4
Source Parameters for On-Road Fleet
BNSF Commerce Mechanical
Commerce, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type[1]	Initial Lateral Dimenison (m)	Release Height[2] (m)	Initial Vertical Dimension (m)
J	On-Road Fleet	Volume	1.64	0.60	0.14
		Area	-	0.60	0.14

Notes:
1. On-Road Fleet modeled as volume sources along distinguishable travel paths and area sources (for travel in larger areas without distinguishable paths).
2. Release height based on ARB Risk Reduction Plan (ARB 2000) and recommendations from ARB staff.

Source:
1. Air Resources Board (ARB). 2000. Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel- Fueled Engines and Vehicles. Appendix VII: Risk Characterization Scenarios. October.

Table 4-5
Source Parameters for Permitted Stationary Sources
BNSF Commerce Mechanical
Commerce, California

Activity Subcategory	Activity Subcategory Description	Modeling Source Type	Release Height[1] (m)	Initial Vertical Dimension (m)
L	Gasoline Dispensing and Storage Facility	Area	0	0

Notes:
1. Release height for the Gasoline Dispensing and Storage Facility conservatively assumed to equal zero.

Table 4-6
Sector-Specific Surface Roughness, Bowen Ratio, and Albedo BNSF Commerce Mechanical
Commerce, California

		2002			2003			2004			2005		
Month	**Sector No**	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Albedo**	**Bowen Ratio**	**Surface Roughness**	**Albedo**	**Bowen Ratio**	**Surface Roughness**
Jan	1	0.18	2.15	0.95	0.18	4.21	0.95	0.18	2.15	0.95	0.18	2.15	0.95
Feb		0.15	2.11	0.95	0.15	1.08	0.95	0.15	1.08	0.95	0.15	0.52	0.95
Mar		0.15	2.11	0.95	0.15	1.08	0.95	0.15	1.08	0.95	0.15	0.52	0.95
Apr		0.17	4.02	0.96	0.17	2.05	0.96	0.17	4.02	0.96	0.17	4.02	0.96
May		0.17	4.02	0.96	0.17	2.05	0.96	0.17	4.02	0.96	0.17	4.02	0.96
Jun		0.17	4.02	0.96	0.17	2.05	0.96	0.17	4.02	0.96	0.17	4.02	0.96
Jul		0.17	4.11	0.95	0.17	4.11	0.95	0.17	1.02	0.95	0.17	4.11	0.95
Aug		0.17	4.11	0.95	0.17	4.11	0.95	0.17	1.02	0.95	0.17	4.11	0.95
Sep		0.17	4.11	0.95	0.17	4.11	0.95	0.17	1.02	0.95	0.17	4.11	0.95
Oct		0.17	4.11	0.95	0.17	4.11	0.95	0.17	1.02	0.95	0.17	4.11	0.95
Nov		0.18	2.15	0.95	0.18	4.21	0.95	0.18	2.15	0.95	0.18	2.15	0.95
Dec		0.18	2.15	0.95	0.18	4.21	0.95	0.18	2.15	0.95	0.18	2.15	0.95
Jan	2	0.19	2.33	0.91	0.19	4.46	0.91	0.19	2.33	0.91	0.19	2.33	0.91
Feb		0.16	2.24	0.91	0.16	1.16	0.91	0.16	1.16	0.91	0.16	0.54	0.91
Mar		0.16	2.24	0.91	0.16	1.16	0.91	0.16	1.16	0.91	0.16	0.54	0.91
Apr		0.17	4.07	0.91	0.17	2.12	0.91	0.17	4.07	0.91	0.17	4.07	0.91
May		0.17	4.07	0.91	0.17	2.12	0.91	0.17	4.07	0.91	0.17	4.07	0.91
Jun		0.17	4.07	0.91	0.17	2.12	0.91	0.17	4.07	0.91	0.17	4.07	0.91
Jul		0.18	4.27	0.91	0.18	4.27	0.91	0.18	1.04	0.91	0.18	4.27	0.91
Aug		0.18	4.27	0.91	0.18	4.27	0.91	0.18	1.04	0.91	0.18	4.27	0.91
Sep		0.18	4.27	0.91	0.18	4.27	0.91	0.18	1.04	0.91	0.18	4.27	0.91
Oct		0.18	4.27	0.91	0.18	4.27	0.91	0.18	1.04	0.91	0.18	4.27	0.91
Nov		0.19	2.33	0.91	0.19	4.46	0.91	0.19	2.33	0.91	0.19	2.33	0.91
Dec		0.19	2.33	0.91	0.19	4.46	0.91	0.19	2.33	0.91	0.19	2.33	0.91
Jan	3	0.19	2.35	0.92	0.19	4.51	0.92	0.19	2.35	0.92	0.19	2.35	0.92
Feb		0.16	2.26	0.92	0.16	1.17	0.92	0.16	1.17	0.92	0.16	0.54	0.92
Mar		0.16	2.26	0.92	0.16	1.17	0.92	0.16	1.17	0.92	0.16	0.54	0.92
Apr		0.17	4.14	0.92	0.17	2.16	0.92	0.17	4.14	0.92	0.17	4.14	0.92
May		0.17	4.14	0.92	0.17	2.16	0.92	0.17	4.14	0.92	0.17	4.14	0.92
Jun		0.17	4.14	0.92	0.17	2.16	0.92	0.17	4.14	0.92	0.17	4.14	0.92
Jul		0.18	4.33	0.92	0.18	4.33	0.92	0.18	1.06	0.92	0.18	4.33	0.92
Aug		0.18	4.33	0.92	0.18	4.33	0.92	0.18	1.06	0.92	0.18	4.33	0.92
Sep		0.18	4.33	0.92	0.18	4.33	0.92	0.18	1.06	0.92	0.18	4.33	0.92
Oct		0.18	4.33	0.92	0.18	4.33	0.92	0.18	1.06	0.92	0.18	4.33	0.92
Nov		0.19	2.35	0.92	0.19	4.51	0.92	0.19	2.35	0.92	0.19	2.35	0.92
Dec		0.19	2.35	0.92	0.19	4.51	0.92	0.19	2.35	0.92	0.19	2.35	0.92
Jan	4	0.19	2.49	0.87	0.19	4.71	0.87	0.19	2.49	0.87	0.19	2.49	0.87
Feb		0.16	2.36	0.87	0.16	1.24	0.87	0.16	1.24	0.87	0.16	0 56	0.87
Mar		0.16	2.36	0.87	0.16	1.24	0.87	0.16	1.24	0.87	0.16	0 56	0.87
Apr		0.18	4.16	0.87	0.18	2.21	0.87	0.18	4.16	0.87	0.18	4.16	0.87
May		0.18	4.16	0.87	0.18	2.21	0.87	0.18	4.16	0.87	0.18	4.16	0.87
Jun		0.18	4.16	0.87	0.18	2.21	0.87	0.18	4.16	0.87	0.18	4.16	0.87
Jul		0.19	4.44	0.87	0.19	4.44	0.87	0.19	1.07	0.87	0.19	4.44	0.87
Aug		0.19	4.44	0.87	0.19	4.44	0.87	0.19	1.07	0.87	0.19	4.44	0.87
Sep		0.19	4.44	0.87	0.19	4.44	0.87	0.19	1.07	0.87	0.19	4.44	0.87
Oct		0.19	4.44	0.87	0.19	4.44	0.87	0.19	1.07	0.87	0.19	4.44	0.87
Nov		0.19	2.49	0.87	0.19	4.71	0.87	0.19	2.49	0.87	0.19	2.49	0.87
Dec		0.19	2.49	0.87	0.19	4.71	0.87	0.19	2.49	0.87	0.19	2.49	0.87
Jan	5	0.18	2.14	0.97	0.18	4.20	0.97	0.18	2.14	0.97	0.18	2.14	0.97
Feb		0.15	2 10	0.97	0.15	1.07	0.97	0.15	1.07	0.97	0.15	0.52	0.97
Mar		0.15	2 10	0.97	0.15	1.07	0.97	0.15	1.07	0.97	0.15	0.52	0.97
Apr		0.16	4.05	0.97	0.16	2.06	0.97	0.16	4.05	0.97	0.16	4.05	0.97
May		0.16	4.05	0.97	0.16	2.06	0.97	0.16	4.05	0.97	0.16	4.05	0.97
Jun		0.16	4.05	0.97	0.16	2.06	0.97	0.16	4.05	0.97	0.16	4.05	0.97
Jul		0.17	4.12	0.97	0.17	4.12	0.97	0.17	1.02	0.97	0.17	4.12	0.97
Aug		0.17	4.12	0.97	0.17	4.12	0.97	0.17	1.02	0.97	0.17	4.12	0.97
Sep		0.17	4.12	0.97	0.17	4.12	0.97	0.17	1.02	0.97	0.17	4.12	0.97
Oct		0.17	4.12	0.97	0.17	4.12	0.97	0.17	1.02	0.97	0.17	4.12	0.97
Nov		0.18	2.14	0.97	0.18	4.20	0.97	0.18	2.14	0.97	0.18	2.14	0.97
Dec		0.18	2.14	0.97	0.18	4.20	0.97	0.18	2.14	0.97	0.18	2.14	0.97

