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Final Report

Toxic Air Contaminant Emissions Inventory and Air Dispersion Modeling Report for the Stockton Rail Yard, Stockton, California

prepared for:

Union Pacific Railroad Company

January 2007

prepared by:

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SUMMARY

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), Union Pacific Railroad Company (UPRR) has prepared a facility-wide emission inventory for the Stockton Rail Yard (Yard) in Stockton, California. The inventory quantifies emissions of specified toxic air contaminants (TACs) (including Diesel particulate matter [DPM]) from stationary, mobile, and portable sources at the Yard. The inventory has been prepared in accordance with CARB's *Rail Yard Emission Inventory Methodology* guidelines (July 2006) and UPRR's *Emission Inventory Protocol* (May 2004).

Activities at the Yard include receiving inbound trains, switching cars, servicing local industries by picking up and delivering freight cars, building and departing outbound trains, repairing freight cars, and servicing and repairing locomotives. Facilities within the Yard include classification tracks, a locomotive service track, a locomotive maintenance shop, a freight car repair shop, an on-site wastewater treatment plant, maintenance of way buildings and storage areas, and various buildings and facilities supporting railroad operations. Altamont Commuter Express (ACE) leases a portion of the Diesel Shop, steam cleaning area, and the locomotive and passenger car wash rack, where locomotive and passenger car cleaning, service, and repair are performed.

Emission sources include, but are not limited to, locomotives, sand tower, wastewater treatment plant, Diesel-fueled trucks and heavy equipment, and storage tanks. Emissions were calculated on a source-specific and facility-wide basis for the 2005 baseline year. Emissions from the ACE-owned and -operated locomotives and other operations are included in the inventory for the Stockton Yard.

An air dispersion modeling analysis was also conducted for the Stockton Yard. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations surrounding the Yard out to a distance of approximately 6 miles. Emissions from locomotives and Diesel-fueled heavy equipment were included in the modeling analysis. The air dispersion modeling was conducted using the AERMOD Gaussian plume dispersion model and wind speed and

direction, temperature and cloud cover data from the Stockton Municipal Airport. The meteorological data were processed using the AERMET program. The modeling analysis was conducted in accordance with the *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006) and UPRR's *Modeling Protocol* (August 2006).

Toxic Air Contaminant Emissions Inventory and Air Dispersion Modeling Report for the Stockton Rail Yard, Stockton, California

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PART I. INTRODUCTION

In accordance with the 2005 California Air Resources Board (CARB)/Railroad Statewide Agreement (MOU), Union Pacific Railroad Company (UPRR) has prepared a facility-wide emission inventory for the Stockton Rail Yard (Yard) in Stockton, California. The inventory quantifies emissions of specified toxic air contaminants (TACs) (including Diesel particulate matter [DPM]) from stationary, mobile, and portable sources at the Yard. Both source-specific and facility-wide emission estimates are shown. The inventory has been prepared in accordance with CARB's *Rail Yard Emission Inventory Methodology* guidelines (July 2006) and the *Emission Inventory Protocol*, which UPRR submitted to CARB in May 2006. Emissions have been calculated for the baseline year of 2005.

Altamont Commuter Express (ACE) leases a portion of the Diesel Shop, steam cleaning area, and the locomotive and passenger car wash rack, where locomotive and passenger car cleaning, service, and repair are performed. Emissions from the ACE-owned and -operated locomotives and other operations are included in the inventory for the Stockton Yard.

An air dispersion modeling analysis was also conducted for the Stockton Yard. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations surrounding the Yard out to a distance of approximately 6 miles. Emission sources included in the modeling analysis were locomotives and Diesel-fueled heavy equipment. The air dispersion modeling was conducted using the AERMOD Gaussian plume dispersion model and surface meteorological data from the Stockton Municipal Airport. The meteorological data was processed using the AERMET program. The modeling analysis was conducted in accordance with the *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006) and UPRR's *Modeling Protocol* (August 2006).

PART II. FACILITY DESCRIPTION

A. Facility Name and Address

Union Pacific Railroad Company
Stockton Rail Yard
833 East 8th St.
Stockton, CA 95206

B. Facility Contact Information

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C. Main Purpose of the Facility

The Stockton Yard is a support facility for railroad operations. Facilities within the Yard include classification tracks, a locomotive service track, a locomotive maintenance shop, a freight car repair shop, a wastewater treatment plant, maintenance-of-way buildings and storage areas, and various buildings and facilities supporting railroad operations.

D. Type of Operations Performed at the Facility

Activities at the Yard include receiving inbound trains, switching cars, servicing local customers by picking up and delivering freight cars, building and departing outbound trains, repairing freight cars, and servicing and repairing locomotives. The Yard includes two main lines with freight and passenger train traffic; the East Yard, which handles most of the in-yard freight traffic; the West Yard (the former SP Yard), which is less heavily used; and a service area with locomotive shop.

Within the Yard, the primary locomotive activities are associated with arriving and departing "manifest" (mixed freight) trains, and servicing the locomotives that power these trains. Arriving and departing trains' locomotives are fueled in the locomotive service area after arrival, and are sent back into the Yard or to other yards after service. The locomotive shop also performs periodic and unscheduled maintenance on locomotives. The Altamont Commuter Express (ACE) is a commuter rail company that also uses a portion of the service area and shop for its trains. In-yard flat switching is carried out by four sets of captive locomotives—two sets on the south end of the East Yard, one set on the north end, and one set in the SP Yard. These are used to move sections of inbound trains to appropriate areas within the Yard for departure on outbound trains.

E. Facility Operating Schedule

The facility operates 24 hours per day, 365 days per year.

F. General Land Use Surrounding the Facility

The land use surrounding the facility is a mix of commercial/industrial and residential. There is a residential area less than 1,000 feet from the Yard's east side. There is also a large residential area less than 1,000 feet from the Yard's west side. There are six schools within one mile of the Yard. The location of these and other specific receptors is further discussed in Part IX.

PART III. MAP AND FACILITY PLOT PLAN

Figure 1
Location Map

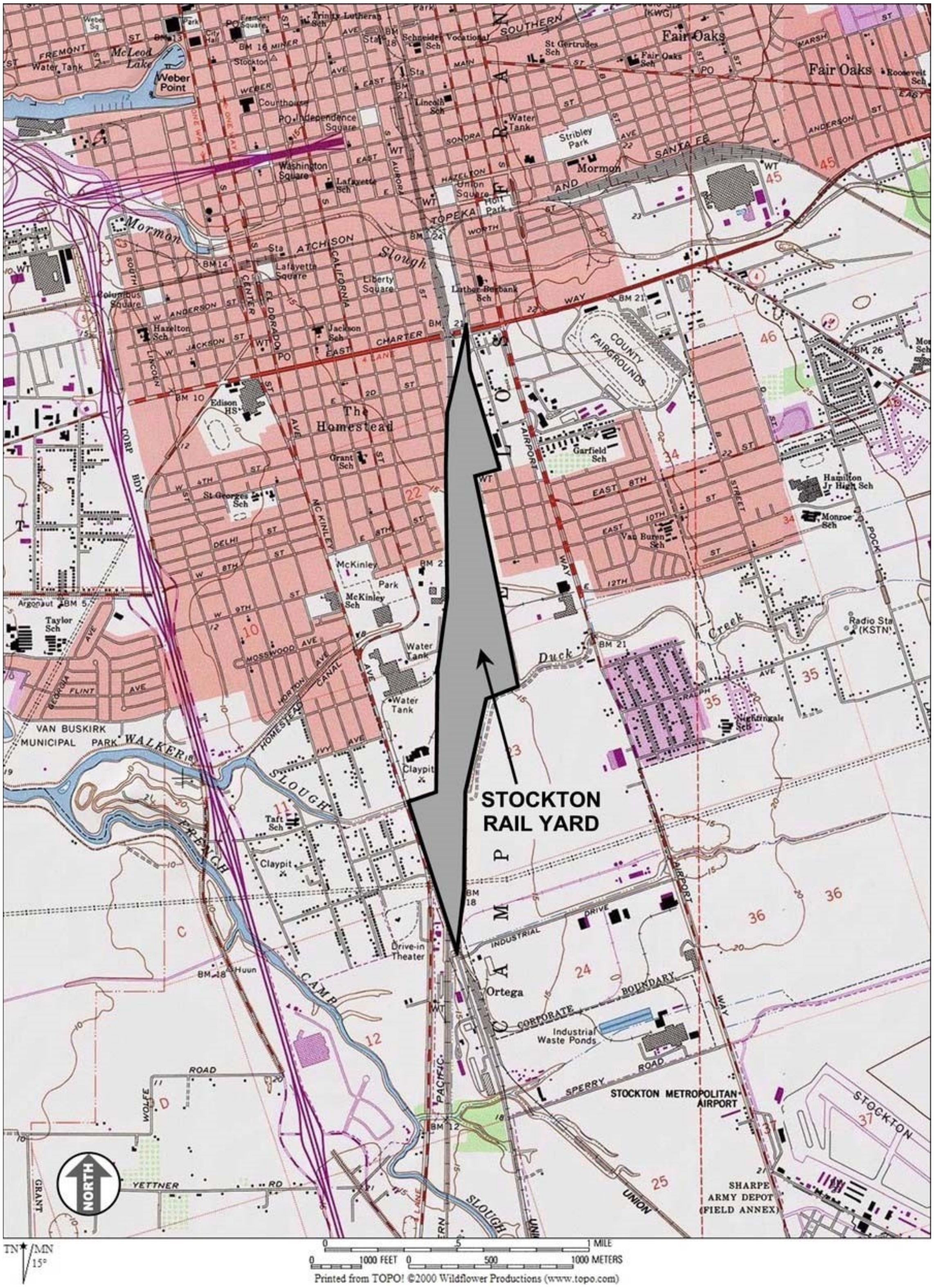


Figure 2
Stockton Rail Yard Layout

Figure 2
Stockton Rail Yard Layout (continued)

PART IV. COVERED SOURCES

This emission inventory quantifies toxic air contaminant (TAC) emissions from the stationary, mobile, and portable sources located or operating at the Stockton Yard. Emission sources include, but are not limited to, locomotives, sand tower, wastewater treatment plant, Diesel-fueled trucks and heavy equipment, and storage tanks. A site-specific equipment inventory is included in Section V below.

In accordance with the UPRR *Emission Inventory Protocol*, stationary point sources that are exempt from local air district rules have been identified, but not included in the detailed emission inventory. Also, de minimis sources, based on weighted risk, have been identified in the inventory but are not further discussed or included in the modeling analysis. De minimis sources are the individual sources that represent less than 3 percent of the facility-total weighted-average site health risk (determined separately for cancer risk and non-cancer chronic health hazard). Total exclusions for all de minimis sources did not exceed 10 percent of the facility-total weighted-average site cancer risk or chronic health hazard. De minimis sources are further discussed in Part VIII of this report.

PART V. SITE-SPECIFIC EQUIPMENT INVENTORY

As discussed in Part IV above, there are a number of mobile, stationary, area, and portable emissions sources operating at the Stockton Yard. The mobile sources include locomotives, heavy-heavy duty (HHD) Diesel-fueled trucks, other on-road Diesel-fueled trucks, and Diesel-fueled heavy equipment. Stationary emission sources at the Yard include storage tanks, the sand tower, wastewater treatment plant (WWTP), Diesel-fueled auxiliary generator sets, and various heaters. Portable equipment operating at the Yard includes welders, steam cleaners, pressure washers, air compressors, a hydraulic jack, and a hydraulic power pack. Each source group is further discussed below.

A. Locomotives

Locomotive activities at the Yard fall into several categories. "Road power" activities (locomotives used on inbound and outbound freight and passenger trains) include hauling through trains on the main lines; pulling arriving trains into the Yard and departing trains out of the Yard; movements of locomotives to and from the service and shop area after arrival and prior to departure. Yard operations include the use of four sets of medium- and low-horsepower locomotives to move sections of trains within the Yard. During 2005, the working sets at the south end of the East Yard were two pair of GP-38s. In the SP Yard, the working set was a single GP-38. At the north end of the East Yard, the working set was a pair of switcher locomotives.

Locomotive servicing and maintenance involves both road power and yard locomotives, and includes idling associated with refueling, sanding, oiling, and waiting to move to outbound trains. In addition, maintenance activities include additional periods of idling and higher throttle settings during load tests following 92-day, semi-annual, and annual inspections, as required by the FRA, and some unscheduled maintenance events.

In addition to the UPRR-owned locomotives, ACE has a fleet of five locomotives at Stockton. Three are used to operate ACE's three trains per day, five days per week, from Stockton to San Jose and back, with the other two available as backups. These are passenger locomotives with the same engine as a GP-40; however, these locomotives also have a 750 hp Diesel generator to provide electrical power to the passenger cars, which remain attached to their locomotives. The three in-use locomotives idle overnight between arrival from San Jose and their departure the next day. One of the three locomotives' generators also runs overnight to provide lighting and heating/air conditioning for the cleaning crews that work overnight to ready the cars for the next day's service. The other two can be shut down, as trackside electrical power is available on two tracks. Emissions from the locomotive generator set are further discussed below. ACE also performs load testing of its five locomotives as part of 92-day, semi-annual, and annual inspections.

Table 1 provides the number of locomotives in operation (arrivals, departures, and through traffic) at the yard during 2005 by locomotive model group and type of train. Through trains use the main lines passing by the facility. Freight trains and passenger trains enter the yard on specified tracks. Power moves are trains with locomotives but no cars whose objective is to either move locomotives to locations where they are needed, or to take malfunctioning units to service facilities.

Table 1
Summary of Locomotives Models (Road Power)
Stockton Rail Yard

Locomotive Model Group	Train Type[1]					
	Through Trains	Freight Trains		Passenger Trains		Power Moves
		Arriving	Departing	Arriving	Departing	
Switch[2]	38	50	48	0	0	0
GP3x	91	552	540	0	0	2
GP4x	4,219	4,847	4,755	782	782	45
GP50	104	35	33	0	0	3
GP60	585	326	323	0	0	23
SD7x	7,942	1,937	1,791	0	0	163
SD90	254	489	499	0	0	26
Dash7	174	58	12	0	0	4
Dash8	1,554	527	471	0	0	54
Dash9	9,050	3,939	3,503	0	0	231
C60A	112	178	188	0	0	3
Unknown	336	169	110	0	0	7
Total	**24,459**	**13,107**	**12,273**	**782**	**782**	**561**

Notes:

1. Includes all locomotives identified on an arriving, a departing, or a through train, including both working and non-working units.
2. Does not include locomotives used for yard operations.

B. HHD Diesel-Fueled Trucks

UPRR operates a small fleet of HHD Diesel-fueled trucks to move heavy equipment, which is housed at the Yard, to locations along the main lines where track, bridge, or signal maintenance is required. The fleet distribution for the HHD Diesel-fueled trucks operating at the Yard is shown in Table 2.

Table 2
Fleet Distribution for HHD Diesel-Fueled Trucks
Stockton Rail Yard

Model Year	Number of Vehicles
1997	2
1998	1
1999	1
2000	1
2005	3
Total	**8**

Notes:
1. Model year distribution provide by Marv Hoagland of UPRR.

C. On-Road Diesel-Fueled Trucks

UPRR also operates a variety of on-road Diesel-fueled trucks that are used in and around the Yard. Table 3 shows the equipment specifications for the on-road Diesel-fueled trucks.

Table 3 Equipment Specifications for On-Road Diesel-Fueled Trucks Stockton Rail Yard				
Equipment Type	Make	Model	Model Year	Vehicle Class
Dump Truck	Ford	Unknown	1985	HHD
Sweeper Truck	Unknown	Unknown	1990	HHD
Pickup Truck	Ford	F800	1992	MHD
Boom Truck	Ford	F800	1993	MHD
Boom Truck	GMC	C7500	1998	MHD
Boom Truck	International	Unknown	1998	MHD
Pickup Truck	Ford	F550	2005	LHD1
Pickup Truck	Ford	F550	2005	LHD1
Boom Truck	Sterling	Unknown	2005	HHD
Pickup Truck	GMC	550	2005	LHD1

Notes:
1. Vehicle specifications provided by UPRR personnel.

D. Heavy Equipment

UPRR operates a variety of heavy equipment in and around the Yard. Table 4 shows the equipment specifications for the Diesel-fueled heavy equipment. Heavy equipment that is housed, but not used in the Stockton Yard was not included in this inventory.

Table 4 Equipment Specifications for Diesel-Fueled Heavy Equipment Stockton Rail Yard				
Equipment Type	Make	Model	Model Year	Rating (hp)
Backhoe	John Deere	610C	1992	95
Backhoe[1]	Case	480C	Pre-1990	177
Trackmobile[2]	Trackmobile	TM4000	1990	115
Fork Lift[3]	Clark	Unknown	Pre-1985	47.5
Crane	Pettibone	25RS	1970	122
Crane	Century	6CT8-3-C	1980	215
Forklift	JCB930	Unknown	2000	365

Notes:
1. The exact model year of this equipment could not be determined. Documentation was found showing that it was older than 1990.
2. Per Trackmobile, these units were manufactured between 1990 and 1998. To be conservative, it was assumed that they were model year 1990 units.
3. The exact model year of this equipment could not be determined. Documentation showing that it was older than 1985 was found.

E. Tanks

There are a number of tanks at the facility that are used to store liquid petroleum products such as Diesel fuel, gasoline, and recovered oil. Table 5 provides detailed information for all storage tanks located at the facility.

Table 5
Storage Tank Specifications
Stockton Rail Yard

Tank No.	Tank Location	Material Stored	Tank Capacity (gallons)
AST-1[1]	Repair Track	Wastewater	2,000
TNKG-0079[2]	Repair Track	Diesel	250
TNKG-0079[2]	Repair Track	Gasoline	250
TNKO-0294	WWTP	Sludge	7,000
TNKS-0056	WWTP	Industrial Storm water	88,000
TNKD-9010	WWTP	Industrial Storm water	357,300
TNKO-0295[1]	WWTP	Recovered Oil	10,000
TNKO-0296[3]	Diesel Shop	Empty	20,000
TNKO-0297[3]	Diesel Shop	Empty	20,000
ACE[2]	Repair Track	Used Oil	200

Notes:
1. Exempt from permitting requirements per SJVAPCD Rule 2020, Section 6.6.5.
2. Exempt from permitting requirements per SJVAPCD Rule 2020, Section 6.6.4.
3. Since these tanks are empty, they are not an emission source and will not be included in the emission inventory or modeling analysis.

Storage tanks with a capacity of 250 gallons or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.6.4. As shown in Table 5, the capacities of TNKG-0079 (Diesel), TNKG-0079 (Gasoline), and the ACE tank are less than 250 gallons; therefore, the tanks are exempt from permitting requirements per Rule 2020, Section 6.6.4. Since the storage tanks are exempt from local air district rules, the emissions from the tanks were not included in the inventory or the dispersion modeling analysis, consistent with the UPRR inventory protocol.

SJVAPCD Rule 2020, Section 6.6.5 exempts unheated storage of organic material within an initial boiling point of 302 °F or greater from permitting requirements. Per the *Air*

Emission Inventory and Regulatory Analysis Report for the Stockton Rail Yard (Trinity Consultants, July 2003), laboratory testing was conducted on the contents of the wastewater and recovered oil tanks at the yard. The testing showed that the initial boiling point of this material was greater than 302 °F. Therefore, tanks AST-1 and TNKO-0295 are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.6.5. Since the storage tanks are exempt from local air district rules, the emissions from the tanks were not included in the inventory or the dispersion modeling analysis, consistent with the UPRR inventory protocol.

F. Sand Tower

Locomotives use sand for traction and braking. The sand tower consists of a storage system and a transfer system. The storage system includes a pneumatic delivery system and a storage silo. The transfer system includes a pneumatic transfer system, an elevated receiving silo, and a moving hopper and gantry system. The system is equipped with a baghouse for emissions control.

G. Wastewater Treatment Plant

The Stockton Yard also has a wastewater treatment plant (WWTP). Equipment at the WWTP includes a primary clarifier, a pair of equalization tanks, a secondary clarifier, a coagulation tank, a mix tank, a dissolved air flotation (DAF) unit, and two storage tanks used for accumulation of used oil and sludge. Air emission sources at the WWTP are the two clarifiers.

H. Auxiliary Generator Sets

In addition to the UPRR operated equipment, ACE also operates three commuter trains that are housed at the Stockton Yard. Each train is equipped with a 750 horsepower, Diesel-fueled auxiliary generator set to provide air conditioning and lighting to railcars when the attached locomotive is not operating. Each generator set is a 1998 model year unit.

I. Heaters

Table 6 summarizes the equipment specifications for the various heaters located at the Stockton Yard.

Heaters with a rating of 5.0 MMBtu/hr or less and fired exclusively with natural gas or propane are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.1. As shown in Table 6, all of the heaters at the Stockton Yard have a rated capacity of less than 5.0 MMBtu/hr and are fired exclusively with natural gas or propane.

Table 6
Equipment Specifications for Heaters
Stockton Rail Yard

Location	Heater Type	Fuel Type	Rating (MMBtu/hr)
Yard Office	Space Heater	Natural Gas	0.065
Yard Office	Space Heater	Natural Gas	0.065
Yard Office	Space Heater	Natural Gas	0.065
Yard Office	Water Heater	Natural Gas	0.035
Signal Shop	Space Heater	Propane	0.125
Engineering Office	Space Heater	Natural Gas	0.05
Engineering Office	Space Heater	Natural Gas	0.05
Engineering Office	Space Heater	Natural Gas	0.05
Engineering Office	Space Heater	Natural Gas	0.05
Engineering Office	Space Heater	Natural Gas	0.05
Engineering Office	Space Heater	Natural Gas	0.05

Notes:
1. Heaters with a rating of 5.0 MMBtu/hr or less and fired exclusively with natural gas or propane are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.1.

Therefore, these heaters are exempt from SJVAPCD permitting requirements. Since the heaters are exempt from local air district rules, the emissions from the heaters were not included in the inventory or the dispersion modeling analysis, consistent with the UPRR inventory protocol.

J. Welders

A variety of portable welders are used in Yard operations. Equipment specifications for welders used at the Yard are shown in Table 7.

Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.2. As shown in Table 7, the rating of each of the portable welders at the Stockton Yard is less than 50 hp. Therefore, these units are exempt from permitting requirements per Rule 2020, Section 6.1.2. In addition, Rule 2020, Section 6.10 exempts welding equipment and operations from permitting requirements. Since the welders are exempt from local air district rules, the emissions from the welders and welding operations (acetylene and rod/electrode use) were not included in this inventory or in the dispersion modeling analysis, consistent with the UPRR inventory protocol.

Table 7
Equipment Specifications for Portable Welders
Stockton Rail Yard

Equipment Location	Fuel Type	Rating (hp)	No. of Units
One Spot Car Department	Gasoline	16	1
One Spot Car Department	Gasoline	15	2
One Spot Car Department	Gasoline	12.5	5
Boom Truck	Diesel	20	1
Boom Truck	Diesel	40	1
Boom Truck	Diesel	35	1
Locomotive Maintenance Truck	Gasoline	20	1
Bridge Maintenance	Gasoline	16	2
Bridge Maintenance	Gasoline	16	1
WWTP Repair Truck	Gasoline	16	1

Notes:
1. Welding equipment and operations are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.10.
2. Internal combustion engines rated at 50 hp or less are exempt form SJVAPCD permitting requirements per Rule 2020, Section 6.1.2.

K. Steam Cleaners

Both UPRR and ACE own and operate steam cleaners at the Yard. Equipment specifications for the portable steam cleaners are shown in Table 8.

Table 8
Equipment Specifications for Portable Steam Cleaners
Stockton Rail Yard

Location	Make	Emission Unit	Fuel Type	Rating (MMBtu/hr or hp)
Locomotive Maintenance	Unknown	Pump	Electric	NA
		Heater	Diesel	0.245
ACE	Lambda	Pump	Gasoline	11
		Heater	Diesel	0.245
Locomotive Maintenance (Contractor Owned)	North Star	Pump	Gasoline	13
		Heater	Diesel	0.245

Notes:
1. Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD requirements per Rule 2020, Section 6.1.2.
2. Diesel-fueled heaters are "low emitting units" per Rule 2020, Section 3.6.

Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.2. As shown in Table 9, the rating of the pumps in each portable steam cleaner at the Stockton Yard is less than 50 hp. Therefore, the pumps in these units are exempt from permitting requirements per Rule 2020, Section 6.1.2. In addition, Rule 2020, Section 3.6 exempts "low emitting units" from permitting requirements. Based on the small size and limited use, these units qualify as "low emitting units" and are therefore exempt from permitting requirements. Since the steam cleaners are exempt from local air district rules, the emissions from these units were not included in this inventory or in the dispersion modeling analysis, consistent with the UPRR inventory protocol.

L. Miscellaneous Combustion Devices

A variety of portable equipment is used to support Yard operations. Equipment specifications for the other miscellaneous portable combustion devices operated at the Stockton Yard are shown in Table 9.

Table 9 Equipment Specifications for Portable Miscellaneous Combustion Devices Stockton Rail Yard			
Location	Equipment Type	Fuel Type	Rating (hp)
MoW Repair Compound	Hydraulic Power Pack	Gasoline	18
MoW Repair Compound	Pressure Washer	Gasoline	18
One Spot Car Department	Air Compressor	Gasoline	5
Locomotive Repair	Pressure Washer	Diesel	10
Locomotive Repair	Pressure Washer	Diesel	10
Bridge Maintenance	Hydraulic Jack	Gasoline	5.5
Maintenance Crew	Air Compressor	Gasoline	5

Note:
1. Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD requirements per Rule 2020, Section 6.1.2.

As previously discussed, internal combustion engines rated at 50 hp or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.2. As shown in Table 9, the rating of each portable combustion device at the Stockton Yard is less than 50 hp. Therefore, these units are exempt from permitting requirements per Rule 2020, Section 6.1.2. Since the portable equipment is exempt from local air district rules, the emissions from these units were not included in this inventory or in the dispersion modeling analysis, consistent with the UPRR inventory protocol.

PART VI. ACTIVITY DATA

Emissions from mobile sources are based on the number and type of equipment, equipment size, load factor, and operation during the baseline year of 2005. Since fuel consumption data were not available, the default load factors from the OFFROAD2006 model and operating data were used for emission calculations. For sources where operating data weren't available, an average operating mode (AOM) was developed based on employee interviews.

A. Locomotives

Locomotive emissions were based on the number, model distribution, and operating conditions (idling, throttle notch, and speeds of movements, etc). Table 10 summarizes the activity data for locomotives operating on trains at the Stockton Yard, including the number of trains and number of working locomotives per consist, as well as their idle and working time, and speed on arrival or departure. In general, arriving trains enter the Yard and stop while the railcars are detached from the locomotive. After the railcars have been detached, the locomotives move to the service area for refueling. On departure, locomotive consists are moved from the service area to the appropriate end of an outbound train. The train departs after completion of the Federal Railroad Administration (FRA) mandated safety inspections (e.g., air pressure and brakes) and the arrival of the train crew. In some cases, trains that are nominally "through" trains (arriving and departing under the same train symbol and date) add or drop cars or locomotives at the Stockton Yard. These trains are counted separately, as the idling period is shorter prior to departure, and the locomotive consist is not disconnected nor moved to the service track.

Table 10
Train Activity Summary
Stockton Rail Yard

Train Type	East Bound		West Bound		Arrival/Departing Speed (mph)	Idle Time (hrs)
	No. of Trains	Locomotives per Consist	No. of Trains	Locomotives per Consist		
Through Trains	3,475	2.58	5,028	2.95	40	0.0
Freight Train Arrivals	1,582	2.81	1,397	2.41	10	1.0
Freight Train Departures	1,642	2.72	1,002	2.44	10	2.0
Other Arrivals & Departures	987	2.68	554	2.85	10	1.0
ACE Arrivals	0	0.00	782	1.00	10	10.0
ACE Departures	782	1.00	0	0.00	10	0.0
Power Moves Through	52	3.50	28	3.39	40	0.0
Power Moves Arriving	11	3.91	0	0.00	10	0.0[1]
Power Moves Departing	139	4.46	69	3.46	10	0.0[1]

Note:
1. Data reflects the number of operating locomotives; locomotives that are being transported, but are not under power, are not shown.
2. In addition to the activities described above, three sets of GP-38s and a pair of switcher locomotives were used for yard operation.
3. Power move idling is included in service time.

The Yard also provides service and maintenance for the road power on trains arriving and departing from other locations. Arriving trains from mountainous routes will typically have higher available horsepower per trailing ton than trains operating in flatter terrain. This can result in "surplus" power, which is sent to other locations for use. In some cases, power moves may occur without a train symbol being assigned, with the result that it does not appear in the train database used to develop locomotive activity data. The total locomotive count for arriving and departing locomotives on trains shows a net imbalance of approximately 700 locomotives for 2005. For purposes of emission calculations, it is assumed that this imbalance represents outbound power moves from Stockton to other locations, with the same average consist size and proportion of east-bound and west-bound units as other identified power moves. This results in a net balance in the number of arriving and departing locomotives. Although power moves may have as many as 10 or more locomotives, typically only one or two locomotives are actually working. For emission calculations, power moves were assumed to have 1.5 working locomotives (except for power moves involving just one locomotive).[1] In addition to road power, four sets of yard locomotives operate in the yard to move sections of inbound trains, spot them in the appropriate areas for handling, and subsequently reconnect these sections and move them to the appropriate outbound train areas. One set of GP-38s operates between 4 PM and 4 AM in the SP Yard; two sets of GP-38s operate at the south end of the East Yard (one 24 hours per day, and the other 16 hours per day); and a set of switchers operates at the north end of the East Yard 24 hours per day.

A separate database provided information on each locomotive handled by the service area and locomotive maintenance shop at Stockton. Locomotive servicing and maintenance involve routine activities to ready a locomotive for operation (refueling, checking oil levels, etc.) as well as a broad range of maintenance activities including both minor repairs (light bulbs, paint, etc.) and major repairs of locomotive components (traction motor replacement, and Diesel engine maintenance requiring load testing). Based on detailed information on the reason and type of service or maintenance performed,

[1] UP personnel report that although the train data records for power moves may show all locomotives "working," in actuality all locomotives except for one at the front and rear end (and more commonly only one at the front end) are shut down as they are not needed to pull a train that consists only of locomotives. Assuming 1.5 working locomotives per power move may slightly overestimate the actual average number of working locomotives per power move.

separate counts of service and maintenance activities were developed, as detailed in Table 11.

Routine service of locomotives involves idling and short movements in the service area associated with refueling, oiling, and other service activities prior to their movement to the ready track area where locomotives are consisted for outbound trains. If maintenance is required at the locomotive shop, additional short movements and idling occur. Depending on the type of maintenance, load testing prior to and after maintenance may be performed. The number of these events was determined based on the location and service codes for each locomotive maintenance event in the database.

Based on estimates provided by UPRR personnel for the *Roseville Rail Yard Study* (October 2004), routine servicing of a locomotive occurs over several hours, during which time the locomotive may be idling or shut down (if equipped with ZTR/AESS[2] technology). Locomotives must be idling during oil checks. Following service, there is a second two-hour period during which the locomotives may be idling or shut down. For emission calculations, it is assumed that ZTR/AESS-equipped locomotives idle for ½ hour during service and ½ hour after service, and that other units idle for two hours during and two hours after service.

Locomotives that are identified as undergoing maintenance at the locomotive shop (a separate facility from the service area) are assumed to have two additional one-hour idling periods before and after maintenance, based on estimates provided by UPRR personnel for the *Roseville Rail Yard Study*. The emissions generated during the short movements between the service area and shop are included with the idling emissions. ZTR/AESS-equipped units are assumed to idle for only ½ hour of each of these periods. Load testing is required by the FRA for periodic quarterly, semiannual, and annual maintenance, and may also be performed as part of unscheduled maintenance. Service

[2] There are two primary types of auto start/stop technology—"Auto Engine Start Stop" (AESS), which is factory-installed on recent model high horsepower units; and the ZTR "SmartStart" system (ZTR), which is a retrofit option for other locomotives. Both are programmed to turn off the Diesel engine after 15 to 30 minutes of idling, provided that various criteria (air pressure, battery charge, and others) are met. The engine automatically restarts if required by one of the monitored parameters. We assume that an AESS/ZTR-equipped locomotive will shut down after 30 minutes of idling in an extended idle event.

and shop databases were used to identify the number of each type of events, as well as the locomotive model, tier, and ZTR/AESS technology distributions. Emission factors were developed for the model distribution for all units in service, and also for the model distribution of the subset of units that underwent load testing. Post-maintenance load testing at Commerce is conducted at the west end of the service building and is assumed to include opacity testing as part of the load testing. The total emissions associated with service and shop activities are the sum of idling during and after service, idling before and after shop maintenance, and load testing. The emissions from shop and service activities are shown in Part VII.

The specific nature (duration and throttle setting) of such load testing events is described in Part VII. For ACE locomotives, it was assumed that each of the five locomotives had four load test events per year in conjunction with routine 92-day, semi-annual, and annual inspections.

Table 11
Service and Shop Releases and Load Test
Stockton Rail Yard

Activity	Number of Events	Idling per event (min)	N1 time (min)	N8 time (min)
Locomotive Service	4,575	240	0	0
Shop Maintenance	532	120	0	0
Planned Maintenance Pre-Test	63	2	0	8
Planned Maintenance Post-Test	63	2	0	8
Quarterly Maintenance Test	112	2	0	8
Unscheduled Maintenance Diagnostic	0	5	0	10
Unscheduled Maintenance Post-Test	102	1	0	5
ACE Load Tests	20	2	0	8

B. HHD Diesel-Fueled Trucks

Emissions from HHD Diesel-fueled trucks are based on the number of truck trips, the length of each trip, and the amount of time spent idling. As shown in Table 2, a small fleet of HHD trucks is used to move heavy equipment that is housed in the Yard to locations along the main lines where maintenance is needed. It was assumed that each truck made one round trip per day. The VMT per trip is based on the distance from the equipment parking area to the Yard entrance. Based on operator interviews, it was assumed that each truck idled no more than 5 minutes per trip. Table 12 summarizes the activity data for HHD Diesel-fueled trucks operating at the Yard.

Table 12
Summary of HHD Diesel Truck Activity Data
Stockton Rail Yard

Number of Truck Trips[1]	VMT Per Trip[2]	VMT per Year	Idling (mins/trip)[3]	Idling (hr/yr)
2,920	0.5	1,460	5	243

Notes:
1. Number of truck trips is equal to 8 vehicles at 1 round trip (in and out of the yard) per day.
2. VMT per trip based on the distance from the equipment parking area to the gate.
3. Idling time per day based on interviews with UPRR personnel.

C. <u>On-Road Diesel-Fueled Trucks</u>

Emissions from the on-road Diesel-fueled trucks operating at the Yard are based on the vehicle class, engine model year, annual vehicle miles traveled (VMT), and the amount of time spent idling. Annual VMT was estimated based on the total vehicle mileage and the amount of time the vehicle operated in the Yard, as estimated by UPRR personnel. Table 13 summarizes the activity data for the other on-road Diesel-fueled trucks operating at the Yard.

Table 13

Activity Data for On-Road Diesel-Fueled Trucks
Stockton Rail Yard

Equipment Type	Make/Model	Model Year	Vehicle Class	Annual VMT[1]	Idling[2] (min/day)	(hr/yr)
Dump Truck	Ford	1985	HHD	600	15	91
Sweeper Truck	Unknown	1990	HHD	250	15	91
Pickup Truck	Ford F800	1992	MHD	1,200	15	91
Boom Truck	Ford F800	1993	MHD	1,040	15	91
Boom Truck	GMC C7500	1998	MHD	1,600	15	91
Boom Truck	International	1998	MHD	1,825	15	91
Pickup Truck	Ford F550	2005	LHDT1	1,100	15	91
Pickup Truck	Ford F550	2005	LHDT1	1,200	15	91
Boom Truck	Sterling	2005	HHD	400	15	91
Pickup Truck	GMC 550	2005	LHDT1	1,800	15	91

Notes:
1. Annual VMT estimated by UPRR personnel based on total vehicle mileage and the amount of time the vehicle operated in the Yard.
2. Idling time (min/day) estimated by UPRR personnel.

D. <u>Heavy Equipment</u>

Emissions from heavy equipment operating at the Yard are based on the number and type of equipment, equipment model year, equipment size, and the annual hours of operation. Annual hours of operation are based on operator interviews. The activity data for the Diesel-fueled heavy equipment are summarized in Table 14.

Table 14
Activity Data for Diesel-Fueled Heavy Equipment
Stockton Rail Yard

Equipment Type	Make/Model	Model Year	Rating (hp)	Hours of Operation (hr/yr)
Backhoe	John Deere 610C	1992	95	300
Backhoe	Case 480C	Pre-1990	177	30
Trackmobile	Trackmobile TM4000	1990	115	730
Fork Lift	Clark	Pre-1985	47.5	10
Crane	Pettibone 25RS	1970	122	120
Crane	Century 6CT8-3-C	1980	215	15
Forklift	JCB930	2000	75	365

Notes:
1. Hours of operation estimated by UPRR personnel.

E. Tanks

Emissions from the non-exempt storage tanks located at the Stockton Yard are based on the size of the tank, material stored, and annual throughput. Activity data for the non-exempt tanks are shown in Table 15.

Table 15
Activity Data for Storage Tanks
Stockton Rail Yard

Tank No.	Location	Material Stored	Throughput (gal/yr)[1,2]
TNKO-0294	WWTP	Sludge	8,000
TNKS-0056	WWTP	Industrial Storm water	1,562,030
TNKD-9010	WWTP	Industrial Storm water	1,562,030

Notes:
1. Annual throughput provided by UPRR personnel.
2. Equal to the annual process rate for the WWTP.