Table 4-7
Approximate Dimensions of Buildings at the Facility
BNSF Commerce Mechanical
Commerce, California

Building/ Structure ID	Structure Name	Approximate Footprint Dimensions[1] (meters)	Height[2] (meters)
1	GE Locomotive Maintenance Building	90 x 32	14.4
2	Freight Car Repair Building	92 x 26	9.3
3	BNSF Mech. Administrative Building	40 x 26	6.5
4	Equipment Repair/ Administrative Building	43 x 33	9.9
5	Fire Suppressant Building[3]	17 x 9	8.2
6	Diesel Fuel Tank 1	10 diameter	14.0
7	Diesel Fuel Tank 2	10 diameter	14.0
8	Diesel Fuel Tank 3	10 diameter	14.0
9	Locomotive Supervisors Office/ Lube Storage	34 x 7	3.4
10	Storage Building	33 x 13	6.7
11	EQ Tank	10 diameter	13.4
12	Waste Water Treatment Plant	43 x 16	8.2

Notes:
1. Approximate footprint dimensions estimated based on aerial photograph of facility.
2. Building heights provided by BNSF personnel unless otherwise indicated.
3. Fire Suppresent Building assumed to be same height as Waste Water Treatment Plant.

Table 4-8

Locations of Sensitive Receptors Within One Mile of the Facility[1]
BNSF Commerce Mechanical
Commerce, California

Sensitive Receptor Name	ddress	UTMx (m)	UTMy (m)	Receptor Type
Childtime Children's Center	4820 S. Eastern Ave, Commerce, CA	392731.6	3761418.5	Child Care Center
Rosewood Park Elementary	2353 Commerce Way, Commerce, CA	393454.8	3763166.9	Public School
Vail High (Continuation)	1230 S. Vail Ave, Montebello, CA	395688.2	3761963.6	Public School
YMCA Montebello-Commerce Preschool & Child Developmen	2353 S. Commerce Way, Commerce, CA	393454.8	3763166.9	Child Care Center

Notes:
1. Locations of sensitive receptors were obtained from the following databases:
a. California Department of Education California School Directory (http://www.cde.ca.gov/re/sd/)
b. The Automated Licensing Information and Report Tracking System (Hospitals and Licensed Care Facilities) (http://alirts.oshpd.ca.gov/AdvSearch.aspx)
c. Yellow pages (http://yp.yahoo.com)

Figure 2-1: General Facility Location
BNSF Commerce Mechanical Rail Yard
Commerce, California

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Figure 2-2: Land Use Within Twenty Kilometers of Facility
BNSF Commerce Mechanical Rail Yard
Commerce, California

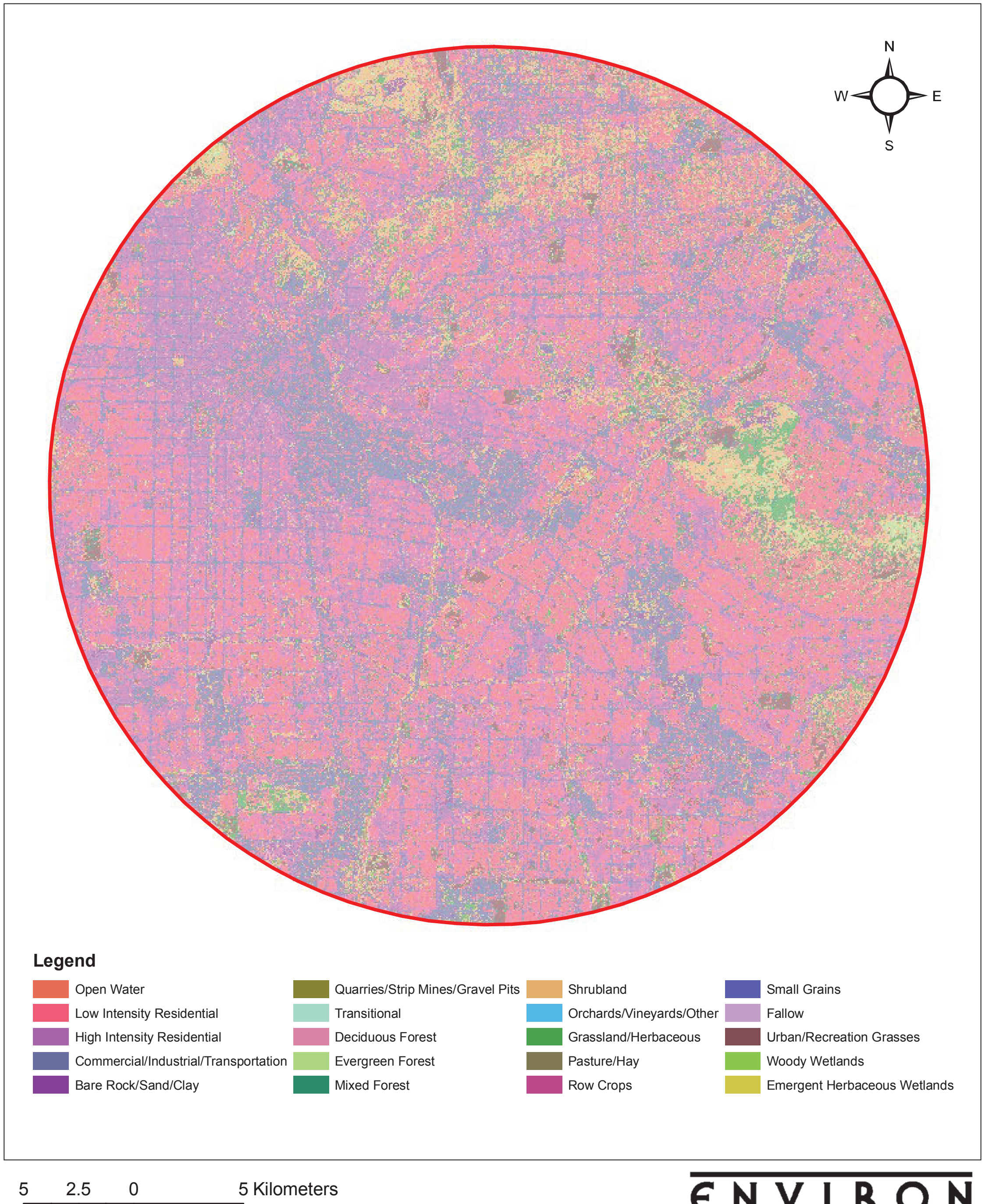

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Figure 2-3: Locomotive Traffic Flow
BNSF Commerce Mechanical Rail Yard
Commerce, California