F. Sand Tower

Emissions from the sand tower are based on the annual sand throughput. Records of actual material throughput for the sand tower were not readily available. Therefore, the monthly sand throughput limit contained in the SJVAPCD Permit to Operate for this source was used. The Permit limits sand throughput to 26 tons per month or 312 tons per year.

G. Wastewater Treatment Plant

Emissions were also calculated for the WWTP. Per the WWTP operator records, during the 2005 baseline year the WWTP processed 1,562,030 gallons of wastewater.

H. Auxiliary Generator Sets

As previously discussed, the auxiliary generator sets are located on the three passenger trains owned and operated by ACE and are used to provide air conditioning and lighting. The generator set on one train is operated each weeknight to provide air conditioning and lighting for cleaning and maintenance crews. The other two trains are connected to trackside power; therefore, the generators are not used. Per discussions with ACE personnel, the generator operates 9 hours per day, 5 days per week (8:00 p.m. to 5:00 a.m. from Sunday through Friday). The total annual hours of operations (2,340 hours) were allocated evenly between the three generators.

PART VII. EMISSIONS

A. Calculation Methodology and Emission Factors

Emission calculations were based on the site-specific equipment inventory, equipment activity data, and the source-specific emission factors. The calculation methodology and emission factors for each specific source type are further discussed below. Emissions were calculated in accordance with CARB Guidelines (July 2006) and the UPRR *Emission Inventory Protocol*.

1. Locomotives

Emissions were calculated for UPRR-owned and -operated locomotives, as well as "foreign" locomotives[3] operating in the rail yard, and through trains on the main lines. Procedures for calculating emissions followed the methods described in Ireson et al. (2005).[4] A copy of Ireson et al is contained in Appendix A-6.

Emissions from locomotive activities were calculated based on the number of working locomotives, time spent in each notch setting, and locomotive model-group distributions, with model groups defined by manufacturer and engine type.[5] A separate calculation was performed for each type of locomotive activity, including line-haul or switcher locomotive operations, consist movements, locomotive refueling, and pre- and-post locomotive service and maintenance testing. Speed, movement duration, and throttle notch values were obtained from UPRR personnel for the Stockton Yard for different types of activities. Detailed counts of locomotive by model, tier and train type are shown in Appendix A-1 and A-2. Maps detailing the principal locomotive routes at the Yard are contained in Appendix A-5.

[3] Foreign locomotives are locomotives not owned by UPRR, including passenger trains and locomotives owned by other railroads that are brought onto the UPRR system via interchange.

[4] Ireson, R.G., M.J. Germer, L.A. Schmid (2005). "Development of Detailed Railyard Emissions to Capture Activity, Technology, and Operational Changes." Proceedings of the USEPA 14th Annual Emission Inventory Conference, *http://www.epa.gov/ttn/chief/conference/eil4/session8/ireson.pdf*, Las Vegas NV, April 14, 2006.

[5] Emission estimates are based on the total number of working locomotives. Therefore, the total number of locomotives used in the emission calculations, shown in Table 10, is slightly lower than the total number of locomotives counted as arriving, departing, or through trains (shown in Table 1). See Appendix A for detailed emission calculations.

Notch-specific emission factors were assembled from a number of sources. These included emission factors presented in CARB's *Roseville Rail Yard Study* (October 2004), as well as EPA certification data and other testing by Southwest Research Institute of newer technology locomotives.

For line haul operations, yard-specific average consist composition (number of units, number of units working, model distribution, locomotive tier distribution, fraction equipped with auto start/stop technology) was developed from UPRR data for different train types. Movement speed, duration, and notch estimates were developed for arriving, departing, through train, and in-yard movements. Idle duration was estimated based on UPRR operator estimates for units not equipped with auto start/stop. Units that were equipped with AESS/ZTR technology were assumed to idle for 30 minutes per extended idle event, with other locomotives idling for the remaining duration of the event. Numbers of arrivals and departures were developed from UPRR data. Emissions were calculated separately for through trains, freight train arrivals and departures, ACE arrivals and departures, and power moves.

Four sets of "captive" locomotives (i.e., dedicated to moving groups of rail cars within the Yard) operate within the facility boundaries. These sets included a single GP-38 working in the SP Yard, two pairs of GP-38s working in the south end of the East Yard, and one pair of switchers working in the north end of the East Yard. The GP-38 in the SP Yard operated from 4 PM to 4 AM. It was assumed that each day's activity for this unit would include 11 working hours and 1.5 hours parked, resulting in a total of 0.5 hours of parked idling if equipped with ZTR SmartStart auto start/stop technology. One setof GP-38s at the south end operated from 7 AM to 11 PM, with an assumed total working time of 14 hours and 2.5 hours of parked idling (or 1 hour for SmartStart units). The other set of GP-38s at the south end and the set of switchers at the north end operated 24 hours per day. This was assumed to include 21 working hours and 3 hours parked idling (1 hour for SmartStart units). Based on information from UPRR personnel, these units were assumed to operate on the EPA switcher duty cycle while working. As the specific locomotives assigned to this work may change from day to day, it was assumed that the fraction of units equipped with SmartStart was the same as the fraction for the same model observed in the Stockton service area records.

Data regarding the sulfur content of 2005 UPRR Diesel fuel deliveries within and outside of California were not available. To develop locomotive emission factors for different types of activities, estimates of fuel sulfur content were developed, and base case emission factors from the primary information sources (e.g., EPA certification data, with an assumed nominal fuel sulfur content of 3,000 ppm) were adjusted based on the estimated sulfur content of in-use fuels. Fuel sulfur content reportedly affects the emission rates for Diesel particulate matter from locomotives. The sulfur content in Diesel fuel varies with the type of fuel produced (e.g., California on-road fuel, 49-state off-road fuel, 49-state on-road fuel), the refinery configuration at which it is produced, the sulfur content of the crude oil being refined, and the extent to which it may be mixed with fuel from other sources during transport. As a result, it is extremely difficult to determine with precision the sulfur content of the fuel being used by any given locomotive at a specific time, and assumptions were made to estimate sulfur content for different types of activities.

To estimate the fuel sulfur content for UPRR locomotives in California during 2005, the following assumptions were made:

- "Captive" locomotives and consists in use on local trains (e.g., commuter rail) are used only Diesel fuel produced in California
- Trains arriving and terminating at California rail yards (with the exception of local trains) used fuel produced outside of California, and arrive with remaining fuel in their tanks at 10 percent of capacity
- On arrival, consists were refueled with California Diesel fuel, resulting in a 90:10 mixture of California and non-California fuel, and this mixture is representative of fuel on departing trains as well as trains undergoing load testing (if conducted at a specific yard).

- The average composition of fuel used in through trains by-passing a yard, and in trains both arriving and departing from a yard on the same day is 50 percent California fuel and 50 percent non-California fuel.

In 2005, Chevron was Union Pacific Railroad's principal supplier of Diesel fuel in California. Chevron's California refineries produced only one grade ("low sulfur Diesel" or LSD) in 2005. Quarterly average sulfur content for these refineries ranged from 59 ppm to 400 ppm, with an average of 221 ppm (Hinckley, 2006). This value is assumed to be representative of California fuel used by UPRR. Non-California Diesel fuel for 2005 is assumed to have a sulfur content of 2,639 ppm. This is the estimated 49-state average fuel sulfur content used by the U.S. Environmental Protection Agency in its 2004 regulatory impact analysis in support of regulation of nonroad Diesel engines (EPA, 2004).

To develop emission inventories for locomotive activity, an initial collection of locomotive model- and notch-specific emissions data was adjusted based on sulfur content. Although there is no official guidance available for calculating this effect, a draft CARB document provides equations to calculate the effect of sulfur content on PM emission rates at specific throttle settings, and for 2-stroke and 4-stroke engines (Wong, undated). These equations can be used to calculate adjustment factors for different fuels as described in Appendix A-7. The adjustment factors are linear in sulfur content, allowing emission rates for a specific mixture of California and non-California fuels to be calculated as a weighted average of the emission rates for each of the fuels. Adjustment factors were developed and used to prepare tables of emission factors for two different fuel sulfur levels: 221 ppm for locomotives operated on California fuel; and 2,639 ppm for locomotives operating on non-California fuel. These results are shown in Tables 16 and 17. Sample emission calculations are shown in Appendix A-3 and A-4.
The calculations of sulfur adjustments are shown in Appendix A-7.

Table 16
Locomotive Diesel Particulate Matter Emission Factors (g/hr)
Adjusted for Fuel Sulfur Content of 221 PPM
Stockton Rail Yard

Model Group	Tier	Throttle Setting										Source[1]
		Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	
Switchers	N	31.0	56.0	23.0	76.0	129.2	140.6	173.3	272.7	315.6	409.1	EPA RSD[1]
GP-3x	N	38.0	72.0	31.0	110.0	174.1	187.5	230.2	369.1	423.5	555.1	EPA RSD[1]
GP-4x	N	47.9	80.0	35.7	134.3	211.9	228.6	289.7	488.5	584.2	749.9	EPA RSD[1]
GP-50	N	26.0	64.1	51.3	142.5	282.3	275.2	339.6	587.7	663.5	847.2	EPA RSD[1]
GP-60	N	48.6	98.5	48.7	131.7	266.3	264.8	323.5	571.6	680.2	859.8	EPA RSD[1]
GP-60	0	21.1	25.4	37.6	75.5	224.1	311.5	446.4	641.6	1029.9	1205.1	SwRI[2] (KCS733)
SD-7x	N	24.0	4.8	41.0	65.7	146.8	215.0	276.8	331.8	434.7	538.0	SwRI[3]
SD-7x	0	14.8	15.1	36.8	61.1	215.7	335.9	388.6	766.8	932.1	1009.6	GM EMD[4]
SD-7x	1	29.2	31.8	37.1	66.2	205.3	261.7	376.5	631.4	716.4	774.0	SwRI[5] (NS2630)
SD-7x	2	55.4	59.5	38.3	134.2	254.4	265.7	289.0	488.2	614.7	643.0	SwRI[5] (UP8353)
SD-90	0	61.1	108.5	50.1	99.1	239.5	374.7	484.1	291.5	236.1	852.4	GM EMD[4]
Dash 7	N	65.0	180.5	108.2	121.2	306.9	292.4	297.5	255.3	249.0	307.7	EPA RSD[1]
Dash 8	0	37.0	147.5	86.0	133.1	248.7	261.6	294.1	318.5	347.1	450.7	GE[4]
Dash 9	N	32.1	53.9	54.2	108.1	187.7	258.0	332.5	373.2	359.5	517.0	SWRI 2000
Dash 9	0	33.8	50.7	56.1	117.4	195.7	235.4	552.7	489.3	449.6	415.1	Average of GE & SwRI[6]
Dash 9	1	16.9	88.4	62.1	140.2	259.5	342.2	380.4	443.5	402.7	570.0	SwRI[2] (CSXT595)
Dash 9	2	7.7	42.0	69.3	145.8	259.8	325.7	363.6	356.7	379.7	445.1	SwRI[2] (BNSF 7736)
C60-A	0	71.0	83.9	68.6	78.6	237.2	208.9	247.7	265.5	168.6	265.7	GE[4] (UP7555)

Notes:
1. EPA Regulatory Support Document, "Locomotive Emissions Regulation," Appendix B, 12/17/97, as tabulated by ARB and ENVIRON
2. Base emission rates provided by ENVIRON as part of the BNSF analyses for the Railyard MOU (Personal communication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to C. Lindhjem, 2006).
3. SwRI final report "Emissions Measurments - Locomotives" by Steve Fritz, August 1995.
4. Manufacturers' emissions test data as tabulated by ARB.
5. Base SD-70 emission rates taken from data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRI Exhaust Plume Study, tabulated and calculated by ENVIRON..

Table 17
Locomotive Diesel Particulate Matter Emission Factors (g/hr)
Adjusted for Fuel Sulfur Content of 2,639 PPM
Stockton Rail Yard

Model Group	Tier	Throttle Setting										Source[1]
		Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	
Switchers	N	31.0	56.0	23.0	76.0	136.9	156.6	197.4	303.4	341.2	442.9	EPA RSD[1]
GP-3x	N	38.0	72.0	31.0	110.0	184.5	208.8	262.2	410.8	457.9	601.1	EPA RSD[1]
GP-4x	N	47.9	80.0	35.7	134.3	224.5	254.6	330.0	543.7	631.6	812.1	EPA RSD[1]
GP-50	N	26.0	64.1	51.3	142.5	299.0	306.5	386.9	653.9	717.3	917.4	EPA RSD[1]
GP-60	N	48.6	98.5	48.7	131.7	282.1	294.9	368.5	636.1	735.4	931.0	EPA RSD[1]
GP-60	0	21.1	25.4	37.6	75.5	237.4	346.9	508.5	714.0	1113.4	1304.9	SwRI[2] (KCS733)
SD-7x	N	24.0	4.8	41.0	65.7	155.5	239.4	315.4	369.2	469.9	582.6	SwRI[3]
SD-7x	0	14.8	15.1	36.8	61.1	228.5	374.1	442.7	853.3	1007.8	1093.2	GM EMD[4]
SD-7x	1	29.2	31.8	37.1	66.2	217.5	291.5	428.9	702.6	774.5	838.1	SwRI[5] (NS2630)
SD-7x	2	55.4	59.5	38.3	134.2	269.4	295.9	329.2	543.3	664.6	696.2	SwRI[5] (UP8353)
SD-90	0	61.1	108.5	50.1	99.1	253.7	417.3	551.5	324.4	255.3	923.1	GM EMD[4]
Dash 7	N	65.0	180.5	108.2	121.2	352.7	323.1	327.1	293.7	325.3	405.4	EPA RSD[1]
Dash 8	0	37.0	147.5	86.0	133.1	285.9	289.1	323.3	366.4	453.5	593.8	GE[4]
Dash 9	N	32.1	53.9	54.2	108.1	215.7	285.1	365.6	429.3	469.7	681.2	SWRI 2000
Dash 9	0	33.8	50.7	56.1	117.4	224.9	260.1	607.7	562.9	587.4	546.9	Average of GE & SwRI[6]
Dash 9	1	16.9	88.4	62.1	140.2	298.2	378.1	418.3	510.2	526.2	751.1	SwRI[2] (CSXT595)
Dash 9	2	7.7	42.0	69.3	145.8	298.5	359.9	399.8	410.4	496.1	586.4	SwRI[2] (BNSF 7736)
C60-A	0	71.0	83.9	68.6	78.6	272.6	230.8	272.3	305.4	220.3	350.1	GE[4] (UP7555)

Notes:
1. EPA Regulatory Support Document, "Locomotive Emissions Regulation," Appendix B, 12/17/97, as tabulated by ARB and ENVIRON
2. Base emission rates provided by ENVIRON as part of the BNSF analyses for the Railyard MOU (Personal communication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to C. Lindhjem, 2006).
3. SwRI final report "Emissions Measurments - Locomotives" by Steve Fritz, August 1995.
4. Manufacturers' emissions test data as tabulated by ARB.
5. Base SD-70 emission rates taken from data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRI Exhaust Plume Study, tabulated and calculated by ENVIRON..

2. HHD Diesel-Fueled Trucks

Emission estimates for the HHD Diesel-fueled trucks are based on the number of trucks by model year and annual VMT within the Yard. Per CARB guidelines, the emissions from idling and traveling modes have been separated because different source treatments (point or volume source) will be used in the air dispersion modeling analysis for these modes. A fleet-weighted average emission factor for traveling emissions was calculated, based on the model year distribution provided by UPRR (see Table 2), using the EMFAC-WD 2006 model with the BURDEN output option. Fleet-weighted idling emission factors were calculated, based on the model year distribution provided by UPRR, using the EMFAC-WD 2006 model with the EMFAC output option. The emission factors for the HHD Diesel-fueled trucks are shown in Table 18. Detailed emission factor derivation calculations and EMFAC-WD 2006 output are contained in Appendix B.

Table 18
Emission Factors for HHD Diesel-Fueled Trucks
Stockton Rail Yard

Operating Mode	Fleet Weighted Emission Factors				
	ROG	CO	NOx	DPM[4]	SOx
Traveling (g/mi)[1]	3.17	7.53	23.66	1.19	0.30
Idling (g/hr)[2]	9.58	47.04	117.70	1.41	0.58

Notes:
1. Emission factors were calculated using the EMFAC-WD 2006 model with the BURDEN output option.
2. Emission factors were calculated using the EMFAC-WD 2006 model with the EMFAC output option.
3. See Table 2 for fleet distribution.
4. Diesel PM_{10} (DPM) is a TAC.

3. On-Road Diesel-Fueled Trucks

Emission estimates for on-road Diesel-fueled trucks are based on the number of trucks by model year, vehicle class, and annual VMT within the Yard. Per CARB guidelines, the emissions from idling and traveling modes have been separated because different source treatments (point or volume source) will be used in the air dispersion modeling analysis for these modes. A vehicle-specific emission factor for traveling emissions was calculated, using the EMFAC-WD 2006 model with the BURDEN output option. Idling emission factors are from EMFAC-WD 2006 with the EMFAC output option. The emission factors for the on-road Diesel-fueled trucks are shown in Table 19. Detailed emission factor derivation calculations and EMFAC-WD 2006 output are contained in Appendix C.

4. Heavy Equipment

Emission estimates for the Diesel-fueled heavy equipment are based on the model year of the equipment, and the hours of operation within the Yard. Emission factors were calculated using CARB's OFFROAD2006 model. The heavy equipment emission factors are shown in Table 20. Detailed emission factor derivation calculations and OFFROAD2006 output are contained in Appendix D.

5. Storage Tanks

The only non-exempt storage tanks (TNKO-0294, TNKS-0056, and TNKD-9010) are located at the wastewater treatment plant. TNKO-0294 stores sludge and other solids from WWTP operations; therefore, emissions from this tank were assumed to be negligible. TNKS-0056 and TNKD-9010 store industrial storm water and are located downstream of the primary clarifier at the WWTP. The primary clarifier has an organics removal efficiency of 99%; therefore, emissions from these tanks were also assumed to be negligible.

Table 19
Emission Factors for On-Road Diesel-Fueled Trucks
Stockton Rail Yard

Equipment Type	Make/Model	Model Year	Vehicle Class	Traveling Mode Emission Factors (g/mi)[1]					Idling Mode Emission Factors (g/hr)[2]				
				ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
Dump Truck	Ford	1985	HHD	9.07	29.94	28.12	4.54	0.00	33.61	74.81	58.65	7.10	0.58
Sweeper Truck	Unknown	1990	HHD	8.72	29.31	28.61	4.19	0.35	19.68	61.68	84.93	3.54	0.58
Pickup Truck	Ford F800	1992	MHD	0.00	9.07	18.14	1.81	0.00	3.17	26.30	75.05	1.40	0.37
Boom Truck	Ford F800	1993	MHD	1.51	7.56	18.14	1.51	0.00	3.17	26.30	75.05	1.40	0.37
Boom Truck	GMC C7500	1998	MHD	0.70	4.88	12.56	0.70	0.00	3.17	26.30	75.05	0.75	0.37
Boom Truck	International	1998	MHD	0.70	4.88	12.56	0.70	0.00	3.17	26.30	75.05	0.75	0.37
Pickup Truck	Ford F550	2005	LHD	0.30	1.51	5.44	0.00	0.00	3.17	26.30	75.05	0.75	0.37
Pickup Truck	Ford F550	2005	LHD	0.30	1.51	5.44	0.00	0.00	3.17	26.30	75.05	0.75	0.37
Boom Truck	Sterling	2005	HHD	0.81	1.30	14.74	0.49	0.32	7.74	43.69	122.65	1.07	0.58
Pickup Truck	GMC 550	2005	LHD	0.30	1.51	5.44	0.00	0.00	3.17	26.30	75.05	0.75	0.37

Notes:
1. Traveling exhaust emission factors were calculated from EMFAC-WD 2006 with the BURDEN output option.
2. Idling exhaust emission factors were calculated from EMFAC-WD 2006 with the EMFAC output option.

Table 20
Emission Factors for Diesel-Fueled Heavy Equipment
Stockton Rail Yard

Equipment Type	Make/Model	Model Year	Exhaust and Crankcase Emission Factors (g/hp-hr)[1]				
			VOC[2]	CO	NOx	DPM[3,4]	SOx[4]
Backhoe	John Deere 610C	1992	1.87	4.64	10.47	0.98	0.06
Backhoe	Case 480C	Pre-1990	1.93	5.72	13.73	0.90	0.06
Trackmobile	Trackmobile TM4000	1990	2.41	5.53	12.29	1.35	0.06
Forklift	Clark	Pre-1985	13.41	25.33	10.38	2.32	0.07
Crane	Pettibone 25RS	1970	1.65	4.26	11.45	0.74	0.06
Crane	Century 6CT8-3-C	1980	1.65	4.26	11.45	0.74	0.06
Forklift	JCB930	2000	1.74	4.40	8.04	0.98	0.06

Notes:
1. Emission factors from CARB's OFFROAD2006 model.
2. VOC evaporative emissions are negligible.
3. Diesel PM_{10} (DPM) is a TAC.
4. Assumes a Diesel fuel sulfur content of 130 ppm.

6. Sand Tower

Emission estimates for the sand tower are based on annual sand throughput and emission factors from EPA's AP-42 document.[6] The sand transfer system consists of two parts: pneumatic transfer and gravity transfer. The pneumatic transfer system is similar to those used to unload cement at concrete batch plants. The gravity feed system is similar to the sand and aggregate transfer operations at concrete batch plants. Therefore, emissions were calculated using the AP-42 emission factors for concrete batch plants. As previously discussed, the system is equipped with a baghouse for emission control. Therefore, the AP-42 emission factors for a controlled system were used. The emission factors are shown in Table 21.

[6] USEPA. *Compilation of Air Pollutant Emission Factors,* Volume 1, Stationary Point and Area Sources, Chapter 11, June 2006.

Table 21 Emission Factors for Sand Tower Operations Stockton Rail Yard		
Pollutant	Emission Factors (lb/ton)	
	Pneumatic Transfer[1]	Gravity Transfer[2]
PM_{10}	0.00034	0.00099

Notes:
1. Emission factor from AP-42, Table 11.12-5, 6/06. Factor for controlled pneumatic cement unloading to elevated storage silo was used. The unit is equipped with a fabric filter.
2. Emission factor from AP-42, Table 11.12-5, 6/06. Factor for sand transfer was used.
3. There are no TAC emissions from this source.

7. Wastewater Treatment Plant

Emission estimates for the WWTP were based on emission rates from the *Air Emission Inventory and Regulatory Analysis Report for Stockton Yard* (Trinity Consultants, July 2003) and the annual wastewater flow rate. Emission rates were calculated by Trinity Consultants using EPA's WATER9 program. The emission rates are shown in Table 22.

Table 22 Emission Factors for the Wastewater Treatment Plant Stockton Rail Yard	
Pollutant	Emission Rate (grams/sec)
Benzene	2.26×10^{-7}
Bis (2-ethylhexyl) Phthalate	2.28×10^{-7}
Bromomethane	4.40 x 10-[7]
Chloroform	2.74×10^{-7}
Ethylbenzene	1.14×10^{-6}
Methylene Chloride	5.15×10^{-6}
Toluene	1.39×10^{-6}
Xylene	2.67×10^{-21}
Total	$\mathbf{8.85 \times 10^{-6}}$

Notes:
1. Emission rates from *Air Emission Inventory and Regulatory Analysis for Stockton Yard*, Trinity Consultants, July 2003.

8. Auxiliary Generator Sets

Emission estimates for the ACE-owned and -operated Diesel-fueled auxiliary generator sets are based on the model year and the hours of operation within the Yard. Emission factors were calculated using CARB's OFFROAD2006 model. The emission factors for the generators are shown in Table 23. Detailed emission factor derivation calculations and OFFROAD2006 output are contained in Appendix E.

Table 23
Emission Factors for Diesel-Fueled Auxiliary Generator Sets
Stockton Rail Yard

Equipment Type	Model Year	Exhaust and Crankcase Emission Factors (g/hp-hr)[1]				
		VOC[2]	CO	NOx	DPM[3,4]	SOx[4]
Aux. Generator Set	1998	0.419	0.966	6.175	0.40	0.053

Notes:
1. Emission factors from CARB's OFFROAD2006 model.
2. VOC evaporative emissions are negligible.
3. Diesel PM_{10} (DPM) is a TAC.
4. Assumes a Diesel fuel sulfur content of 130 ppm.

B. TAC Emissions by Source Type

TAC emission calculations for each source type were based on the site-specific equipment inventory (shown in Part V of this report), equipment activity data (shown in Part VI of this report), and the source-specific emission factors shown in Part VII.A above.

Emissions from locomotive operations were based on the emission factors shown in Tables 16 and 17, the number of events, the number of locomotives per consist, duration, and duty cycle of different types of activity. Table 24 shows the duty cycles assumed for different types of activities.

Table 24
Locomotive Duty Cycles
UPRR Stockton Yard

Activity	Duty Cycle
Through train movement	EB: N4 - 100%; WB: N3- 100%
Movements within the yard	N1 -50%, N2- 50%
Yard operations	EPA Switch Duty Cycle[1]

Notes:
1. EPA (1998) Regulatory Support Document.

For locomotive models and tiers for which specific emission factors were not available, the emissions for the next lowest tier were used, or the next highest tier if no lower tier data were available. Emission factors for the "average locomotive" for different types of activity were developed from the emission factors and the actual locomotive model and technology distributions for that activity. Separate distributions were developed for seven types of activity: through trains (including through power moves); eastbound freight; westbound freight; arriving and departing power moves; ACE arrivals and departures; GP-38 yard operations; and switcher yard operations. Table 25 shows the TAC emission estimates for the different types of activities.

Table 25
DPM Emissions from Locomotives
Stockton Rail Yard

Activity	DPM Emissions (tpy)
Through trains	0.381
Freight trains	1.276
ACE trains	0.418
Power moves	0.005
Yard operations	3.578
Service and Shop Idling	0.782
Load tests	0.032
Total	**6.472**

Notes:
1. See Table 1 for equipment specifications.
2. See Table11 for activity data.
3. See Tables 16 and 17 for emission factors.
4. Emissions from yard operations are based on the locomotive type and the hours of operation for each captive unit, the EPA Switch Duty Cycle, and the emission factors shown in Tables 16 and 17.
5. See Appendices A-3 and A-4 for detailed emission calculations. The calculations of sulfur adjustments are shown in Appendix A-7.

DPM emissions from HHD Diesel-fueled trucks are shown in Table 26. DPM emissions from on-road Diesel-fueled trucks are shown in Table 27. Table 28 summarizes the DPM emissions from Diesel-fueled heavy equipment operating at the Yard. TAC emissions from the WWTP emissions are shown in Table 29. DPM emissions from the Diesel-fueled auxiliary generator set are shown in Table 30. As discussed above, emissions from storage tanks AST-3, AST-5, and AST-6 are negligible and there are no TAC emissions from sand tower operations. Detailed emission calculations for each source group are contained in Appendix F.

Table 26
DPM Emissions from HHD Diesel-Fueled Trucks
Stockton Rail Yard

	Emissions (tpy)		
Pollutant	Traveling Mode	Idling Mode	Total
DPM	0.002	0.172	0.174

Notes:
1. See Table 2 for equipment inventory.
2. See Table 12 for activity data.
3. See Table 18 for emission factors.

Table 27
DPM Emissions from On-Road Diesel-Fueled Trucks
Stockton Rail Yard

			Emissions (tpy)		
Equipment Type	Make/Model	Model Year	Traveling Mode	Idling Mode	Total
Dump Truck	Ford	1985	0.0030	0.0007	0.0035
Sweeper Truck	Unknown	1990	0.0012	0.0004	0.0014
Pickup Truck	Ford F800	1992	0.0005	0.0001	0.0006
Boom Truck	Ford F800	1993	0.0004	0.0001	0.0005
Boom Truck	GMC C7500	1998	0.0002	0.0001	0.0003
Boom Truck	International	1998	0.0002	0.0001	0.0003
Pickup Truck	Ford F550	2005	0.0000	0.0001	0.0001
Pickup Truck	Ford F550	2005	0.0000	0.0001	0.0001
Boom Truck	Sterling	2005	0.0001	0.0001	0.0002
Pickup Truck	GMC 550	2005	0.0000	0.0001	0.0001
Total			**0.0056**	**0.0019**	**0.0075**

Notes:
1. See Table 3 for equipment inventory.
2. See Table 13 for activity data.
3. See Table 19 for emission factors.

Table 28 DPM Emissions from Diesel-Fueled Heavy Equipment Stockton Rail Yard			
Equipment Type	Make/Model	Model Year	Emissions (tpy)
Backhoe	John Deere 610C	1992	0.017
Backhoe	Case 480C	Pre-1990	0.003
Trackmobile	Trackmobile TM4000	1990	0.064
Forklift	Clark	Pre-1985	0.000
Crane	Pettibone 25RS	1970	0.005
Crane	Century 6CT8-3-C	1980	0.001
Forklift	JCB930	2000	0.009
Total			**0.099**

Notes:
1. See Table 4 for equipment inventory.
2. See Table 14 for activity data.
3. See Table 20 for emission factors.

Table 29 TAC Emissions from the WWTP Stockton Rail Yard	
Pollutant	Emissions (tpy)
Benzene	1.11×10^{-5}
Bis (2-ethylhexyl) Phthalate	1.12×10^{-5}
Bromomethane	2.15×10^{-5}
Chloroform	1.34×10^{-5}
Ethylbenzene	5.58×10^{-5}
Methylene Chloride	2.52×10^{-4}
Toluene	6.81×10^{-5}
Xylene	1.31×10^{-19}
Total	$\mathbf{4.33 \times 10^{-4}}$

Notes:
1. See Part V for equipment inventory.
2. See Part VI for activity data.
3. See Table 22 for emission factors.

Table 30 DPM Emissions from Auxiliary Generator Sets Stockton Rail Yard	
Equipment Type	DPM Emissions (tpy)
Auxiliary Generator Sets	0.068

Notes:
1. See Part V for equipment specifications.
2. See Part VI for activity data.
3. See Table 23 for emission factors.

C. Facility Total Emissions

Facility-wide DPM emissions are shown in Table 31. The only source of TAC emissions other than DPM is the WWTP. Therefore, other TAC emissions are summarized in Table 29.

Table 31
Facility-Wide Diesel Particulate Emissions
Stockton Rail Yard

Source	Emissions (tpy)
Locomotives[1]	6.472
HHD Diesel-Fueled Trucks[2]	0.174
On-Road Diesel-Fueled Trucks[3]	0.007
Diesel-Fueled Heavy Equipment[4]	0.099
Auxiliary Generator Set[5]	0.068
Total	**6.819**

Notes:
1. See Table 25.
2. See Table 26.
3. See Table 27.
4. See Table 28.
5. See Table 30.

PART VIII: RISK SCREENING CALCULATIONS

As discussed in Part IV of this report and agreed upon with CARB, de minimis sources, based on weighted health risk, were identified in the inventory but were not included in the modeling analysis. De minimis sources are the individual source categories that represent less than 3 percent of the facility-total weighted-average site health impacts (determined separately for cancer risk and non-cancer chronic health hazard). Total exclusions for all de minimis sources did not exceed 10 percent of the facility-total weighted-average site health impacts.

The OEHHA unit risk factor for each pollutant was multiplied by the annual emissions of that pollutant to generate a risk index value for each source. Each source-specific risk index was divided by the facility total risk index to get the fractional contribution to the total risk for each source. Table 32 summarizes the cancer risk, the non-cancer health hazard index, and the fractional contribution to the cancer risk and non-cancer chronic health hazard for each source. Detailed cancer risk and non-cancer health hazard index calculations are in Appendix G.

Table 32
Summary of Weighted Risk by Source Category
Stockton Rail Yard

Source	Cancer Risk		Non-Cancer Chronic Health Hazard	
	Risk Index Value	Percent of Total Risk	Health Hazard Index Value	Percent of Total Hazard
Locomotives	1.94×10^{-3}	94.90	3.24×10^{1}	94.24
HHD Diesel-Fueled Trucks	5.21×10^{-5}	2.55	8.69×10^{-1}	2.53
On-Road Diesel-Fueled Trucks	2.23×10^{-6}	0.11	3.71×10^{-2}	0.11
Heavy Equipment	2.97×10^{-5}	1.45	4.95×10^{-1}	1.44
WWTP	6.44×10^{-10}	0.00	2.38×10^{-1}	0.69
Auxiliary Generator Sets	2.03×10^{-5}	0.99	3.38×10^{-1}	0.99
Total	**2.05×10^{-3}**	**100**	**3.43×10^{1}**	**100**

Sources that represent less than 3 percent each of the facility-total weighted-average cancer risk and non-cancer chronic risk, as shown in Table 32, are de minimis. Table 33 lists the de minimis sources for the Stockton Yard.

Table 33 Summary of De Minimis Sources Stockton Rail Yard	
De minimis Sources for Cancer Risk	De Minimis Sources for Non-Cancer Chronic Health Hazard
HHD Diesel-Fueled Trucks On-Road Diesel-Fueled Trucks Heavy Equipment Auxiliary Generator Sets WWTP	HHD Diesel-Fueled Trucks On-Road Diesel-Fueled Trucks Heavy Equipment Auxiliary Generator Sets WWTP

Sources that are de minimis for both cancer risk and non-cancer chronic health hazard (i.e., on-road Diesel-fueled trucks, HHD Diesel-fueled trucks, auxiliary generator sets, and the WWTP) are not included in the dispersion modeling analysis. At CARB's request, heavy equipment was included in the dispersion modeling analysis notwithstanding their de minimis risk contribution.

PART IX: AIR DISPERSION MODELING

An air dispersion modeling analysis was conducted for the Stockton Yard. The purpose of the analysis was to estimate ground-level concentrations of DPM and other TACs, emitted from Yard operations, at receptor locations surrounding the Yard out to a distance of approximately 6 miles. Air dispersion modeling was conducted in accordance with the *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006) and UPRR's *Modeling Protocol* (August 2006). Each aspect of the modeling is further described below.

A. Model Selection and Preparation

1. Modeled Sources and Source Treatment

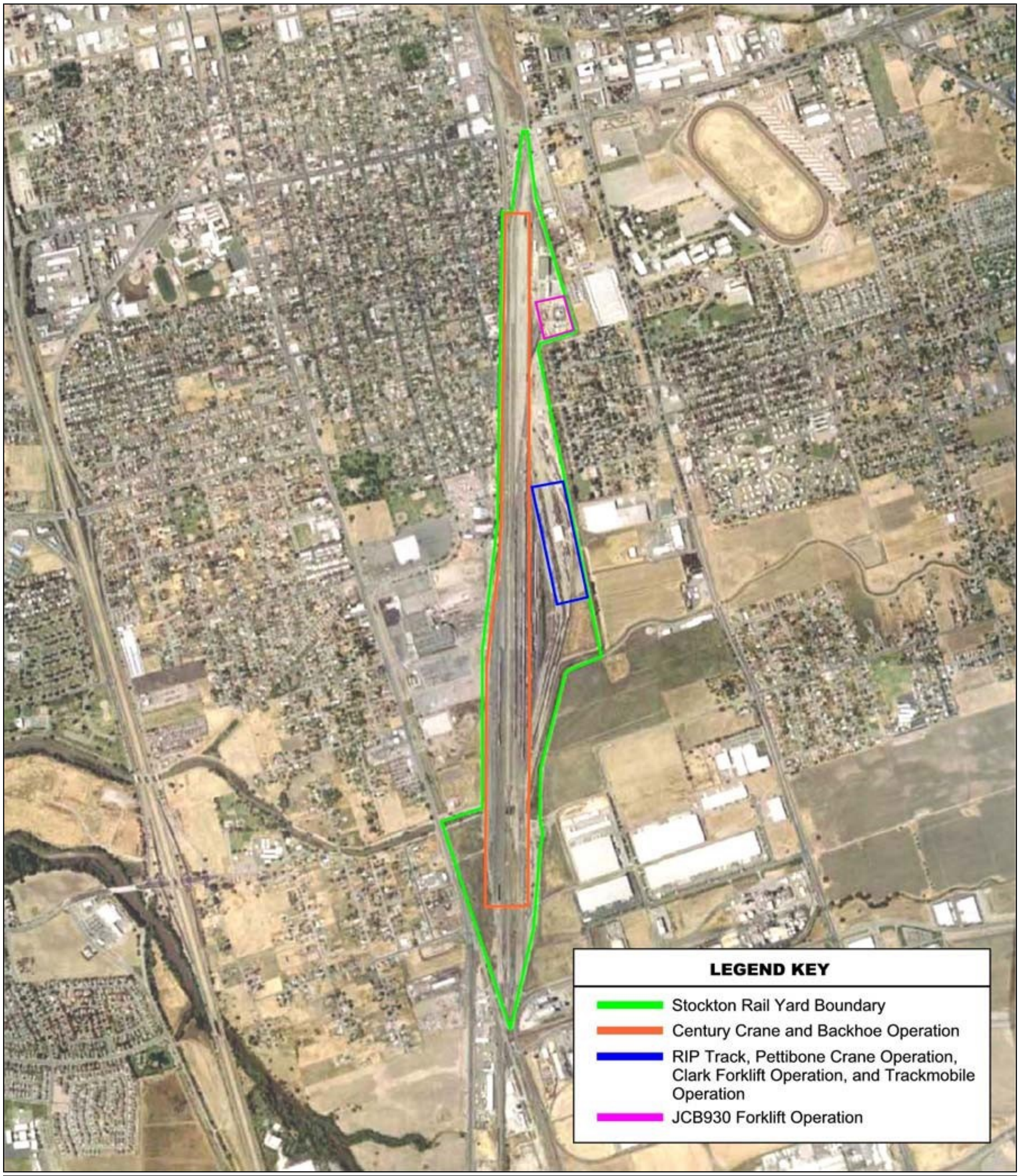
As discussed in Part VIII, only sources that represent more than 3 percent of the facility-total weighted-average site health impacts (determined separately for cancer risk and non-cancer chronic health hazard) were included in the dispersion modeling analysis. At the request of CARB, heavy equipment was included as well, notwithstanding their de minimis risk contribution. Emissions from heavy equipment and moving locomotives were simulated as a series of volume sources along their corresponding travel routes and work areas. Idling and load testing of locomotives was simulated as a series of point sources within the areas where these events occur. The elevation for each source was interpolated from a 50 m grid of USGS terrain elevations. Table 34 shows the sources that were included in the modeling analysis and treatment used for each source. Assumptions used to spatially allocate emissions from locomotive operations within the Yard are included in Appendix A-4. Assumptions used to spatially allocate emissions from non-locomotive sources are contained in Appendix H.