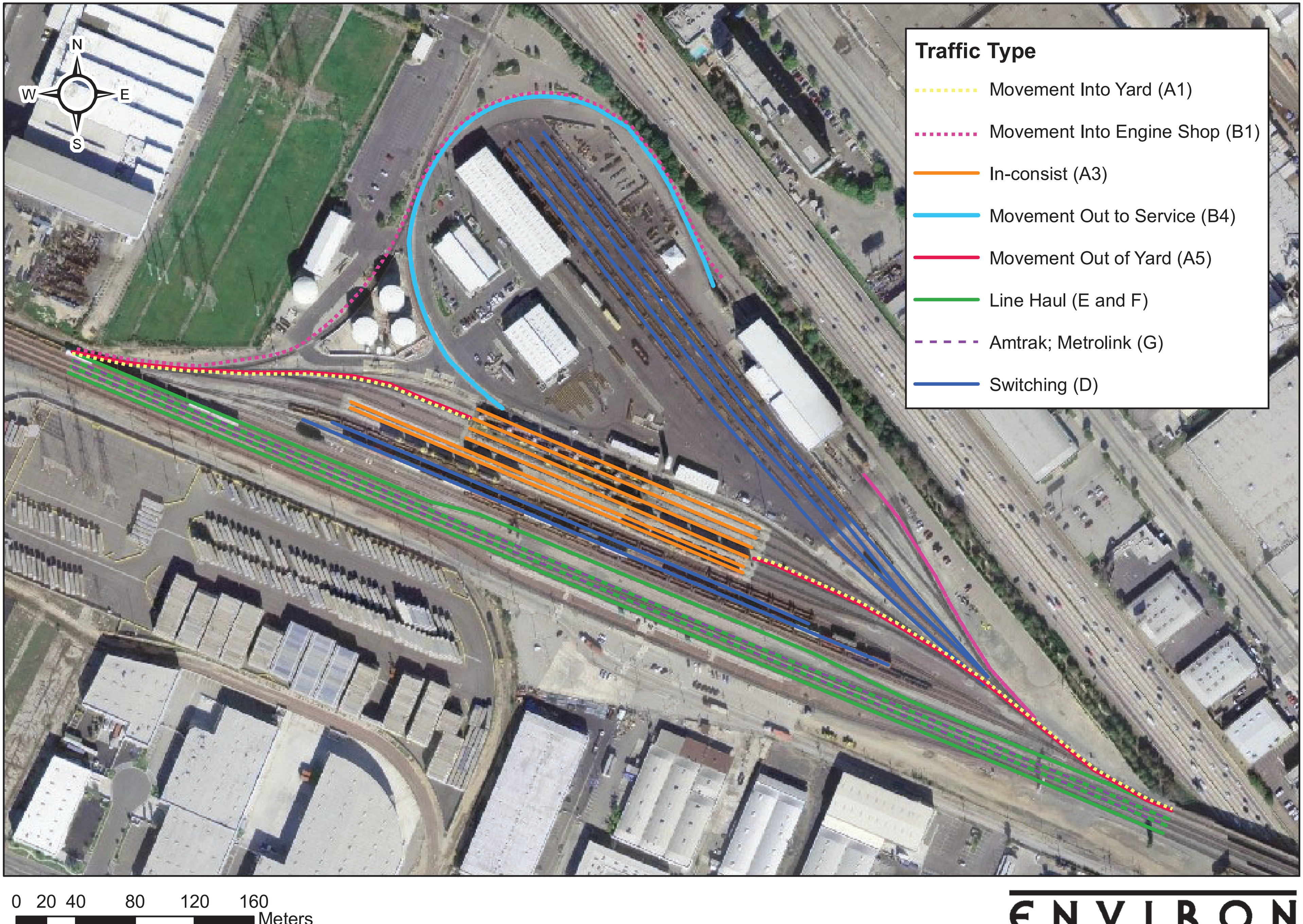

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Figure 2-4: Locomotive Maintenance, Other Off-Road Equipment, and Permitted Stationary Sources BNSF Commerce Mechanical Rail Yard Commerce, California

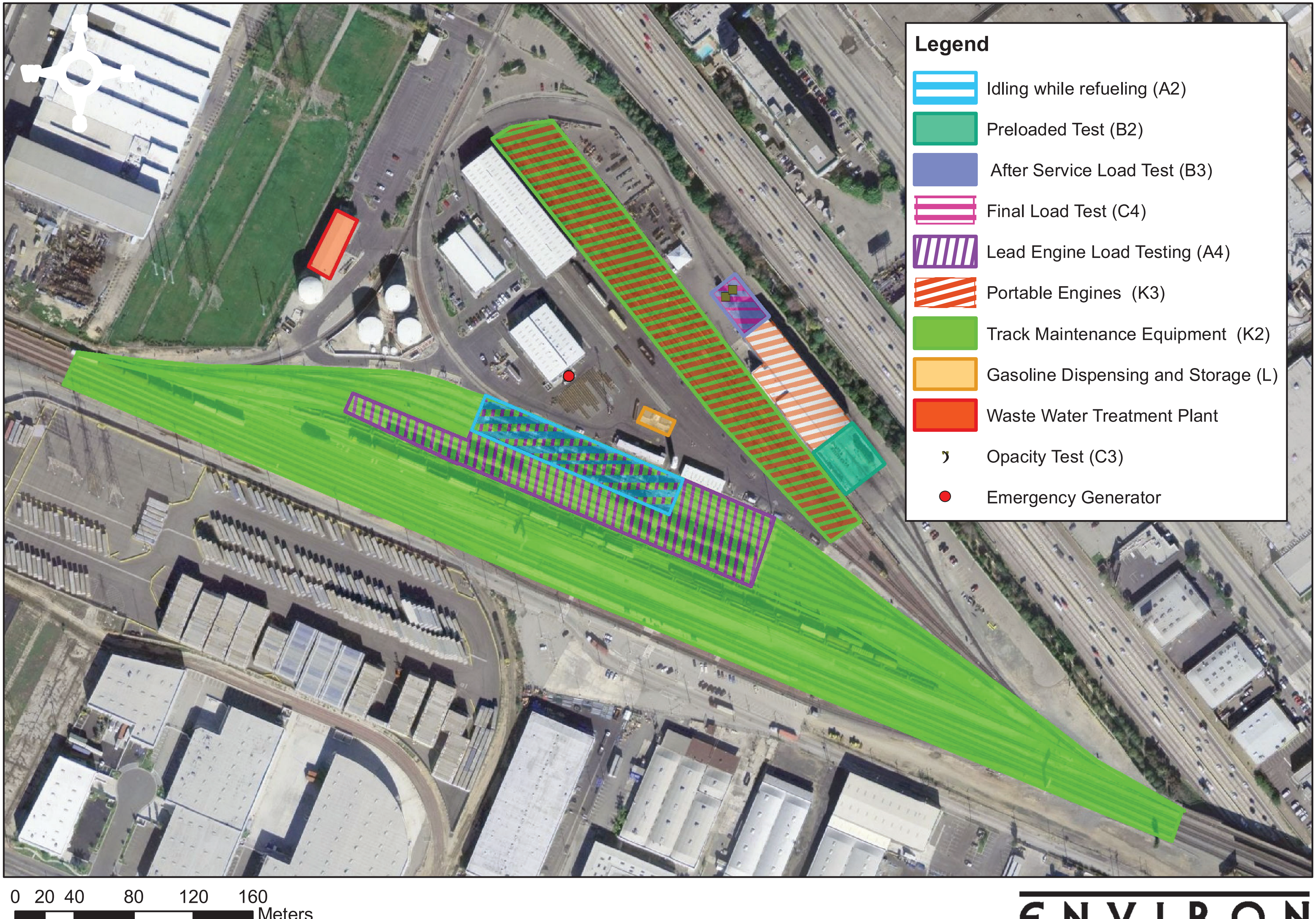

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Figure 2-5: Vehicle Travel Routes and Destinations
BNSF Commerce Mechanical Rail Yard
Commerce, California

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Figure 4-1a: Locations of Modeled Stationary Locomotive Sources
BNSF Commerce Mechanical Rail Yard
Commerce, California

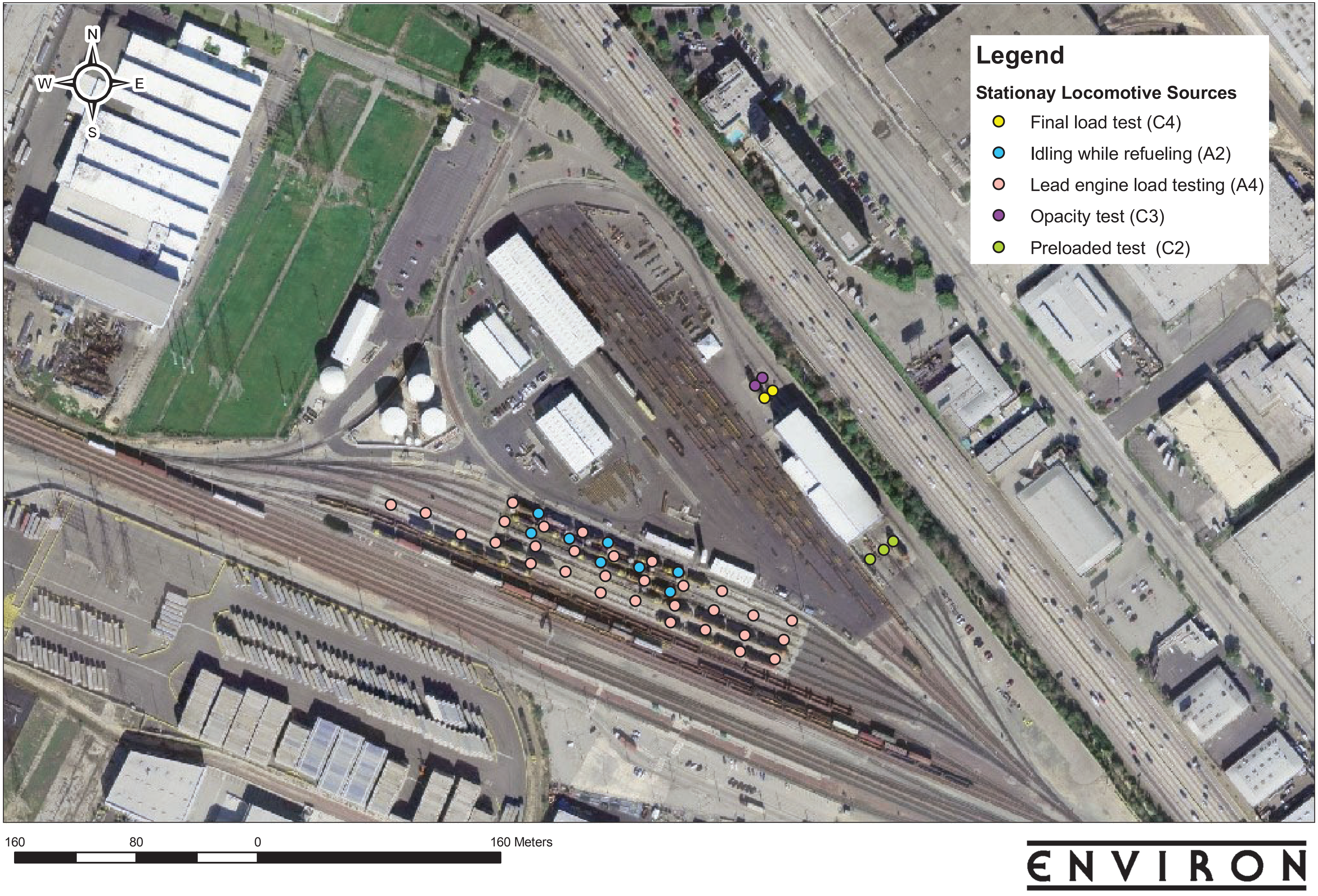

Figure 4-1b: Locations of Modeled Stationary Locomotive Sources
BNSF Commerce Mechanical Rail Yard
Commerce, California