Table 34
Source Treatment for Air Dispersion Modeling
Stockton Rail Yard

Source	Source Treatment
Locomotives (idling)	Point
Locomotives (traveling)	Volume
Heavy Equipment (idling)	Volume
Heavy Equipment (traveling)	Volume

Notes:
1. See Figure 3 for source locations.

Figure 3
Source Locations



2. Model Selection

Selection of air dispersion models depends on many factors, including the type of emissions source (point, line, or volume) and type of terrain surrounding the emission source. The USEPA-approved guideline air dispersion model, AERMOD, was selected for this project. AERMOD is recommended by EPA as the preferred air dispersion model, and is the recommended model in CARB's *Health Risk Assessment Guidance for Rail Yard and Intermodal Facilities* (July 2006).

AERMOD is a steady-state,[7] multiple-source, Gaussian dispersion model designed for use with emission sources situated in terrain where ground elevations can exceed the release heights of the emission sources (i.e., complex terrain).[8] AERMOD was used with hourly wind speed and direction, temperature and cloud cover data from the Stockton Municipal Airport. AERMOD used these parameters to select the appropriate dispersion coefficients.

Standard AERMOD control parameters were used, including stack-tip downwash, non-screening mode, non-flat terrain, and sequential meteorological data check. Following USEPA guidance, the stack-tip downwash option adjusted the effective stack height downward following the methods of Briggs (1972) for stack exit velocities less than 1.5 times the wind speed at stack top.

Two AERMET preprocessors (Stages 1 and 2, and Stage 3) were used to prepare meteorological data for use in AERMOD. Surface roughness, albedo and Bowen ratio[9] were estimated in multiple wind direction sectors surrounding the meteorological monitoring site at the Stockton Municipal Airport. The Yard is close enough to the

[7] The term "steady-state" means that the model assumes no variability in meteorological parameters over a one-hour time period.
[8] Federal Register, November 9, 2005; Volume 70, Number 216, Pages 68218-68261.
[9] The albedo of a specified surface is the ratio of the radiative flux reflected from the surface to the radiative flux incident on the surface. Flux is the amount of energy per unit time incident upon or crossing a unit area of a defined flat plane. For example, the albedo for snow and ice varies from 80% to 85% and the albedo for bare ground from 10% to 20%. Bowen ratio is the ratio of heat energy used for sensible heating (conduction and convection) of the air above a specified surface to the heat energy used for latent heating (evaporation of water or sublimation of snow) at the surface. The Bowen ratio ranges from 0.1 for the ocean surface to more that 2.0 for deserts; negative values are also possible.

airport so that the selection of values for these three parameters in sectors around the airport is reasonably representative of the same parameters around the Yard.

As suggested by USEPA (2000), the surface characteristics were specified in sectors no smaller than a 30-degree arc. Specifying surface characteristics in narrower sectors becomes less meaningful because of expected wind direction variability during an hour, as well as the encroachment of characteristics from the adjacent sectors with a one-hour travel time. Use of weighted-average[10] characteristics by surface area within a 30-degree (or wider) sector made it possible to have a unique portion of the surface significantly influence the properties of the sector that it occupies. The length of the upwind fetch for defining the nature of the turbulent characteristics of the atmosphere in each sector surrounding the source location was 3 kilometers as recommended by Irwin (1978) and USEPA's *Guideline on Air Quality Models.*[11]

3. Modeling Inputs

Modeling was based on the annual average emissions for each source as discussed in Part VII.B above. Diurnal and/or seasonal activity scalars were applied to locomotive activities and heavy equipment operations. The following profiles were used in the modeling. See Appendix A-4 for the profiles used and Appendix I for a description of the methods used to develop these profiles.

- A seasonal/diurnal activity profile was calculated for freight locomotive idling based on the number of arrivals and departures in each hour of the day and the number of arriving and departing trains in each season. Each hourly factor was based on the number of arrivals and departures in that hour, the number of arrivals in the preceding two hours, and the number of departures in the following two hours. This approach captures the idling times for consists on arrival and departure. These factors were applied to consist idling for arriving and departing trains, and idling at the service track.
- A seasonal/diurnal activity profile was calculated for in-yard locomotive movements of road power using the same approach as for idling. In this case,

[10] Weighting was based on wind direction frequency, such as determined from a wind rose.
[11] USEPA (1986), and published as Appendix W to 40 CFR Part 51 (as revised).

however, only the number of arriving and departing trains in a single hour was used for that hour's factor.

- Diurnal profiles were developed for switching operations in the different areas of the yard based on operating shift schedules for the yard switchers. Seasonal adjustment factors were not used for yard switching.
- A seasonal profile was applied to freight locomotive service activities as the level of activity increased substantially from the beginning to the end of 2005.
- Diurnal profile for ACE commuter train idling and movements were developed based on their operating schedules. No seasonal adjustment factors were applied to commuter rail activity.

The volume source release heights and vertical dispersion parameters (σ_z) were those used by CARB for the Truck Stop Scenario in Appendix VII of the Diesel Risk Reduction Plan for mobile vehicles and equipment other than locomotives. For locomotives, the release height and σ_z values used were those developed by CARB for daytime and nighttime locomotive movements in the Roseville Risk Assessment modeling. Stack parameters used to create the AERMOD input file for locomotive operations are shown in Table 35. Table 36 summarizes the modeling inputs used to create the AERMOD input file for each non-locomotive source at the Yard.

Table 35
Locomotive Modeling Inputs
Stockton Rail Yard

Source	Point/Idling Source Parameters				Volume Source Parameters		
	Stack Ht (m)	Stack Dia. (m)	Exit Velocity (m/s)	Temp (° K)	σ_z (m)	σ_y[5] (m)	Release Ht (m)
Locomotives (idling and load tests)[1]							
Road power at all yards-SD7x[2]	4.6	0.625	3.1	364	-	-	-
Load tests - N1[3]	4.6	0.625	8.0	420	-	-	-
Load tests - N8[3]	4.6	0.625	36.6	589	-	-	-
Yard locomotives ST-SP-GP3x	4.6	0.305	7.5	342	-	-	-
Yard locomotives ST-EydN-SW	4.6	0.305	5.6	341	-	-	-
Yard locomotives ST-EydS-GP-3x	4.6	0.305	7.5	342	-	-	-
Stockton ACE-GP4x	4.6	0.666	3.7	352	-	-	-
Locomotives (traveling)[4]					-	-	-
Day[5]	-	-	-	-	2.6	20-50	5.6
Night[5]	-	-	-	-	6.79	20-50	14.6

Notes:
1 Stack parameters for stationary locomotives taken from the CARB Roseville modeling.
2 Idling road power stack parameters are those of the most prevalent locomotive model (SD-7x).
3 Load test stack parameters are those of the most prevalent locomotive model (SD-7x).
4 All locomotive movements for road power and yard locomotives while working are the day and night volume source parameters for moving locomotives from the CARB Roseville modeling.
5 Lateral dispersion coefficient (σ_y) for moving locomotive volume sources was set to values between 20 and 50 m, depending on the spacing of sources in different areas of the yard and proximity to yard boundaries.

Table 36
Non-Locomotive Modeling Inputs
Stockton Rail Yard

Source	Point/Idling Source Parameters				Volume Source Parameters		
	Stack Height (m)	Stack Diameter (m)	Exit Velocity (m/s)	Temp (° K)	σ_z (m)	σ_y (m)	Release Height (m)
Cranes[1]	12.5	0.13	20	644.3	-	-	-
Backhoes[2]	-	-	-	-	1.39	20-50	4.15
Forklifts[2]	-	-	-	-	1.39	20-50	4.15
Trackmobile[2]	-	-	-	-	1.39	20-50	4.15

Notes:
1. Stack parameters from equipment manufacturers.
2. Low level sources treated as volume sources using the release height and vertical dispersion parameter (σ_z) from the CARB Diesel Risk Reduction Plan (Sept 13, 2000), Appendix VII, Table 2 (Truck stop scenario).
3. Low level source lateral dispersion parameter (σ_y) set to a value between 20 and 50 meters based on spacing between sources and proximity to the yard boundary.

4. Meteorological Data Selection

The Yard does not monitor meteorological variables on site. Surface data from the nearby (i.e., 2.6 miles) Stockton Municipal Airport, and upper air data from the Oakland International Airport, operated by the National Weather Service, were used for this project. Missing surface data were replaced according to USEPA guidance[12]. The completed dataset was processed in AERMET, the meteorological preprocessor for AERMOD.

Fifteen years, 1991 through 2005, of meteorological data were processed with AERMET to assure that an adequate number of years of acceptable data completeness and quality would be available for AERMOD modeling. It is expected that year-to-year variability would not cause significant differences in the modeled health impacts and, hence, would justify needing only to subject the full set of receptors to one year of meteorological data. For rail yard dispersion modeling, the meteorological data from 2005 were selected, the most current year available.

In the absence of more detailed data and given the inability of steady-state Gaussian models such as AERMOD to treat non-uniform flow fields, some uncertainty will exist in the ability of the model to predict the locations of highest concentrations outside of the Yard.

Because rail yards, especially emissions from locomotives, tend to be aligned linearly along the main track routes, the directions of prevailing surface winds were important to model predictions in the near field. For longer transport distances (e.g., 1 to 10 km), surface winds were still the primary consideration, with atmospheric stability also playing an important role. Due to the relatively low release heights and limited plume rise of rail yard sources, modeled concentrations are relatively insensitive to mixing heights, temperatures, and vertical temperature and wind profiles. Due to the generally flat terrain throughout the modeling domain and the proximity of the surface wind station to the

[12] USEPA "Meteorological Monitoring Guidance for Regulatory Modeling Applications" Section 6.8; Atkinson & Lee "Procedures for Substituting Values for Missing NWS Meteorological Data for Use in Regulatory Air Quality Models"

Yard, the meteorological data used should be reasonably representative of conditions at the Yard.

5. Model Domain and Receptor Grids

A domain size of 20 km by 20 km with varying receptor spacing was used. Within 300 m of the facility, receptor spacing was 50 m. Between 300 and 600 m, and between 600 m and 1 km, receptor spacings were 100 m and 200 m, respectively. Receptors were spaced 500 m apart throughout the rest of the domain.

All receptors were identified by UTM coordinates. United States Geological Survey (USGS) 7.5 Minute digital elevation model (DEMs) information was used to identify terrain heights at each receptor. Figures 4 and 5 show the outline of the Yard along with the coarse and fine receptor grids.

Sensitive receptors, consisting of hospitals, schools, day-care centers, and elder care facilities, within a 1-mile radius of the Yard, were identified. Table 37 lists the address, elevations, and UTM coordinates for each sensitive receptor. Figure 6 shows the outline of the Yard and the location of each sensitive receptor identified in Table 37.

Table 37
Sensitive Receptor Locations
Stockton Rail Yard

Receptor	Address	Elevation (m)	UTM-E (m)	UTM-N (m)
Apostolic Christian Academy	2222 Lever Blvd, Stockton, CA 95206	3	649726	4199028
Clare Mohammed School	2065 E Eighth St, Stockton, CA 95206	7	653436	4199974
Edison High School	1425 S Center St, Stockton, CA 95206	4	650561	4200187
Garfield Elementary School	1670 E Sixth St, Stockton, CA 95206	6	652578	4200078
Golden Valley Secondary Community Day School	1141 E Weber St, Stockton, CA 95205	6	651413	4202354
Grant Elementary School	1800 S Sutter St, Stockton, CA 95206	5	651149	4199893
Great Valley Elementary School	4223 McDougald Blvd, Stockton, CA 95336	4	649839	4196607
Hamilton Middle School	2245 E Eleventh St, Stockton, CA 95206	7	653759	4199746
Hazelton Elementary School	535 W Jefferson St, Stockton, CA 95206	4	649837	4200595
Huerta Elementary School	1644 S. Lincoln St, Stockton, CA 95206	3	650194	4199902
McKinley Elementary School	30 W Ninth St, Stockton, CA 95206	4	650976	4199077
Monroe Elementary School	2236 E Eleventh St, Stockton, CA 95206	7	653805	4199615
Nightingale Elementary School	1721 Carpenter Rd, Stockton, CA 95206	6	653326	4198362
Samuel N Hancock School	1610 E Main St, Stockton, CA 95205	7	652012	4202260
St George School	144 W 5th St, Stockton, CA 95206	4	650613	4199641
St Gertrude School	1701 E Main St, Stockton, CA 95205	7	652177	4202327
Stockton Seventh Day Adventist School	2929 S B St, Stockton, CA 95206	7	653585	4199073
Taft Elementary School	419 S Downing Ave, Stockton, CA 95206	4	650808	4197663
Van Buren Elementary School	1628 E Tenth St, Stockton, CA 95206	6	652906	4199510
Creative Child Care - Conway Development Center	742 Dallas Ave, Stockton, CA 95206	3	649696	4198568
Creative Child Care - Sierra Vistchild Development Center	1700 E Eleventh St, Stockton, CA 95206	6	653056	4199315
Head Start Child Development Council - Gemini Community Center	1807 E Tenth St, Stockton, CA 95206	7	653070	4199600

Head Start Child Development Council - Grant Village	2040 S Grant St, Stockton, CA 95206	5	651619	4199772
Head Start Child Development Council - Kennedy Community Center	2800 S D St, Stockton, CA 95206	6	652397	4199411
Head Start Child Development Council - Latin American Club	548 S Wilson Way, Stockton, CA 95205	7	652001	4201723
Head Start Child Development Council - Leo Gloria Center	215 W Fifth St, Stockton, CA 95206	4	650423	4199683
Head Start Child Development Council - White Rose Church	2340 S Pilgrim St, Stockton, CA 95206	6	652181	4199415
Picola Frye Daycare	3219 Volney St, Stockton, CA 95206	6	652913	4198509
Sedalia s Place	1637 Spring St, Stockton, CA 95206	6	652760	4199823
Sister Diane s Day Care Center	1616 E Main St, Stockton, CA 95205	7	651976	4202309
Community Medical Center	701 E Channel St, Stockton, CA 95202	5	650898	4202338
Primary Care Physicians Critical Care Center	102 S San Joaquin St, Stockton, CA 95202	5	650523	4201884
San Joaquin County Public Health Center	1601 E Hazelton Ave, Stockton, CA 95205	7	652126	4201703
Notes: 1. UTM Coordinates are in Zone 11, NAD 83.				