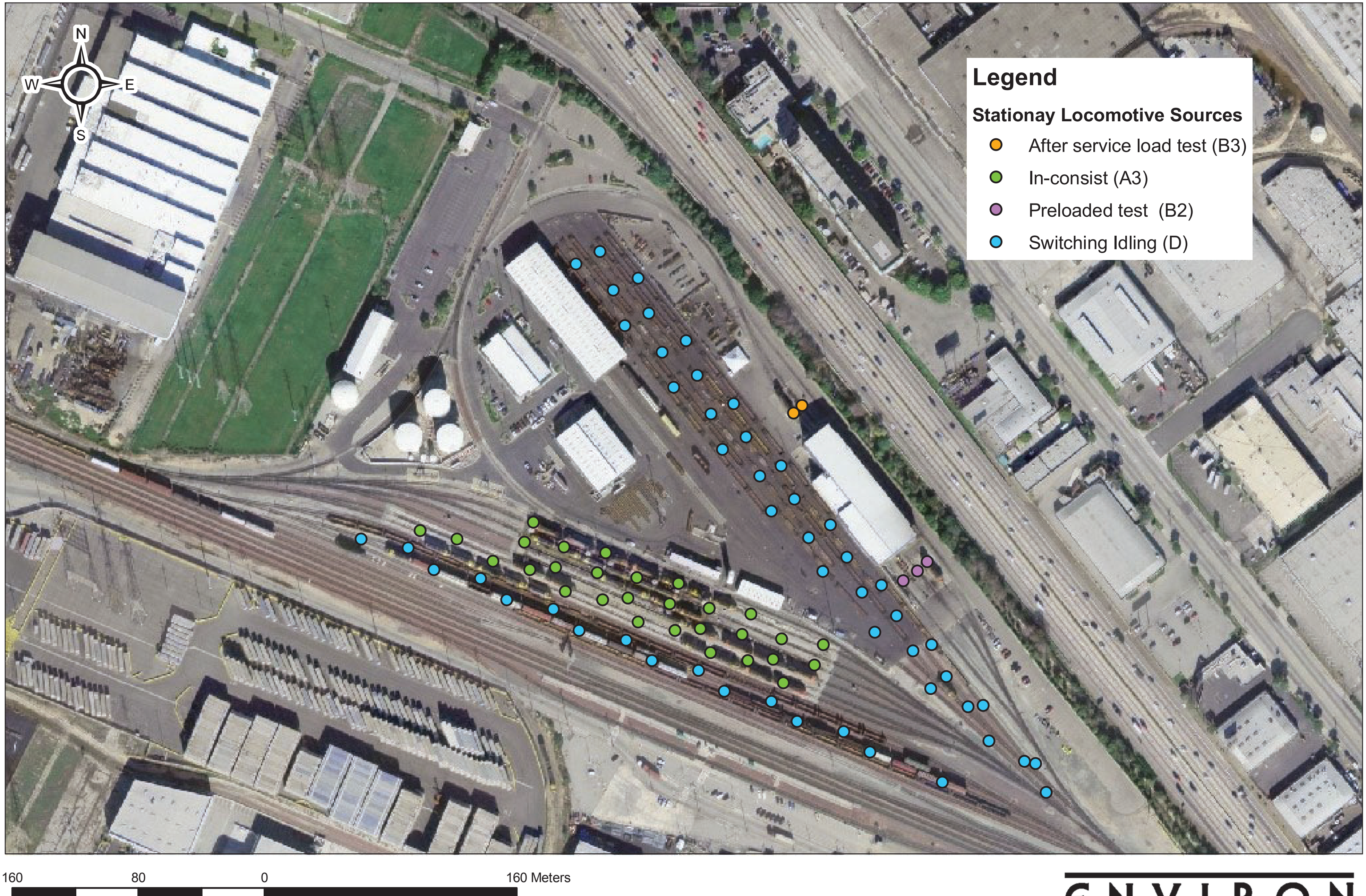

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Figure 4-2: Locations of Modeled Movement Locomotive Sources
BNSF Commerce Mechanical Rail Yard
Commerce, California

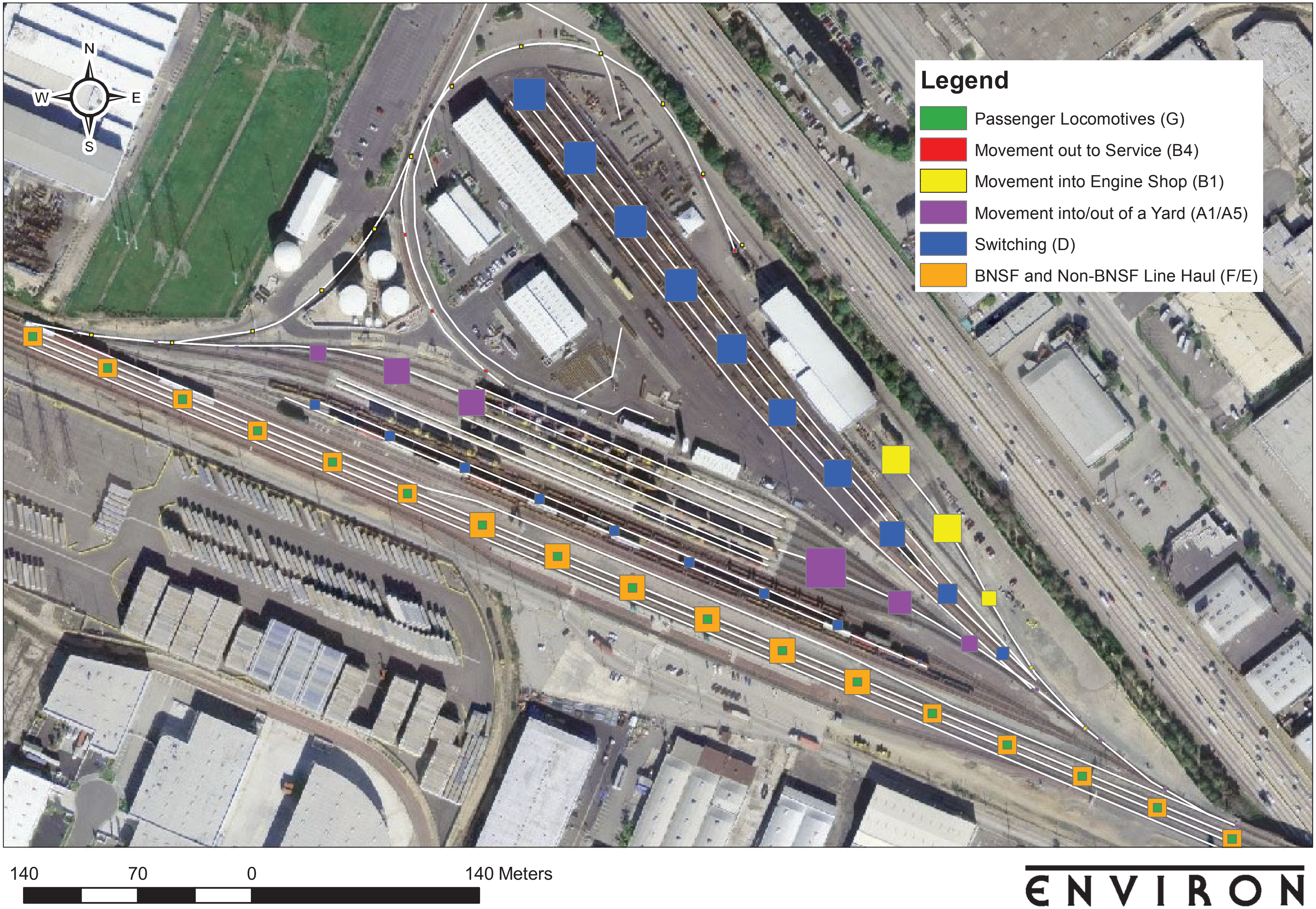

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Figure 4-3: Locations of Modeled Off-Road Equipment Sources
BNSF Commerce Mechanical Rail Yard
Commerce, California

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Figure 4-4a: Locations of Modeled On-Road Fleet Sources (Travel Route 1)
BNSF Commerce Mechanical Rail Yard
Commerce, California

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Figure 4-4b: Locations of Modeled On-Road Fleet Sources (Travel Route 2)
BNSF Commerce Mechanical Rail Yard
Commerce, California