Figure 4
Coarse Modeling Grid

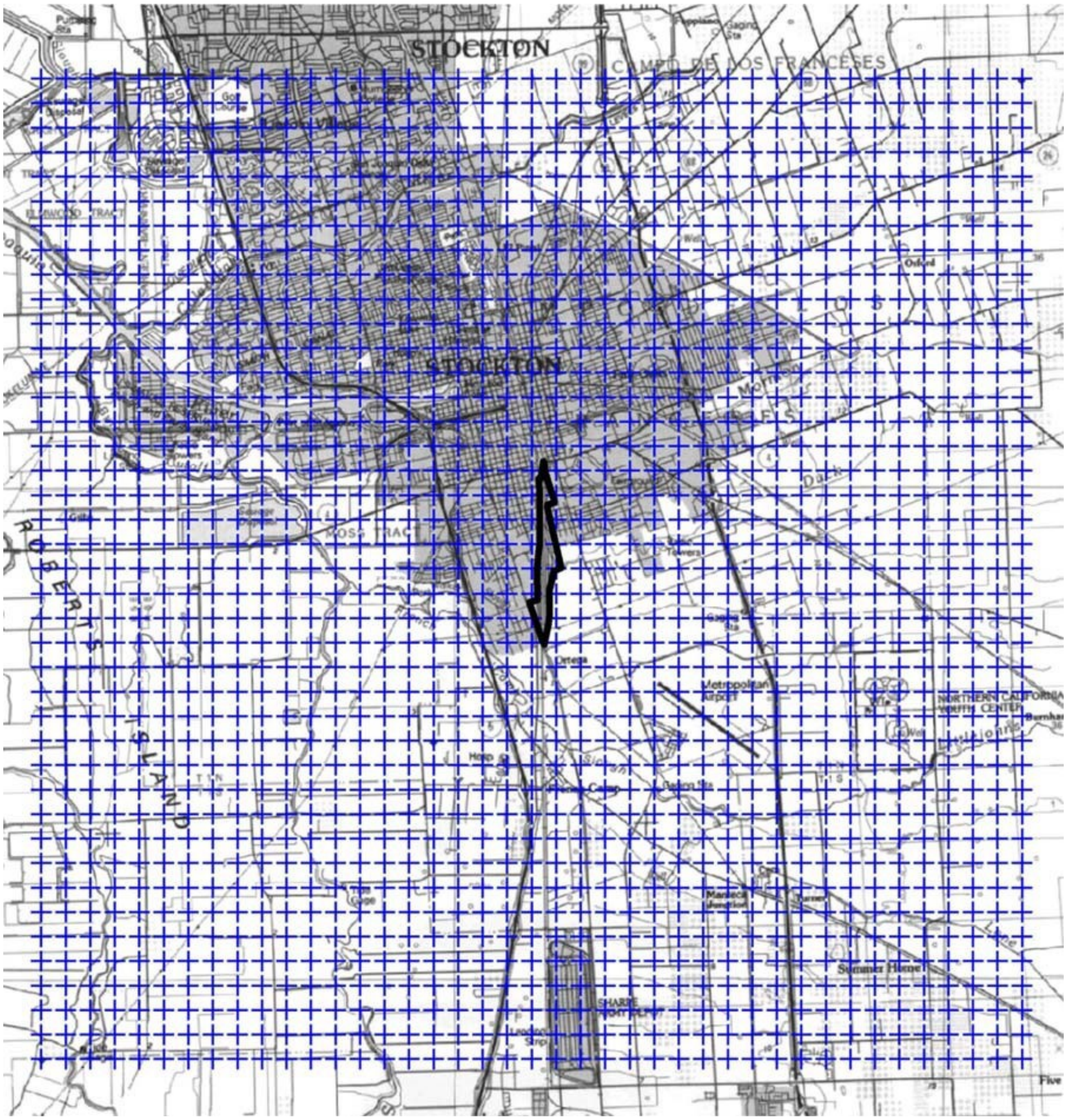


Figure 5
Fine Modeling Grid

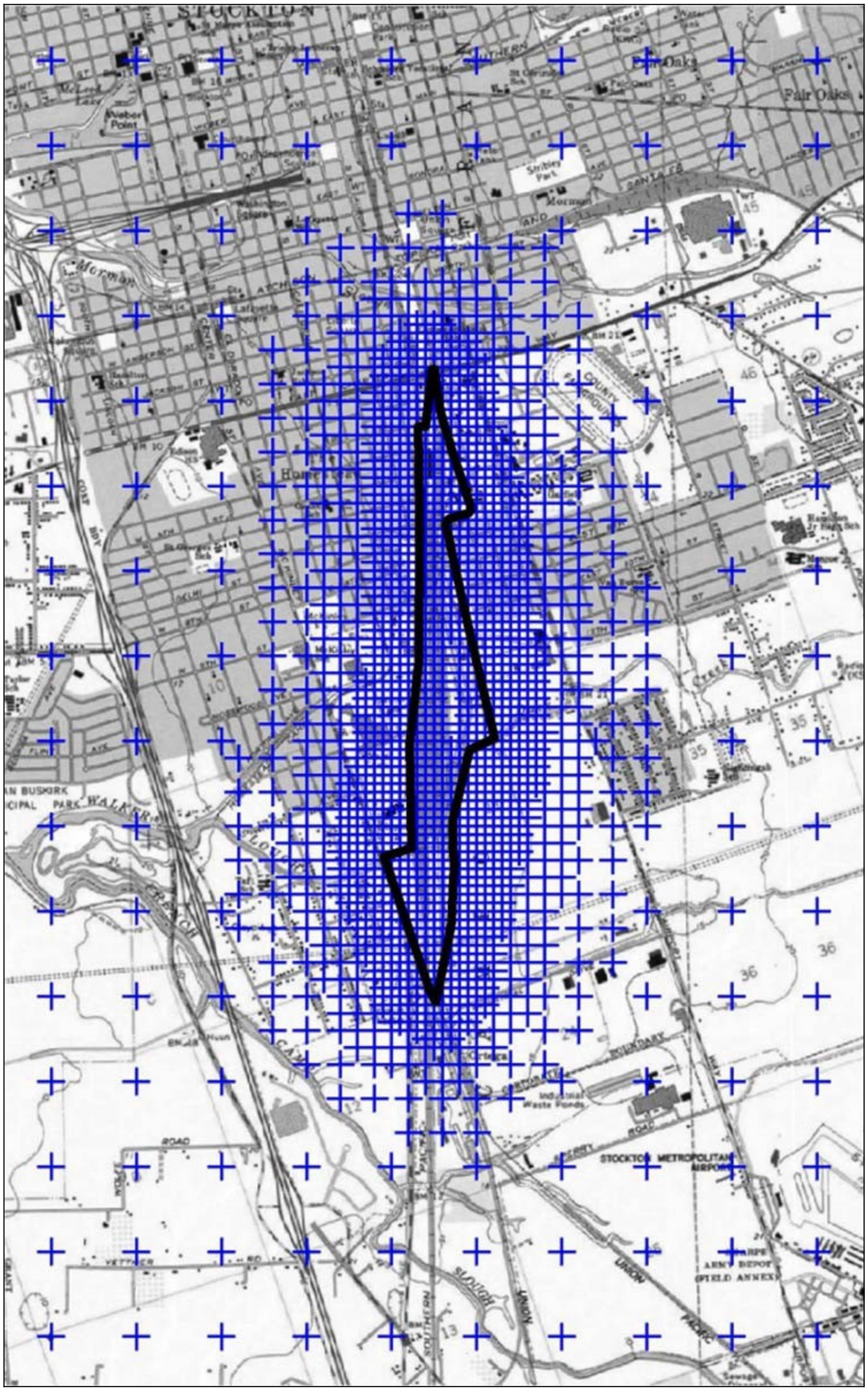
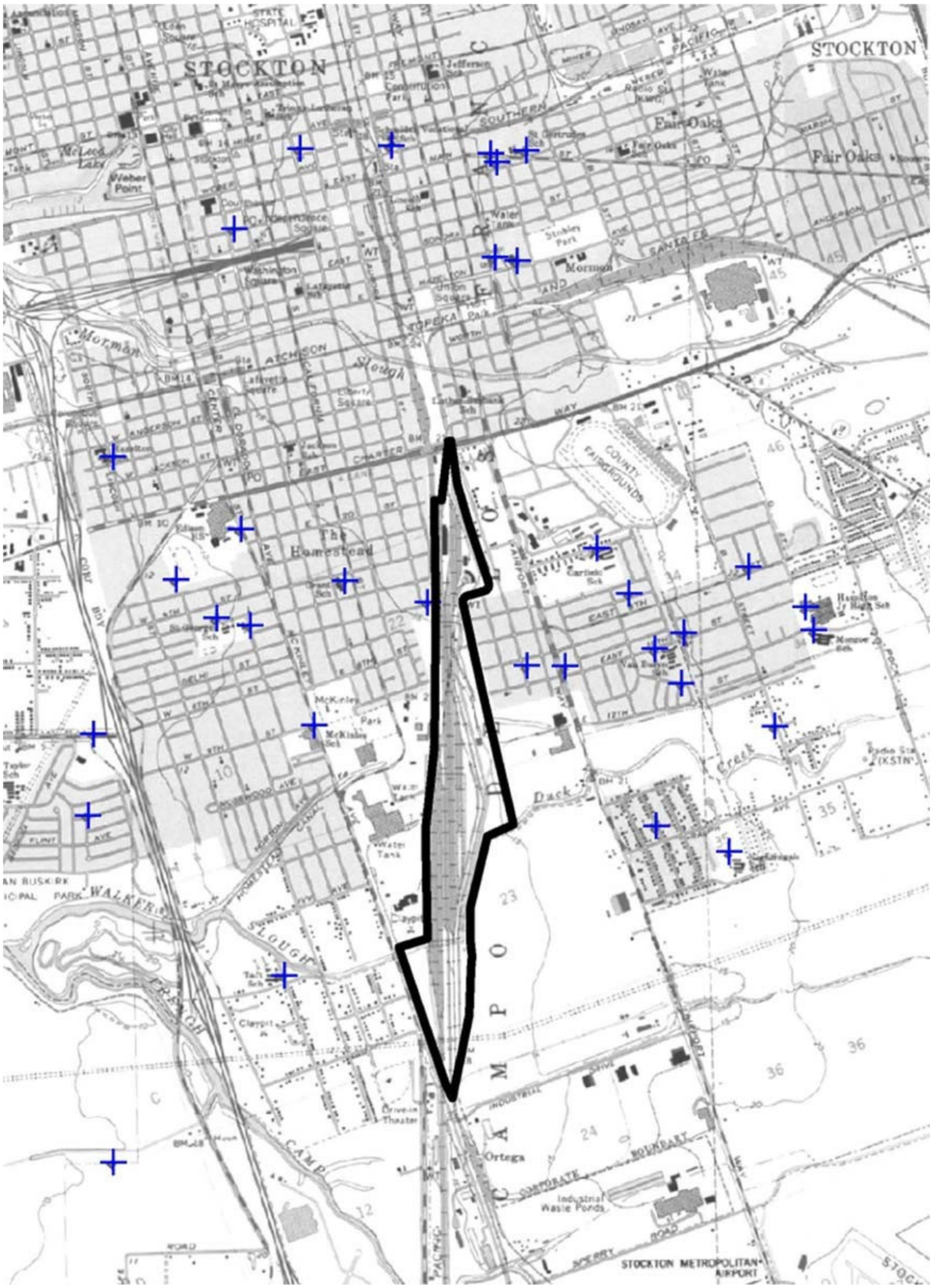


Figure 6
Sensitive Receptors



6. Dispersion Coefficients

Dispersion coefficients are used in air dispersion models to reflect the land use over which the pollutants are transported. The area surrounding the Stockton Municipal Airport was divided into sectors to characterize the surface roughness, albedo, and Bowen ratio. These parameters were provided along with the meteorological data to the AERMET software. The resulting meteorological input file allows AERMOD to select appropriate dispersion coefficients during its simulation of air dispersion. AERMOD also provides an urban input option to use the overall size of the Standard Metropolitan Statistical Area that contains the emission source (i.e., the Yard) in accounting for the urban heat island effect on the nocturnal convective boundary layer height. If the option is not selected, AERMOD defaults to rural dispersion coefficients. If the urban option is selected, but no surface roughness is specified (not to be confused with the surface roughness parameters already specified for sectors around the meteorological monitoring station and input to AERMET), AERMOD assigns a default "urban" surface roughness of 1 meter. For the Stockton Yard, AERMOD was run with the urban option. Based on CARB and USEPA guidance,[13] namely "*For urban areas adjacent to or near other urban areas, or part of urban corridors, the user should attempt to identify that part of the urban area that will contribute to the urban heat island plume affecting the source,*" the area encompassed by the surrounding City of Stockton was considered to determine the urban heat island effect on the nocturnal convective boundary layer height. The population of Stockton[14] is approximately 286,926, and the surface roughness that characterizes this metropolitan area was set to the URBANOPT default of 1 m. See Appendix J for additional discussion of this issue.

7. Building Downwash

Building downwash effects were considered for the Yard. Stack-tip downwash adjusted the effective stack height downward following the methods of Briggs (1972) when the

[13] AERMOD Implementation Guide**,** September 27, 2005, http://www.epa.gov/scram001/7thconf/aermod/aermod_implmtn_guide.pdf

[14] City of Stockton. http://www.city-data.com/city/Stockton-California.html.

stack exit velocity was less than 1.5 times the wind speed at stack top. The locomotives are the only structures in the Yard of sufficiently large size and close enough proximity to the modeled emission sources (i.e., their own stacks) to be entered into the Building Profile Input Program (BPIP) with one set of dimensions for a "standard" locomotive (24.2 m. long x 4.0 m. wide x 4.6 m. high).

B. Modeling Results

The AERMOD input and output files have been provided to CARB in an electronic format.

C. Demographic Data

Demographic data files have been provided to CARB in an electronic format. See Appendix K for a description of the data.

PART X: REFERENCES

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APPENDIX A

LOCOMOTIVE DATA

APPENDIX A-1

LOCOMOTIVE MODEL, TIER, AND
AUTO-START/STOP TECHNOLOGY
FREQUENCY BY TRAIN TYPE

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

Through Trains

EB arr 3475

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	6	1668	28	141	13	24	2	451	401	2	35
9	8	7	0	1	0	0	0	0	47	0	0
0	0	40	0	45	1651	9	0	92	544	17	0
1	3	0	0	1	10	0	0	0	424	0	0
0	0	0	0	0	267	0	0	0	27	0	0
0	0	0	0	0	1429	0	0	0	969	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	169	0	0	0	432	0	0

EB dep 3475

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	6	1670	28	140	13	24	2	451	402	2	35
9	8	7	0	1	0	0	0	0	47	0	0
0	0	40	0	45	1651	9	0	91	543	17	0
1	3	0	0	1	10	0	0	0	424	0	0
0	0	0	0	0	268	0	0	0	27	0	0
0	0	0	0	0	1429	0	0	0	966	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	169	0	0	0	432	0	0

WB arr 5028

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
3	20	2336	60	282	35	153	172	821	1942	2	292
13	30	9	0	3	0	0	0	0	80	0	0
0	0	50	2	78	1981	45	0	133	974	86	0
2	3	0	0	0	13	0	0	0	687	0	0
0	0	0	0	0	350	0	0	0	44	0	0
0	0	0	0	0	1677	0	0	0	1688	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	207	0	0	0	578	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

WB dep 5028

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
3	20	2336	60	283	35	153	172	821	1941	2	292
13	30	9	0	3	0	0	0	0	80	0	0
0	0	50	2	78	1980	45	0	133	975	86	0
2	3	0	0	0	13	0	0	0	687	0	0
0	0	0	0	0	351	0	0	0	43	0	0
0	0	0	0	0	1677	0	0	0	1689	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	206	0	0	0	578	0	0

Arriving Trains

EB arr 1582

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
2	61	2757	6	97	4	10	0	96	57	0	50
15	151	56	0	0	0	0	0	0	9	0	0
0	10	74	0	26	182	1	0	23	107	7	0
2	4	0	0	5	1	0	0	0	113	0	0
0	0	0	0	0	17	0	0	0	10	0	0
0	0	0	0	0	145	0	0	0	306	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	7	0	0	0	30	0	0

EB dep 0

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

WB arr 1397

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	77	766	8	31	7	180	49	107	637	0	73
6	178	62	0	0	0	0	0	0	7	0	0
0	17	7	0	13	148	56	0	12	276	85	0
8	2	0	0	3	2	0	0	0	58	0	0
0	0	0	0	0	37	0	0	0	0	0	0
0	0	0	0	0	130	0	0	0	232	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	27	0	0	0	68	0	0

WB dep 0

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

Departing s
EB arr 0

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

EB dep 1642

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	61	2840	7	117	3	92	2	79	155	0	57
12	153	54	0	0	0	0	0	0	7	0	0
0	10	70	0	25	117	26	0	22	137	54	0
3	2	0	0	6	1	0	0	0	59	0	0
0	0	0	0	0	17	0	0	0	3	0	0
0	0	0	0	0	78	0	0	0	159	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	15	0	0	0	22	0	0

WB arr 0

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

WB dep 1002

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	64	590	7	11	2	105	1	65	179	0	7
7	178	64	0	0	0	0	0	0	11	0	0
0	17	3	0	9	143	30	0	16	223	50	0
5	2	0	0	2	2	0	0	0	110	0	0
0	0	0	0	0	24	0	0	0	8	0	0
0	0	0	0	0	134	0	0	0	321	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	13	0	0	0	42	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

Arriving anparting Trains

EB arr 987

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	4	608	12	55	4	102	1	106	221	0	19
1	7	4	0	1	0	0	0	0	8	0	0
0	0	24	0	34	262	32	0	21	248	57	0
1	1	0	0	1	1	0	0	0	105	0	0
0	0	0	0	0	48	0	0	0	6	0	0
0	0	0	0	0	200	0	0	0	321	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	35	0	0	0	98	0	0

EB dep 987

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	4	595	11	52	3	95	2	113	211	0	18
2	8	4	0	1	0	0	0	0	7	0	0
0	0	24	0	34	268	34	0	21	227	55	0
0	1	0	0	1	1	0	0	0	72	0	0
0	0	0	0	0	50	0	0	0	5	0	0
0	0	0	0	0	209	0	0	0	282	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	37	0	0	0	93	0	0

WB arr 554

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	2	358	3	34	2	14	1	84	85	0	11
2	4	2	0	1	0	0	0	0	8	0	0
0	1	11	0	6	242	4	0	21	104	5	0
0	0	0	0	2	0	0	0	0	68	0	0
0	0	0	0	0	48	0	0	0	1	0	0
0	0	0	0	0	190	0	0	0	168	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	33	0	0	0	62	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

WB dep	554										
Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	2	316	5	35	3	20	7	96	151	0	22
0	1	1	0	1	0	0	0	0	8	0	0
0	1	11	0	5	247	4	0	22	124	3	0
0	0	0	0	1	1	0	0	0	97	0	0
0	0	0	0	0	48	0	0	0	2	0	0
0	0	0	0	0	191	0	0	0	236	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	32	0	0	0	77	0	0

Power Mo ough

EB arr	52										
Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	19	0	9	0	0	0	12	9	0	0
0	1	0	0	0	0	0	0	0	3	0	0
0	0	0	0	2	33	0	0	2	13	0	0
0	0	0	0	0	0	0	0	0	19	0	0
0	0	0	0	0	6	0	0	0	1	0	0
0	0	0	0	0	18	0	0	0	23	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	0	0	8	0	0

EB dep	52										
Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	21	0	9	0	3	0	14	10	0	1
0	1	0	0	0	0	0	0	0	3	0	0
0	0	0	0	3	34	0	0	2	14	0	0
0	0	0	0	0	0	0	0	0	19	0	0
0	0	0	0	0	7	0	0	0	1	0	0
0	0	0	0	0	17	0	0	0	24	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	4	0	0	0	8	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

WB arr 28

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	4	0	1	1	0	3	19	20	0	5
0	0	0	0	0	0	0	0	0	2	0	0
0	0	0	0	1	8	0	0	3	3	0	0
0	0	0	0	0	0	0	0	0	3	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	11	0	0	0	6	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0	2	0	0

WB dep 28

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	4	0	1	1	0	3	19	20	0	5
0	0	0	0	0	0	0	0	0	2	0	0
0	0	0	0	1	8	0	0	3	3	0	0
0	0	0	0	0	0	0	0	0	3	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	11	0	0	0	6	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0	2	0	0

Power Mo iving
EB arr 11

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	6	0	2	6	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	9	0	0	0	5	0	0
0	0	0	0	0	0	0	0	0	3	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	1	0	0	0	10	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

EB dep	0										
Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

WB arr	0										
Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

WB dep	0										
Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

Power Mo arting

EB arr 0

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

EB dep 26

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	4	0	2	0	5	0	3	10	0	0
0	1	0	0	0	0	0	0	0	2	0	0
0	0	0	0	0	22	4	0	0	14	3	0
0	0	0	0	0	0	0	0	0	4	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	15	0	0	0	19	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	7	0	0

WB arr 0

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	0	0	0

Appendix A-1
Locomotive Model, Tier, and Auto-Start/Stop Technology Frequency by Train Type

WB dep 13

Switch	GP3x	GP4x	GP50	GP60	SD7x	SD90	Dash7	Dash8	Dash9	C60A	Unknown
0	0	3	0	0	0	4	1	3	4	0	1
0	0	0	0	0	0	0	0	0	1	0	0
0	0	0	0	0	7	1	0	0	4	0	0
0	0	0	0	0	0	0	0	0	3	0	0
0	0	0	0	0	1	0	0	0	0	0	0
0	0	0	0	0	2	0	0	0	9	0	0
0	0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0	0	0	0	1	0	0

APPENDIX A-2

LOCOMOTIVE MODEL DISTRIBUTION
BY TRAIN TYPE GROUPS

Appendix A2
Locomotive Model Distribution by Train Type Groups

Through Trains

Tier	AESS/ZTR	Switch	GP3x	GP4x	GP5x	SD60	SD7x	SD90	Dash7	Dash8	Dash9	C60
N	N	0.0001	0.0011	0.1695	0.0037	0.0182	0.0021	0.0075	0.0075	0.0549	0.0998	0.0002
N	Y	0.0009	0.0016	0.0007	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0056	0.0000
0	N	0.0000	0.0000	0.0038	0.0001	0.0053	0.1545	0.0023	0.0000	0.0097	0.0646	0.0043
0	Y	0.0001	0.0003	0.0000	0.0000	0.0000	0.0010	0.0000	0.0000	0.0000	0.0477	0.0000
1	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0263	0.0000	0.0000	0.0000	0.0030	0.0000
1	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.1319	0.0000	0.0000	0.0000	0.1130	0.0000
2	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0161	0.0000	0.0000	0.0000	0.0429	0.0000

Tier	AESS/ZTR	EB Trains										
N	N	0.0001	0.0093	0.4875	0.0026	0.0230	0.0010	0.0214	0.0004	0.0282	0.0462	0.0000
N	Y	0.0022	0.0229	0.0085	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0022	0.0000
0	N	0.0000	0.0014	0.0138	0.0000	0.0085	0.0594	0.0067	0.0000	0.0062	0.0515	0.0124
0	Y	0.0004	0.0006	0.0000	0.0000	0.0009	0.0003	0.0000	0.0000	0.0000	0.0250	0.0000
1	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0095	0.0000	0.0000	0.0000	0.0017	0.0000
1	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0453	0.0000	0.0000	0.0000	0.0766	0.0000
2	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0067	0.0000	0.0000	0.0000	0.0174	0.0000

Tier	AESS/ZTR	WB Trains										
N	N	0.0000	0.0160	0.2243	0.0025	0.0123	0.0016	0.0353	0.0064	0.0389	0.1162	0.0000
N	Y	0.0017	0.0399	0.0143	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0038	0.0000
0	N	0.0000	0.0040	0.0035	0.0000	0.0037	0.0862	0.0104	0.0000	0.0079	0.0803	0.0158
0	Y	0.0014	0.0004	0.0000	0.0000	0.0009	0.0006	0.0000	0.0000	0.0000	0.0368	0.0000
1	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0174	0.0000	0.0000	0.0000	0.0012	0.0000

Appendix A2
Locomotive Model Distribution by Train Type Groups

1	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0713	0.0000	0.0000	0.0000	0.1058	0.0000
2	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	Y	0.0000	0.0000	0.0002	0.0000	0.0000	0.0116	0.0000	0.0000	0.0000	0.0275	0.0000

Tier	AESS/ZTR	Power Moves										
N	N	0.0000	0.0000	0.0345	0.0000	0.0099	0.0000	0.0739	0.0049	0.0394	0.0985	0.0000
N	Y	0.0000	0.0049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0148	0.0000
0	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.1872	0.0246	0.0000	0.0000	0.1133	0.0148
0	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0493	0.0000
1	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0099	0.0000	0.0000	0.0000	0.0000	0.0000
1	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0887	0.0000	0.0000	0.0000	0.1872	0.0000
2	N	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
2	Y	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0443	0.0000

Note: ACE trains are all pre-tier 0 GP-40 equivalents without SmartStart

Note: Yard operation switch and GP-38 SmartStart and tier fractions are the same as observed at the service area.

Appendix A-3
Locomotive Service and Load Tests by Train Type Groups

Locomotives in Service

Service distn

Switch	GP3x	GP4x	GP5x	SD60	SD7x	SD90	Dash7	Dash8	Dash9	C60
0.00241	0.01247	0.38897	0.00284	0.01772	0.00066	0.02778	0	0.02188	0.04704	0
0.0175	0.04157	0.01947	0	0	0	0	0	0	0.00306	0
0	0.00197	0.01685	0	0.00634	0.05644	0.01335	0	0.007	0.06979	0.01553
0.00678	0.00481	0	0	0	0.00044	0	0	0	0.03107	0
0	0	0	0	0	0.00613	0	0	0	0.00175	0
0	0	0	0	0	0.04594	0	0	0	0.09232	0
0	0	0	0	0	0	0	0	0	0.00263	0
0	0	0	0	0	0.00634	0	0	0	0.01116	0

Locomotives Load Tested

LT distn

Switch	GP3x	GP4x	GP5x	SD60	SD7x	SD90	Dash7	Dash8	Dash9	C60
0	0.01282	0.32051	0.01282	0.01709	0	0.03419	0	0.02137	0.04274	0
0	0.11538	0.05128	0	0	0	0	0	0	0.00427	0
0	0	0.00855	0	0	0.04274	0.01709	0	0.00427	0.08974	0.03419
0	0.00427	0	0	0	0.00427	0	0	0	0.02991	0
0	0	0	0	0	0.00427	0	0	0	0	0
0	0	0	0	0	0.04274	0	0	0	0.07692	0
0	0	0	0	0	0	0	0	0	0	0
0	0	0	0	0	0.00427	0	0	0	0.00427	0

APPENDIX A-3

SAMPLE CALCULATIONS

CONFIDENTIAL BUSINESS INFORMATION/TRADE SECRET

Appendix A-3
Sample Calculations

Activity Types	Activity Code	Number of Events/Year	Locomotives per Consist	Emission Factor Group	Locomotives per Consist Working	Fraction of Calif. Fuel
Thru EB Arriving	1	3475	2.582	1	2.582	0.50
Thru EB Departing	2	3475	2.582	1	2.582	0.50
Thru WB Arriving	3	5028	2.954	1	2.954	0.50
Thru WB Departing	4	5028	2.954	1	2.954	0.50
Freight Train EB Arrivals	5	1582	2.807	2	2.807	0.00
Freight Train WB Arrivals	6	1397	2.412	3	2.412	0.00
Freight Train EB Departures	7	1642	2.719	2	2.719	0.90
Freight Train WB Departures	8	1002	2.441	3	2.441	0.90
Other EB Arriving and Departing Arrivals	9	987	2.683	2	2.683	0.50
Other EB Arriving and Departing Departures	10	987	2.573	2	2.573	0.50
Other WB Arriving and Departing Arrivals	11	554	2.847	3	2.847	0.50
Other WB Arriving and Departing Departures	12	554	3.195	3	3.195	0.50
Power Moves Thru EB Arriving	13	52	3.500	1	1.500	0.50
Power Moves Thru EB Departing	14	52	3.750	1	1.500	0.50
Power Moves Thru WB Arriving	15	28	3.393	1	1.500	0.50
Power Moves Thru WB Departing	16	28	3.393	1	1.500	0.50
Power Moves EB Arrivals	17	11	3.909	4	1.500	0.00
Power Moves EB Departures	18	139	4.462	4	1.500	0.90
Power Moves WB Departures	19	69	3.462	4	1.500	0.90
ACE Arrivals	20	782	1.000	5	1.000	1.00
ACE Departures	21	782	1.000	5	1.000	1.00
Yard Operations - SP Yard GP-38	22	365	1.000	6	1.000	1.00
Yard Operations - East Yard South End GP-38s	23	365	2.000	6	2.000	1.00
Yard Operations - East Yard North End Switchers	24	365	2.000	7	2.000	1.00

Appendix A-3
Sample Calculations

Emission Factors Weighted by Model/Tier/ZTR Fractions - DPM g/hr per Locomotive

Consist Groups	Group ID	Idle-NonZTR	Idle-All	DB	N1	N2	N3	N4	N5	N6	N7	N8
California Fuel												
Thru Trains and Power Moves	1	21.77	30.70	60.45	49.24	107.28	219.79	277.30	369.86	517.60	571.39	675.98
EB Trains	2	34.13	39.58	72.52	43.71	120.91	216.58	254.71	336.06	486.18	550.49	695.43
WB Trains	3	26.76	35.21	67.59	48.20	113.08	216.02	266.91	359.40	475.06	515.67	649.31
Power Moves	4	21.02	29.45	61.44	52.24	105.23	222.97	297.83	403.40	497.15	520.70	661.98
ACE Trains	5	47.94	47.94	80.04	35.70	134.30	211.93	228.61	289.68	488.55	584.17	749.94
Yard Operations - GP-38s	6	9.02	38.00	72.00	31.00	110.00	174.13	187.48	230.17	369.15	423.51	555.15
Yard Operations - Switchers	7	2.80	31.00	56.00	23.00	76.00	129.19	140.61	173.27	272.65	315.58	409.05
47-State Fuel												
Thru Trains and Power Moves	1	21.77	30.70	60.45	49.24	107.28	242.03	307.73	414.23	582.93	657.48	783.33
EB Trains	2	34.13	39.58	72.52	43.71	120.91	234.87	283.03	378.56	545.18	618.62	783.10
WB Trains	3	26.76	35.21	67.59	48.20	113.08	237.62	296.21	402.48	535.41	595.78	752.66
Power Moves	4	21.02	29.45	61.44	52.24	105.23	247.71	330.30	450.36	562.19	613.30	781.53
ACE Trains	5	47.94	47.94	80.04	35.70	134.30	224.50	254.62	330.01	543.65	631.56	812.06
Yard Operations - GP-38s	6	9.02	38.00	72.00	31.00	110.00	184.46	208.82	262.22	410.78	457.87	601.13
Yard Operations - Switchers	7	2.80	31.00	56.00	23.00	76.00	136.86	156.61	197.40	303.41	341.18	442.94

Note: Idle-NonZTR is the average per-locomotive idle emission rate for the fraction of locomotives not equipped with ZTR/Auto start-stop technology

Locomotive Model Distributions
Thru Trains and Power Moves

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	**No**	0.0001	0.0011	0.1695	0.0037	0.0182	0.0021	0.0075	0.0075	0.0549	0.0998	0.0002
Pre Tier 0	**Yes**	0.0009	0.0016	0.0007	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0056	0.0000
Tier 0	**No**	0.0000	0.0000	0.0038	0.0001	0.0053	0.1545	0.0023	0.0000	0.0097	0.0646	0.0043
Tier 0	**Yes**	0.0001	0.0003	0.0000	0.0000	0.0000	0.0010	0.0000	0.0000	0.0000	0.0477	0.0000
Tier 1	**No**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0263	0.0000	0.0000	0.0000	0.0030	0.0000
Tier 1	**Yes**	0.0000	0.0000	0.0000	0.0000	0.0000	0.1319	0.0000	0.0000	0.0000	0.1130	0.0000
Tier 2	**No**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	**Yes**	0.0000	0.0000	0.0000	0.0000	0.0000	0.0161	0.0000	0.0000	0.0000	0.0429	0.0000

EB Trains

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0001	0.0093	0.4875	0.0026	0.0230	0.0010	0.0214	0.0004	0.0282	0.0462	0.0000
Pre Tier 0	Yes	0.0022	0.0229	0.0085	0.0000	0.0001	0.0000	0.0000	0.0000	0.0000	0.0022	0.0000
Tier 0	No	0.0000	0.0014	0.0138	0.0000	0.0085	0.0594	0.0067	0.0000	0.0062	0.0515	0.0124
Tier 0	Yes	0.0004	0.0006	0.0000	0.0000	0.0009	0.0003	0.0000	0.0000	0.0000	0.0250	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0095	0.0000	0.0000	0.0000	0.0017	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0453	0.0000	0.0000	0.0000	0.0766	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0067	0.0000	0.0000	0.0000	0.0174	0.0000

WB Trains

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0000	0.0160	0.2243	0.0025	0.0123	0.0016	0.0353	0.0064	0.0389	0.1162	0.0000
Pre Tier 0	Yes	0.0017	0.0399	0.0143	0.0000	0.0002	0.0000	0.0000	0.0000	0.0000	0.0038	0.0000
Tier 0	No	0.0000	0.0040	0.0035	0.0000	0.0037	0.0862	0.0104	0.0000	0.0079	0.0803	0.0158
Tier 0	Yes	0.0014	0.0004	0.0000	0.0000	0.0009	0.0006	0.0000	0.0000	0.0000	0.0368	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0174	0.0000	0.0000	0.0000	0.0012	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0713	0.0000	0.0000	0.0000	0.1058	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0002	0.0000	0.0000	0.0116	0.0000	0.0000	0.0000	0.0275	0.0000

Power Moves

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0000	0.0000	0.0345	0.0000	0.0099	0.0000	0.0739	0.0049	0.0394	0.0985	0.0000
Pre Tier 0	Yes	0.0000	0.0049	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0148	0.0000
Tier 0	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.1872	0.0246	0.0000	0.0000	0.1133	0.0148
Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0493	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0099	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0887	0.0000	0.0000	0.0000	0.1872	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0443	0.0000

ACE Trains

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Yard GP-38s

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0000	0.2374	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre Tier 0	Yes	0.0000	0.7626	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Yard Switchers

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0902	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre Tier 0	Yes	0.9098	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix A-3
Sample Calculations

Track Segment	Segment Number	Length (mi)
Main Line	1	2.2808
South End to East Yard South End	2	0.6048
North End to East Yard North End	3	0.6793
East Yard South End	4	0.4985
East Yard South End to RIP Track	5	0.4783
RIP Track to East Yard North End	6	0.5476
East Yard North End to Service	7	0.3300
Service to North End of Yard	8	0.3532
SP Yard	9	0.9132
East Yard South End Yard Operations	10	0.4985
East Yard North End Yard Operations	11	0.4985
East Yard North End	12	0.4985

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
Thru EB	1 or 2	1	40	1	0	0	1
Thru WB	3 or 4	1	40	2	0	0	1
Freight Train EB Arrivals	5	2	10	3	0	0	1
"	5	4	10	3	0	0	1
"	5	12	10	3	0.5	0.5	0.6
"	5	-12	10	3	0	0	0.4
"	5	-7	10	3	0	0	1
Freight Train WB Arrivals	6	3	10	3	0	0	1
"	6	12	10	3	0	0	1
"	6	4	10	3	0.5	0.5	0.6
"	6	-4	10	3	0	0	0.4
"	6	-5	10	3	0	0	1
"	6	-6	10	3	0	0	1
"	6	-7	10	3	0	0	1
Freight Train EB Departures	7	-7	10	3	0	0	1
"	7	-12	10	3	0	0	0.4
"	7	12	10	3	1.5	0.5	0.4
"	7	3	10	3	0	0	1
Freight Train WB Departures	8	-7	10	3	0	0	1
"	8	-6	10	3	0	0	1
"	8	-5	10	3	0	0	1
"	8	-4	10	3	0	0	0.4
"	8	4	10	3	1.5	0.5	0.4
"	8	2	10	3	0	0	1
Other Arrivals and Departures EB Arriving	9	2	10	3	0	0	1
"	9	4	10	3	0	0	1
"	9	12	10	3	0.5	0.5	0.6
Other Arrivals and Departures EB Departing	10	12	10	3	0	0	0.4
"	10	3	10	3	0	0	1
Other Arrivals and Departures WB Arriving	11	3	10	3	0	0	1
"	11	12	10	3	0	0	1
"	11	4	10	3	0.5	0.5	0.6
Other Arrivals and Departures WB Departing	12	4	10	3	0	0	0.4
"	12	2	10	3	0	0	1
EB Power Moves Thru	13	-1	40	1	0	0	1
WB Power Moves Thru	15	-1	40	2	0	0	1

Appendix A-3
Sample Calculations

Movement Type	Activity Code	Segment Number	Speed (mph)	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Fraction of Segment Moving
EB Power Moves Arriving	17	-2	10	3	0	0	1
"	17	-4	10	3	0	0	1
"	17	-12	10	3	0	0	1
"	17	-7	10	3	0	0	1
EB Power Moves Departing	18	-8	10	3	0	0	1
WB Power Moves Departing	19	-7	10	3	0	0	1
"	19	-12	10	3	0	0	1
"	19	-4	10	3	0	0	1
"	19	-2	10	3	0	0	1
ACE Trains Arriving	20	8	10	3	10	0	1
ACE Trains Departing	21	8	10	3	0	0	1

Notes
(1) Segment numbers listed as negative values are in-yard power moves from arriving trains to service or from service to departing trains
(2) Non-ZTR Idling is the duration of an idle event when units without ZTR continue to idle after ZTR-equipped units have shut down
(3) Idling All is the duration of idling during which all locomotives continue to idle
(4) Fraction of Segment Moving is the fraction of the length of the segment over which the movement occurs
(On departure, power moves from service are assumed to connect to trains 20% of the way into a track segment)

Yard Operations	Activity Code	Duty Cycle Number	Non-ZTR Idle Time (hrs)	ZTR Idle Time (hrs)	Working Time (hrs)
SP Yard (GP-38)	22	4	1	0.5	11
East Yard South End Day and Night Shift Set (GP-38s)	23	4	1.5	1	14
East Yard South End Three-Shift Set (GP-38s)	23	4	2	1	21
East Yard North End Three-Shift Set (Switchers)	24	4	2	1	21

Duty Cycles (Percent of Time by Notch)	Duty Cycle Number	Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8
Thru EB	1	0.0%	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%
Thru WB	2	0.0%	0.0%	0.0%	0.0%	100.0%	0.0%	0.0%	0.0%	0.0%	0.0%
In Yard Movement	3	0.0%	0.0%	50.0%	50.0%	0.0%	0.0%	0.0%	0.0%	0.0%	0.0%
Yard Operations	4	59.8%	0.0%	12.4%	12.3%	5.8%	3.6%	3.6%	1.5%	0.2%	0.8%

Appendix A-3
Sample Calculations

Emission Factors Weighted by Model/Tier/ZTR Fractions - DPM g/hr per Locomotive

Locomotive Model Group	Group ID	Idle-NonZTR	Idle-All	DB	N1	N2	N3	N4	N5	N6	N7	N8
California Fuel (221 ppm S)												
Service (UPRR)	1	30.78	38.72	71.63	44.01	118.46	213.63	253.95	340.53	473.18	526.43	670.80
Load Test (UPRR)	2	29.10	40.13	72.73	44.26	118.00	212.80	250.14	341.16	463.75	508.61	654.99
Load Test (ACE)	3	47.94	47.94	80.04	35.70	134.30	211.93	228.61	289.68	488.55	584.17	749.94
47-State Fuel (2639 ppm S)												
Service (UPRR)	1	30.78	38.72	71.63	44.01	118.46	232.42	282.11	382.94	531.36	595.99	760.32
Load Test (UPRR)	2	29.10	40.13	72.73	44.26	118.00	231.51	277.88	383.55	520.91	576.45	742.19
Load Test (ACE)	3	47.94	47.94	80.04	35.70	134.30	224.50	254.62	330.01	543.65	631.56	812.06

Note: Idle-NonZTR is the average per-locomotive idle emission rate for the fraction of locomotives not equipped with ZTR/Auto start-stop technology

Service and Shop Activity

			Duration of Activity per Locomotive (minutes)											
Activity	**Number of Locomotives**	**Fraction of Calif. Fuel**	**Idle-NonZTR**	**Idle-All**	**DB**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**	
Service - Inbound & Service	4575	0.00	90	30	0	0	0	0	0	0	0	0	0	
Service - Post-Service	4575	0.90	90	30	0	0	0	0	0	0	0	0	0	
Shop - Inbound and Outbound	532	0.90	60	60	0	0	0	0	0	0	0	0	0	
Pre-Maintenance Load Test	63	0.90	0	2	0	0	0	0	0	0	0	0	8	
Post-Maintenance Load Test	63	0.90	0	2	0	0	0	0	0	0	0	0	8	
Quarterly Maintenance Load Tes	112	0.90	0	2	0	0	0	0	0	0	0	0	8	
Unscheduled Mtc Post Test	102	0.90	0	1	0	0	0	0	0	0	0	0	5	
ACE Load Tests	20	1.00	0	2	0	0	0	0	0	0	0	0	8	