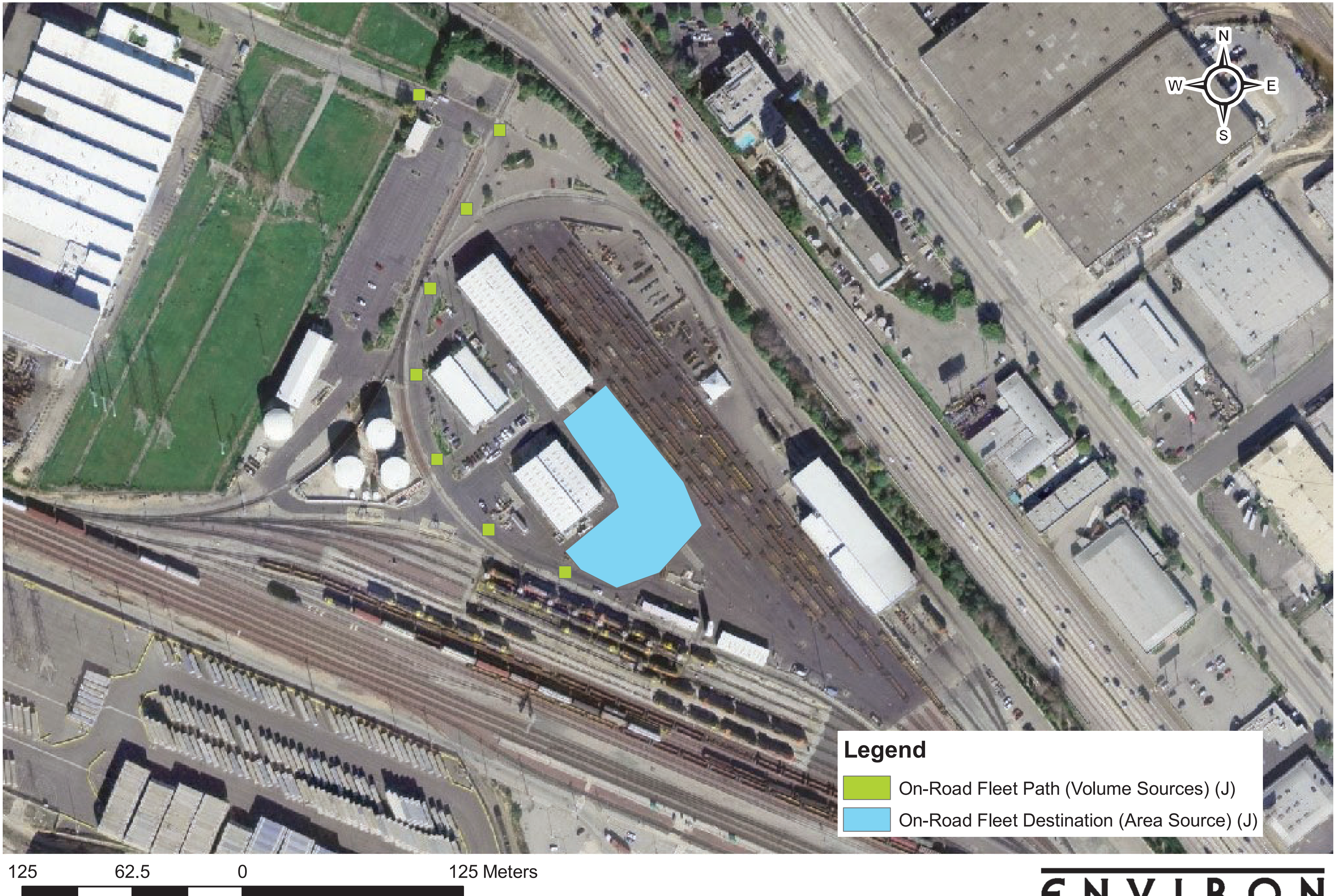

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Figure 4-4c: Locations of Modeled On-Road Fleet Sources (Travel Route 3)
BNSF Commerce Mechanical Rail Yard
Commerce, California

Figure 4-4d: Locations of Modeled On-Road Fleet Sources (Travel Route 4)
BNSF Commerce Mechanical Rail Yard
Commerce, California

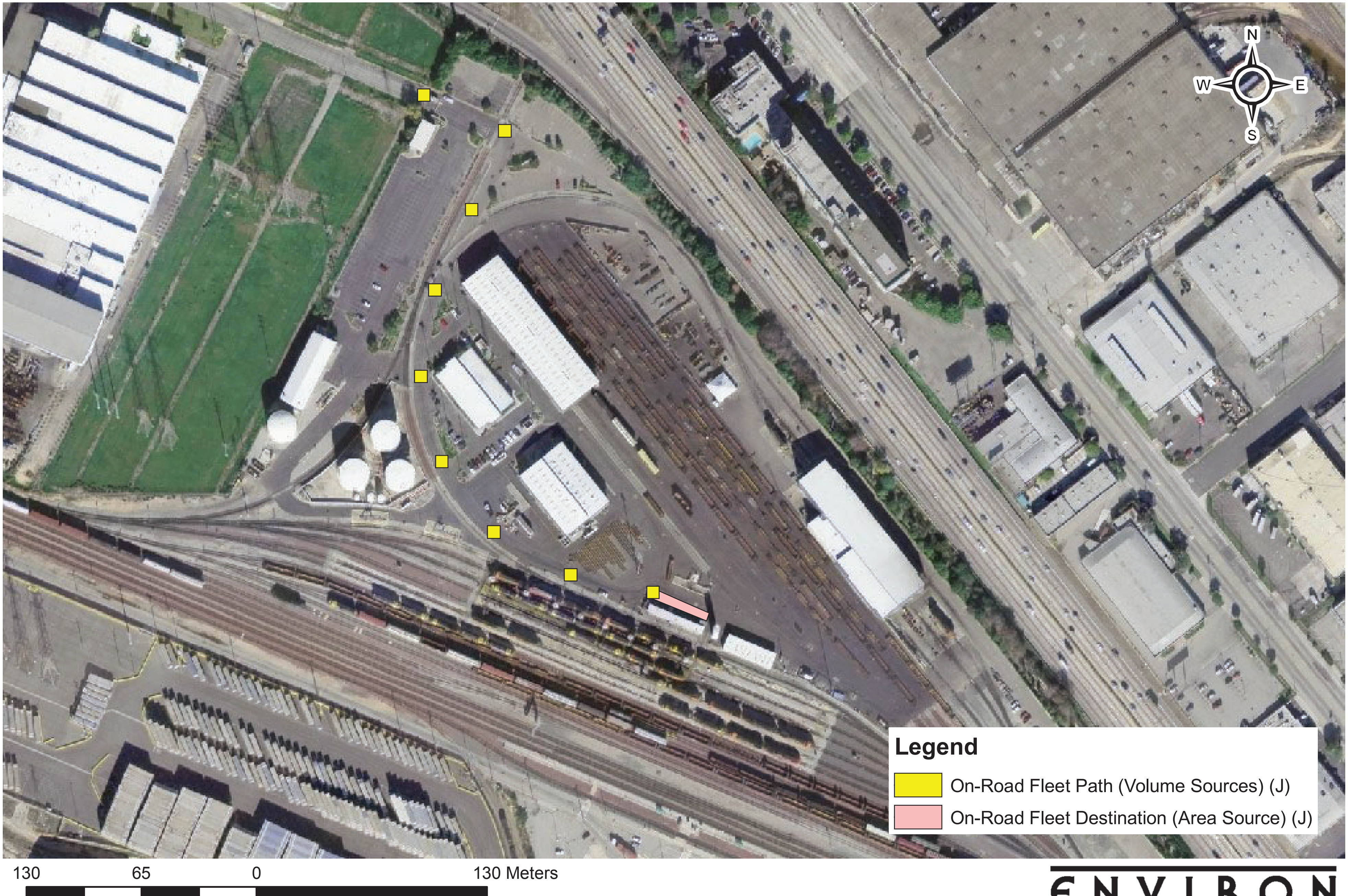

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Figure 4-5: Location of Modeled Permitted Stationary Source
BNSF Commerce Mechanical Rail Yard
Commerce, California

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Figure 4-6: Selection of Sectors for Surface Parameter Analysis
BNSF Commerce Mechanical Rail Yard
Commerce, California

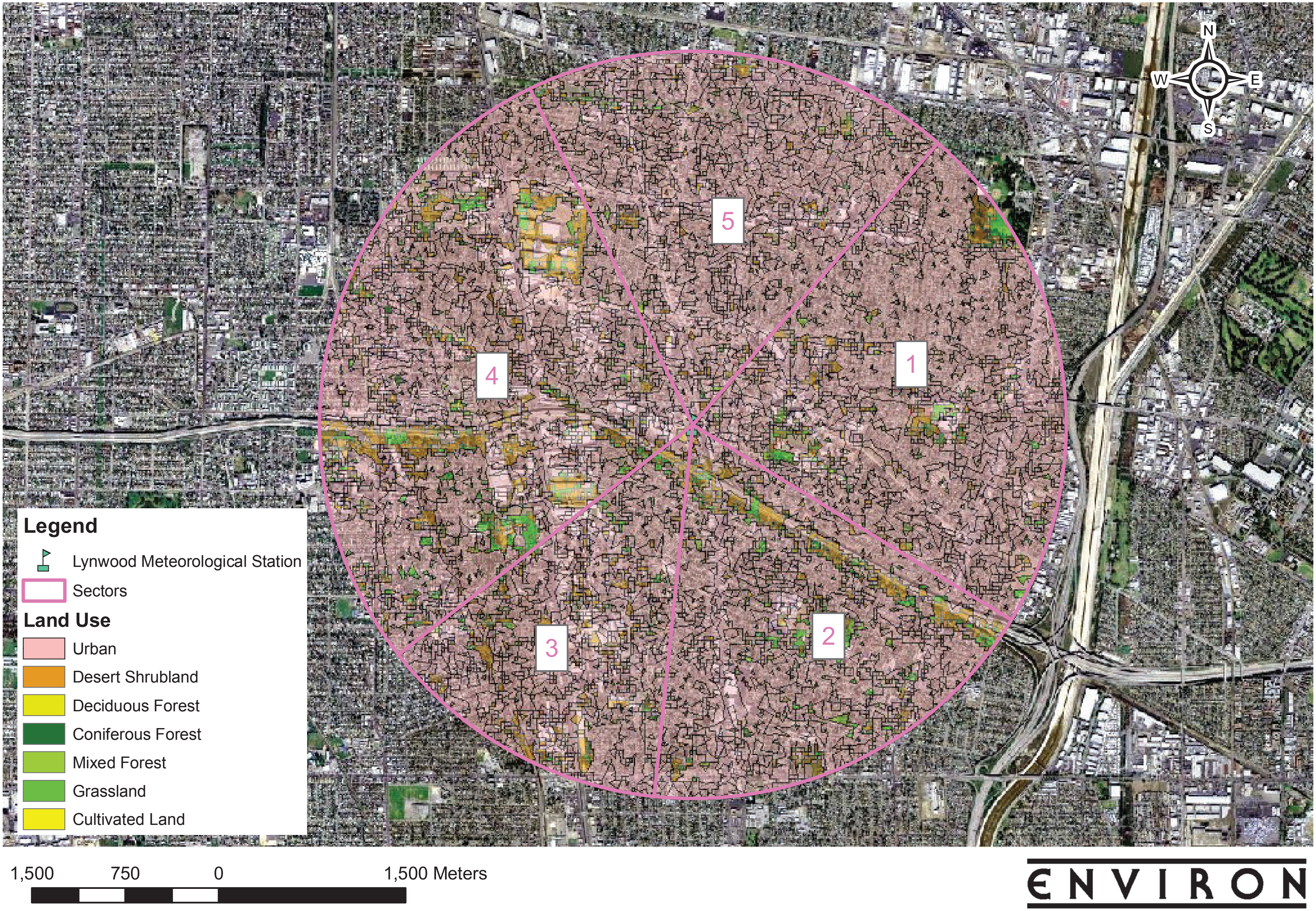

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Figure 4-7: Locations of Buildings and Structures
BNSF Commerce Mechanical Rail Yard
Commerce, California

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Figure 4-8: Land Use Within Three Kilometers of Facility
BNSF Commerce Mechanical Rail Yard
Commerce, California

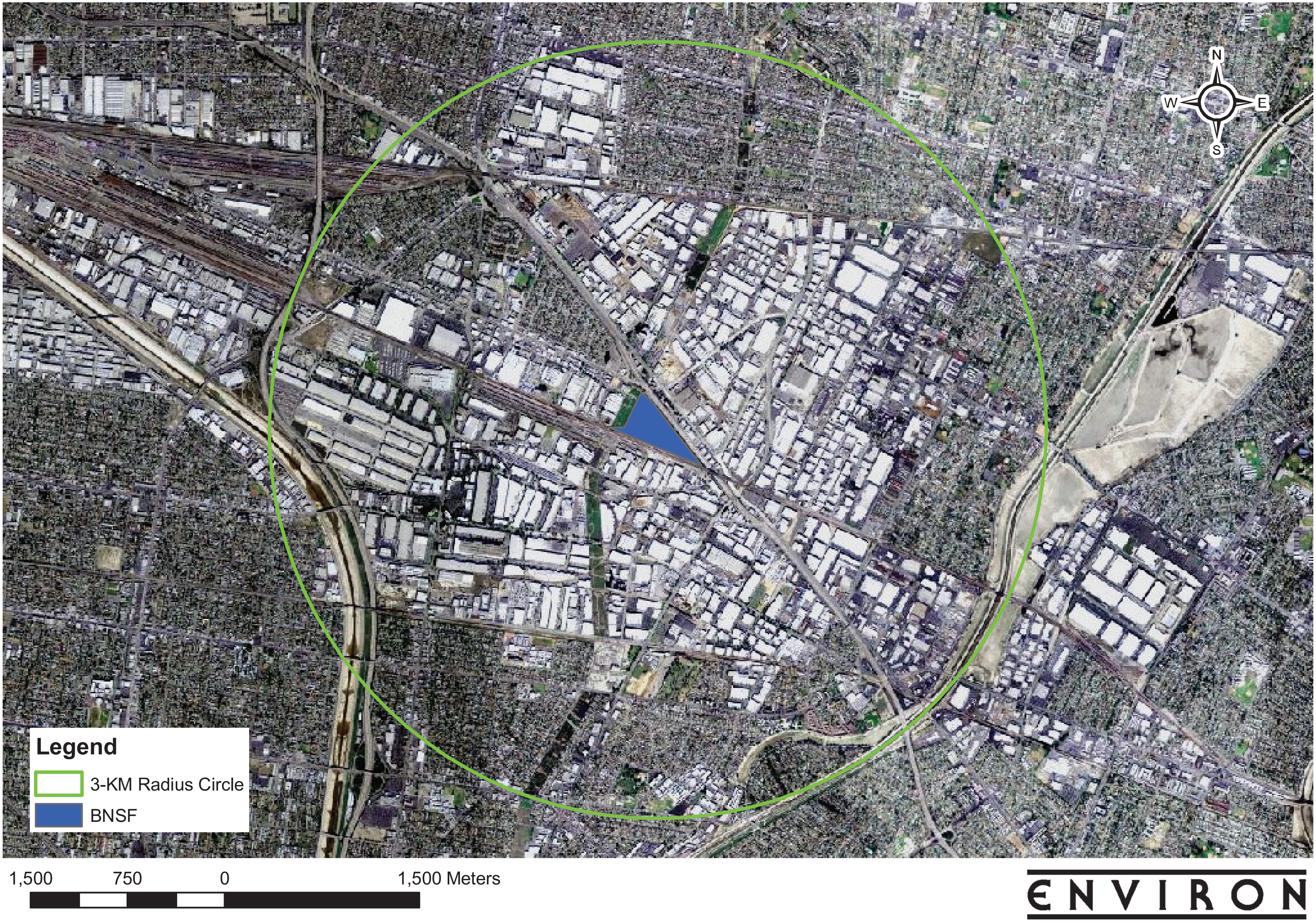

Figure 4-9a: Locations of Discrete Receptors in Coarse Grid
BNSF Commerce Mechanical Rail Yard
Commerce, California

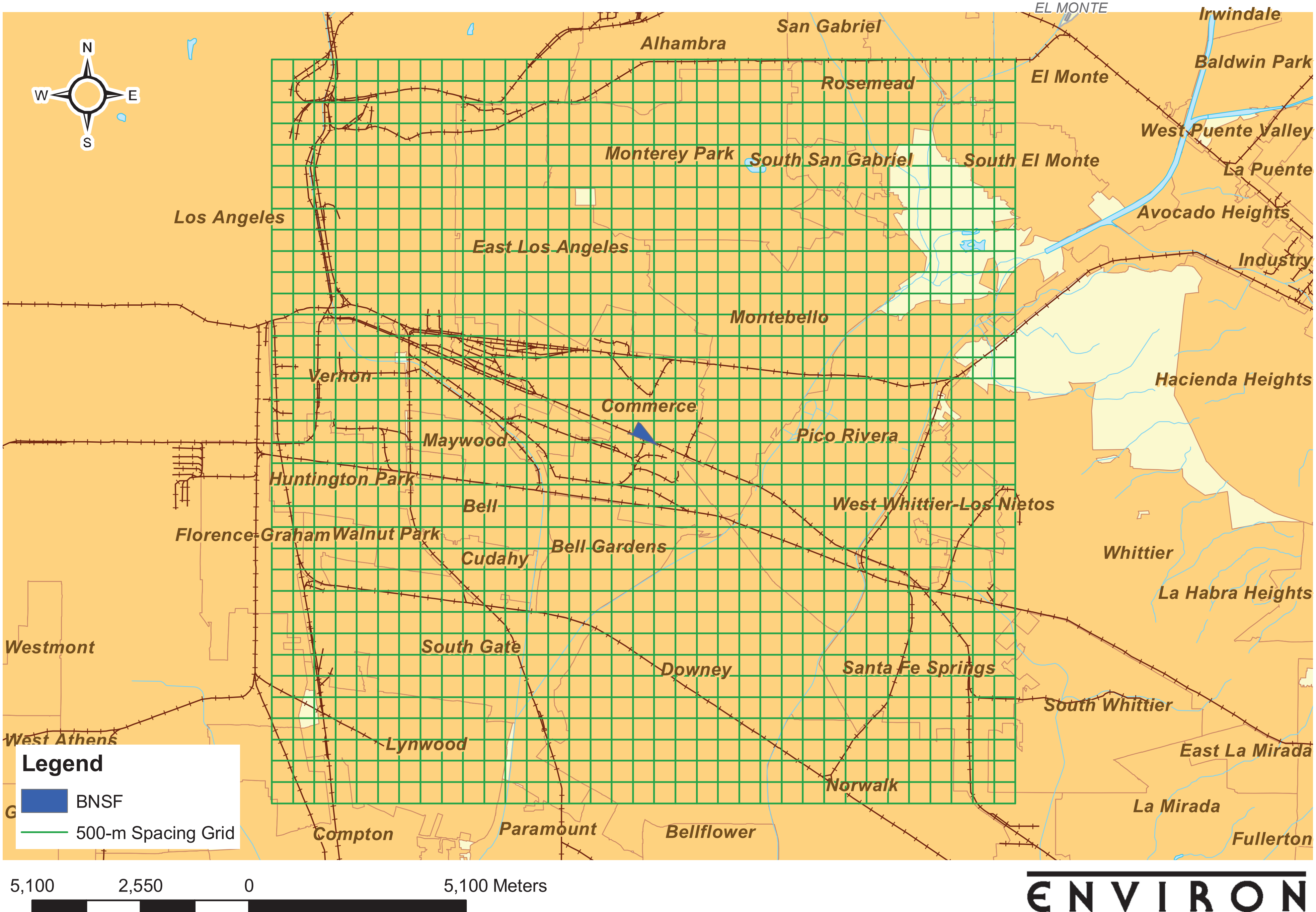

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Figure 4-9b: Locations of Discrete Receptors in Medium Grid
BNSF Commerce Mechanical Rail Yard
Commerce, California

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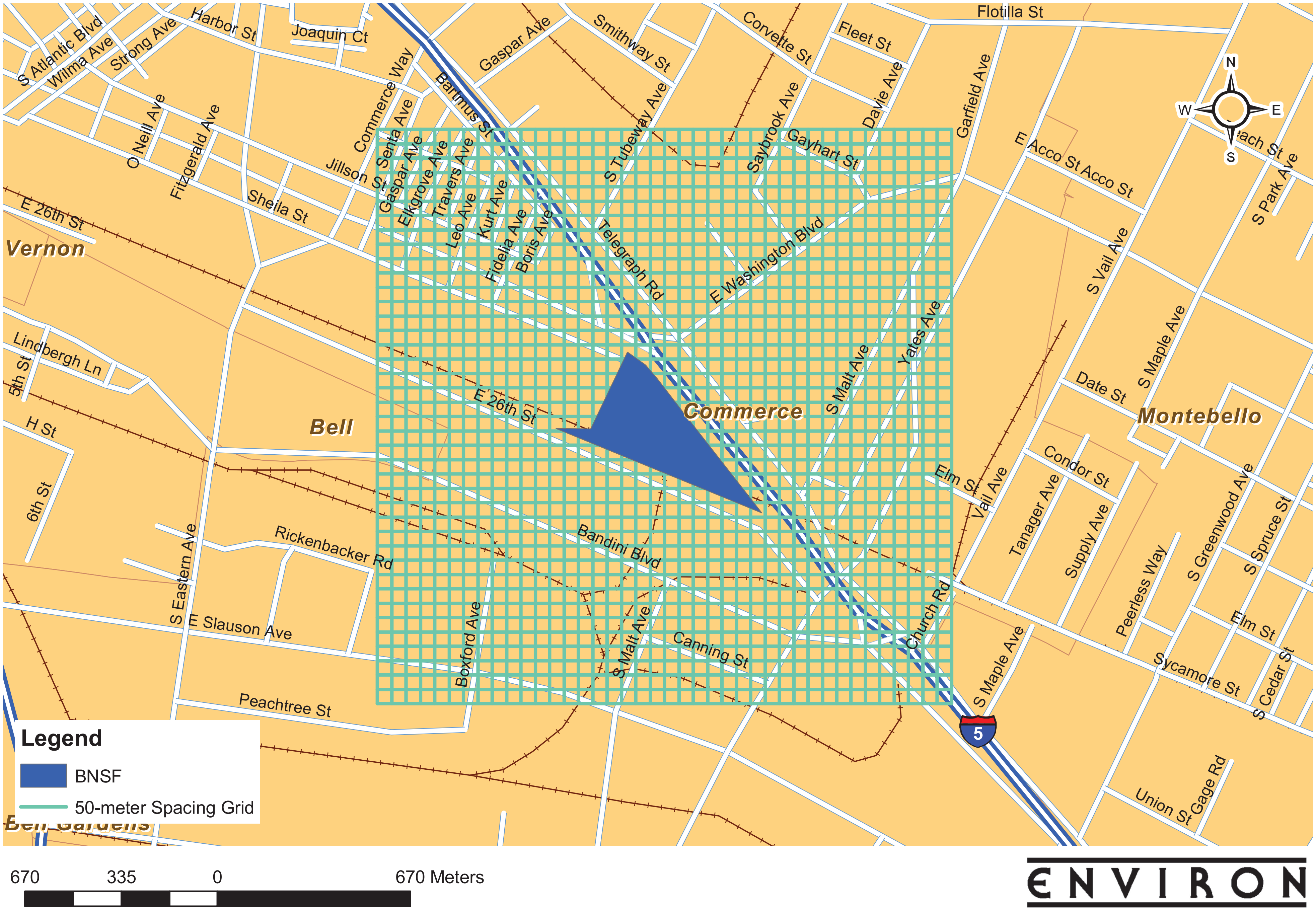
Figure 4-9c: Locations of Discrete Receptors in Fine Grid
BNSF Commerce Mechanical Rail Yard
Commerce, California



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