Appendix A-3
Sample Calculations

Locomotive Model Distributions
Locomotives Serviced

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0024	0.0125	0.3890	0.0028	0.0177	0.0007	0.0278	0.0000	0.0219	0.0470	0.0000
Pre Tier 0	Yes	0.0175	0.0416	0.0195	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0031	0.0000
Tier 0	No	0.0000	0.0020	0.0169	0.0000	0.0063	0.0564	0.0134	0.0000	0.0070	0.0698	0.0155
Tier 0	Yes	0.0068	0.0048	0.0000	0.0000	0.0000	0.0004	0.0000	0.0000	0.0000	0.0311	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0061	0.0000	0.0000	0.0000	0.0018	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0459	0.0000	0.0000	0.0000	0.0923	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0026	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0063	0.0000	0.0000	0.0000	0.0112	0.0000

Locomotives Load Tested

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0000	0.0128	0.3205	0.0128	0.0171	0.0000	0.0342	0.0000	0.0214	0.0427	0.0000
Pre Tier 0	Yes	0.0000	0.1154	0.0513	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0043	0.0000
Tier 0	No	0.0000	0.0000	0.0086	0.0000	0.0000	0.0427	0.0171	0.0000	0.0043	0.0897	0.0342
Tier 0	Yes	0.0000	0.0043	0.0000	0.0000	0.0000	0.0043	0.0000	0.0000	0.0000	0.0299	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0043	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0427	0.0000	0.0000	0.0000	0.0769	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0043	0.0000	0.0000	0.0000	0.0043	0.0000

ACE Locomotives

Technology	ZTR/AESS	Switcher	GP-3x	GP-4x	SD-50	GP-60	SD-7x	SD-90	Dash 7	Dash 8	Dash 9	C-60
Pre Tier 0	No	0.0000	0.0000	1.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Pre Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 0	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 1	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	No	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tier 2	Yes	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000

Appendix A-3
Sample Calculations

Example 1 -- WB Arriving Freight Train

Parameter	Value
Activity Code	6
Number of Events	1397
Locomotives per Consist on Train	2.412
Locomotives per Consist Working During Power Moves	1.5
Emission Factor Group	3
Fraction of Calif. Fuel	0.00

Route Followed	Segment Number	Length (miles)	Speed (mph)	Power Move	Non-ZTR Idle (hrs)	ZTR Idle (hrs)	Fraction of Segment Moving	Locomotive Hours Moving	Locomotive Hours NonZTR Idle	Locomotive Hours ZTR Idle
North End to East Yard North End	3	0.679	10	N	0	0	1	228.89	0.00	0.00
East Yard North End	12	0.499	10	N	0	0	1	167.97	0.00	0.00
East Yard South End	4	0.499	10	N	0.5	0.5	0.6	167.97	1684.78	1684.78
East Yard South End	-4	0.499	10	Y	0	0	0.4	104.46	0.00	0.00
East Yard South End to RIP Track	-5	0.478	10	Y	0	0	1	100.23	0.00	0.00
RIP Track to East Yard North End	-6	0.548	10	Y	0	0	1	114.75	0.00	0.00
East Yard North End to Service	-7	0.330	10	Y	0	0	1	69.15	0.00	0.00
Total								*3.43*	*1684.78*	*1684.78*

Emission Factors	Group ID	Idle-NonZTR	Idle-All	DB	N1	N2	N3	N4	N5	N6	N7	N8
WB Trains - Calif Fuel	3	26.76	35.21	67.59	48.20	113.08	216.02	266.91	359.40	475.06	515.67	649.31
WB Trains - 47-State Fuel	3	26.76	35.21	67.59	48.20	113.08	237.62	296.21	402.48	535.41	595.78	752.66
CA Fuel-Fraction Adjusted Rates		*26.76*	*3 .21*	*67.*	*48.20*	*113.08*	*237.62*	*2 6.21*	*402.48*	*3 .41*	*.78*	*7 2.66*
Duty Cycle Moving	3	0%	0%	0%	50%	50%	0%	0%	0%	0%	0%	0%
Weighted g/hr emissions		0	0	0	24.1	56.54	0	0	0	0	0	0

Appendix A-3
Sample Calculations

	Moving	Idle-NonZTR	Idle-All
Emission Rate (g/hr)	80.64	26.76	35.21
Locomotive Hours	953.43	1684.78	1684.78
Total Emissions (g/yr)	**76885**	**45085**	**59321**

Example 2 -- Quarterly Maintenance Load Testing

Number of Quarterly Maintenance Load Tests	112
Fraction of Calif. Fuel	0.90

Emission Factors (g/hr)	**Group ID**	**Idle-NonZTR**	**Idle-All**	**DB**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**
UPRR Load Test - CA Fuel	2	29.10	40.13	72.73	44.26	118.00	212.80	250.14	341.16	463.75	508.61	654.99
UPRR Load Test - 47-State Fuel	2	29.10	40.13	72.73	44.26	118.00	231.51	277.88	383.55	520.91	576.45	742.19
CA Fuel-Fraction Adjusted Rates		*2 .10*	*40.13*	*72.73*	*44.26*	*118.00*	*214.67*	*2 2. 1*	*34 .40*	*46 .47*	*1 .3*	*663.71*

								Duration (minutes)				
Activity	**Number of Locomotives**	**Idle-NonZTR**	**Idle-All**	**DB**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**
Quarterly Maintenance Load Test	112	0	2	0	0	0	0	0	0	0	0	8
Emissions (g)												
Notch-Specific		0.0	149.8	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9911.4

Total Emissions (g/yr)	**10061**

APPENDIX A-4

METHODOLOGY FOR ESTIMATING LOCOMOTIVE EMISSIONS AND GENERATING AERMOD EMISSION INPUTS

Appendix A-4

Methodology for Estimating Locomotive Emissions and Generating AERMOD Emission Inputs

Overview

This appendix describes the general procedures followed for developing locomotive emission inventories for the Union Pacific Railroad (UPRR) rail yards under the Memorandum of Understanding with the California Air Resources Board. It also describes the procedure by which the emission inputs for both locomotive and non-locomotive sources used in AERMOD dispersion modeling.

EMISSION CALCULATIONS

This section describes the details of the development of activity inputs, emission factors, and emission estimates for locomotive operations. Separate procedures are followed for estimating activity associated with locomotives on trains, locomotive consist movements within a yard, service and shop activity (if occurring at a specific yard), and yard switching operations within a yard. Emission factors are developed for each of the types of locomotive activity based on the model and technology distribution of locomotives involved in each activity. Emission estimates are then developed for the activities and specific areas of a yard in which each activity occurs. The data used to calculate these emissions are included in the Appendix A-3 Excel workbook, which includes a "Sample Calculations" worksheet showing the linkages between the various activities, emission factors, and operating characteristics data.

Train Activity

Train activity data for emissions calculations includes a number of separate components:

- The number of trains arriving, departing, or passing through a yard, broken down by type of train
- The average composition of working locomotives in each consist[1], including the fraction of locomotives of different models, emissions technology tier, and automatic idling control equipment[2]
- The identification of routes followed for different types of train activities

[1] The term "consist" refers to the group of locomotives (typically between one and four) that provide power for a specific train.

[2] Two types of automatic idling control equipment are in use, known as ZTR SmartStart (typically retrofit equipment on low horsepower units) and AESS (typically factory installed on newer high horsepower units). Both are programmed to automatically shut of the engines of parked idling locomotives after a specified period of time, and to restart the unit if any of a number of operating parameters (battery state, air pressure, coolant temperature, etc.) reach specified thresholds.

- Identification of the speeds and throttle settings for different types of train activities in different locations.

The primary source of information for estimating train activity is a database identifying the arrival and departure of locomotives at a specific yard. This database identifies locomotives by their ID numbers and models, the status on the train (working or not working), and the specific train to which they are connected. From these data, the total numbers of trains of different types are identified based on train symbols, train dates, train origination and termination indicators, and dates and times of arrival and departure. For each type of train and activity, the average number of locomotives per consist is calculated along with the distribution of locomotive models, emission technology tiers, and automatic idling control equipment. A separate database of UPRR locomotives is consulted based on locomotive ID to determine the tier and date of any retrofits of automatic idling controls to complete the development of these model distributions. The activity data so derived are shown on the "Activities" worksheet in the Appendix A-3 Excel workbook, and the model and technology distributions are shown on the "Consist Emissions" worksheet.

The types of trains to be identified can vary from yard to yard. For all yards, through trains (which bypass the yard itself on mainline tracks adjacent to the yard) are identified. Depending on the yard, trains entering or departing from the yard can be of several types, including:

- Intermodal trains
- Automobile trains
- "Manifest" or freight trains
- Local trains
- Power moves

Power moves are trains consisting only of locomotives which are either arriving at the yard to be serviced or used for departing trains, or departing from the yard to be serviced at another location or used for trains departing from another location. The routes followed by each type of train on arrival and departure are identified in consultation with UPRR yard personnel, along with estimates of average speeds and duty cycles (fraction of time spent at different throttle settings) for different areas.

Specific track subsections are identified by UTM coordinates digitized from georeferenced aerial photographs. The segments identified and their lengths are shown on the "Track Segments" worksheet of Appendix A-3. For each train type, direction, and route, a listing of track segments, segment lengths, and duty cycles is developed. Duty cycles are shown on the "Consist Emissions" worksheet of Appendix A-3, and the segment speeds, duty cycles, idling durations are shown on the "Movements and Yard Operations" worksheet. This listing, along with the number of locomotives per consist and number of trains of each type, allows calculation of the number of locomotive hours in each duty cycle to be calculated for each section of track. For arriving and departing trains, estimates of the duration of idling were developed in consultation with UPRR personnel. These idling periods were divided into two parts – the assumed amount of time that all locomotives in a consist would idle on arrival or departure, and the amount of time that only locomotives not equipped with automatic idle controls would idle. Idling periods were assigned to a segment of the arrival or departure track one fifth of the length of the track at the appropriate end.

Service and Shop Activity

If there is a service track and/or shop at a yard, locomotives (including both road power from trains as well as yard switchers) undergo a variety of activities at these locations. If present at a yard, details of the service and shop activity, model distributions, and emission factors are shown on the "Service and Shop" worksheet of Appendix A-3. Specific locomotive activities involve idling while awaiting or undergoing routine service (cleaning, refueling, oiling, sanding, and other minor maintenance), movement and idling between service and maintenance areas, and stationary load testing associated with specific types of maintenance events. A database of service events at individual yards identifies the number of service events during the year, the locomotive ID and model, and the nature of servicing performed. Routine servicing involves periods of idling prior to and during service, and additional idling prior to movement of consists to departing trains in the yard. Estimates of the duration of idling associated with servicing are developed in consultation with UPRR personnel. As was done for trains, these idling periods were separated into two parts, the average total duration of idling by all locomotives, and the average duration of additional idling by locomotives not equipped with automatic idling controls.

The database also specifically identifies load test events and the type of maintenance with which the load testing is associated. These types include planned maintenance at different intervals (e.g., quarterly, semiannual) as well as unscheduled maintenance which may involve both diagnostic load testing prior to maintenance and post-maintenance load testing. The duration of load test events in each throttle setting depend on the equipment available and types of maintenance performed at the yard. Estimates of these durations, as well as the identification of load testing activity by type of load test and the time and duration of any additional idling and movements are developed in consultation with UPRR personnel.

A total number of events (servicing and load testing by location and type) are developed from these data, as are locomotive model and technology distributions for all locomotives serviced and for those specific locomotives undergoing load testing (if applicable). From these event counts and durations, the total number of hours of locomotive idling and higher throttle setting operation in different portions of the service areas are calculated for each of the two model distributions.

Yard Switcher Activity

In each yard, there are routine jobs assigned to individual switchers or sets of switchers. These activities are generally not tracked from hour to hour, but they occur routinely within yard boundaries during specified work shifts. Similarly, the specific yard switcher locomotive IDs assigned to these jobs are not routinely tracked, but these yard jobs are generally assigned to a specific model of low horsepower locomotive. From the assigned yard switcher jobs and shifts, and in consultation with UPRR personnel, an estimate of the hours per day of switcher operation in a yard are developed, along with the specific times of day when these activities occur (time of day assignments were made only if operation was less than 24 hour per day). Duty cycles for switching operation are also developed in consultation with local UPRR personnel. Depending on the type of activity and type of trains being handled in a yard, duty cycle estimates may vary. In the absence of more detailed information, the USEPA switcher duty cycle is assumed to be representative of each switcher's operation[3]. The total number of locomotive hours of operation for each model are calculated and assigned to the areas in which the units work. In some cases, yard jobs are assigned to specific areas within the yard and specific models of locomotives. In these cases, the switcher activities are assigned specifically to these areas of the yard.

Emission Factor Development

The locomotive model and technology group distributions derived in the development of activity data are grouped by type or types of activity with consideration for the level and nature of the activity. For example, a single distribution is used for through trains of all types, including power moves, while consist model distributions for different types of trains within a yard may be treated as separate distributions if they are handled in different areas of a yard. As shown in Part VII of this report model-group-specific emission factors by throttle setting were developed based on emission test data and sulfur content adjustment factors. From these emission factors and the locomotive model and technology distributions for different types of trains and activities, weighted average emission factors are calculated for the "average" locomotive for that train type or activity on a gram per hour basis. For each train type or activity, two separate idle emission rates are calculated. The first is the straight weighted average emission rate for all locomotives, while the second is the weighted average only for the fraction of locomotives without automatic idle controls. Mathematically,

$$\bar{Q}(l) = \sum_{i=1}^{11}\sum_{j=1}^{4}\sum_{k=1}^{2} F(i,j,k)\ \ Q(i,j,l)$$

for l corresponding to idle through N8, and

$$\bar{Q}(l^*) = \sum_{i=1}^{11}\sum_{j=1}^{4} F(i,j,1)\ \ Q(i,j,l^*)$$

for idling emission rate during periods when only locomotives without automatic idle controls are idling

where

[3] USEPA (1998). Locomotive Emission Standards -- Regulatory Support Document. (Available at *www.epa.gov/otaq/regs/nonroad/locomotv/frm/locorsd.pdf*).

$\overline{\overline{Q}}(l)$ = weighted average emission factor for throttle setting l

$Q(i,j,l)$ = the base g/hr emission factor of a particular model group/technology class and throttle setting

$F(i,j,k)$ = the fraction of locomotives of a particular model group/technology class

i = model group index (Switcher, GP-3x, etc.)

j = technology tier index (pre-Tier 0, Tier 0, Tier 1, Tier 2)

k = automatic idle control status index (with or without)

l = throttle setting (idle, N1, . . ., N8)

l^* = index for idle throttle of locomotives without automatic idle controls.

Thus, for each defined locomotive model distribution, gram per hour emission factors are generated for each throttle setting.

Emission Calculations - Locomotive Movements

From the train activity analysis, the following data are available for each segment of track: track length of segment $L(i)$; speed $V(i)$; movement duty cycle $\mathbf{D}(i)$ (a vector of fractions of time spent in each throttle setting); number of trains of each type $N(j)$; and number of working locomotives per consist for each train type $C(j)$. For each type of train j, there is a set of throttle-specific emission factors $Q_j(l)$ for the "average" locomotive used on that train type. If a particular type of train or consist movement can follow multiple paths within the yard, the activity is allocated to sequences of track segments representing each such path. Total annual emissions $q_{tot}(i)$ for each segment are then calculated as

$$q_{tot}(i) = \frac{L(i)}{V(i)} \cdot \sum_j N(j) \cdot C(j) \sum_l D(i,l) \quad Q_j(l) \; .$$

Emission Calculations - Locomotive Idling

Locomotive idling is calculated in a similar manner for road power and locomotives in service. For each train type and for service events, activity data provide a number of annual events $N(i)$, duration of idling by locomotives with ($T_{all}(i)$) and without ($T_{nZTR}(i)$)automatic idle control, and gram per hour emission rates for the "average" locomotive $Q_{all}(i)$, and the "average" locomotive excluding those with automatic idle controls $Q_{nZTR}(i)$. Total annual emissions are calculated as

$$q_{idle} = \sum_i \; N(i) \cdot \; C(i) \cdot \; (T_{all}(i) \cdot Q_{all}(i) + T_{nZTR}(i) \cdot Q_{nZTR}(i)) \; .$$

If a particular type of activity occurs at multiple locations within the yard (e.g., on multiple arrival or departure tracks), then the idling time is allocated to different segments of track as appropriate so that segment-specific emissions are obtained.

Emission Calculations - Load Testing

Load testing emissions are calculated separately for each throttle setting (idle, N1 and N8) using the weighted average emission factors for the load-tested units, the number of load tests of different types, and the duration of testing in each throttle setting for each type of test.

Emission Calculations - Yard Switcher Operations

Activity data provide the number and model group information for yard switchers, and the number of operating hours per day. Model-group specific emission factors are multiplied by the duty cycle to generate weighted average gram per hour emissions for idling and for combined emissions from operation in notch 1 through notch 8. Emissions are calculated directly from the number of units, hours per day working, and duty cycle weighted emission factors for both idle and non-idle throttle settings during work shifts.

AERMOD EMISSION INPUT PREPARATION

Emissions from both locomotives and from other emission sources in a yard are allocated to multiple individual point or volume sources in AERMOD inputs. In addition to each type of activity's emission rates, the locations of emissions, the release parameters, and other inputs (e.g., building downwash parameters, temporal variation in emissions, etc.) are required by AERMOD. Emission inputs are prepared sequentially for different types of activities and the areas within which they occur. The source elevation for each point or volume source is interpolated from a high resolution terrain file.

Locomotive Movements

For each type of locomotive movement, emissions calculated for each track segment are uniformly allocated to a series of evenly spaced volume sources along that track segment. The maximum spacing between sources is specified and the number of sources to be used for each segment is calculated from the segment length. The raw emission rate value in the AERMOD inputs (g/sec) is based directly on the annual emission total for the segment divided by the number of sources on that segment. For locomotive movements, separate day and night release parameters are needed. Therefore, each source is duplicated (but with a different source ID and parameters) in the AERMOD inputs, with temporal profile inputs (EMISFACT HROFDY) that use day time parameters from 0600-1800 and night time parameters for 1800-0600.

Locomotive Idling and Load Testing

Locomotive idling and load testing emissions are allocated to track segments in the same manner as locomotive movements, but as point, rather than volume sources. Each source location may have up to three separate sources identified, with different stack parameters used for idle, notch 1 and notch 8. Building downwash inputs are assigned from a pre-

prepared set of records for a typical locomotives dimensions and the orientation of the track segment on which the emissions occur.

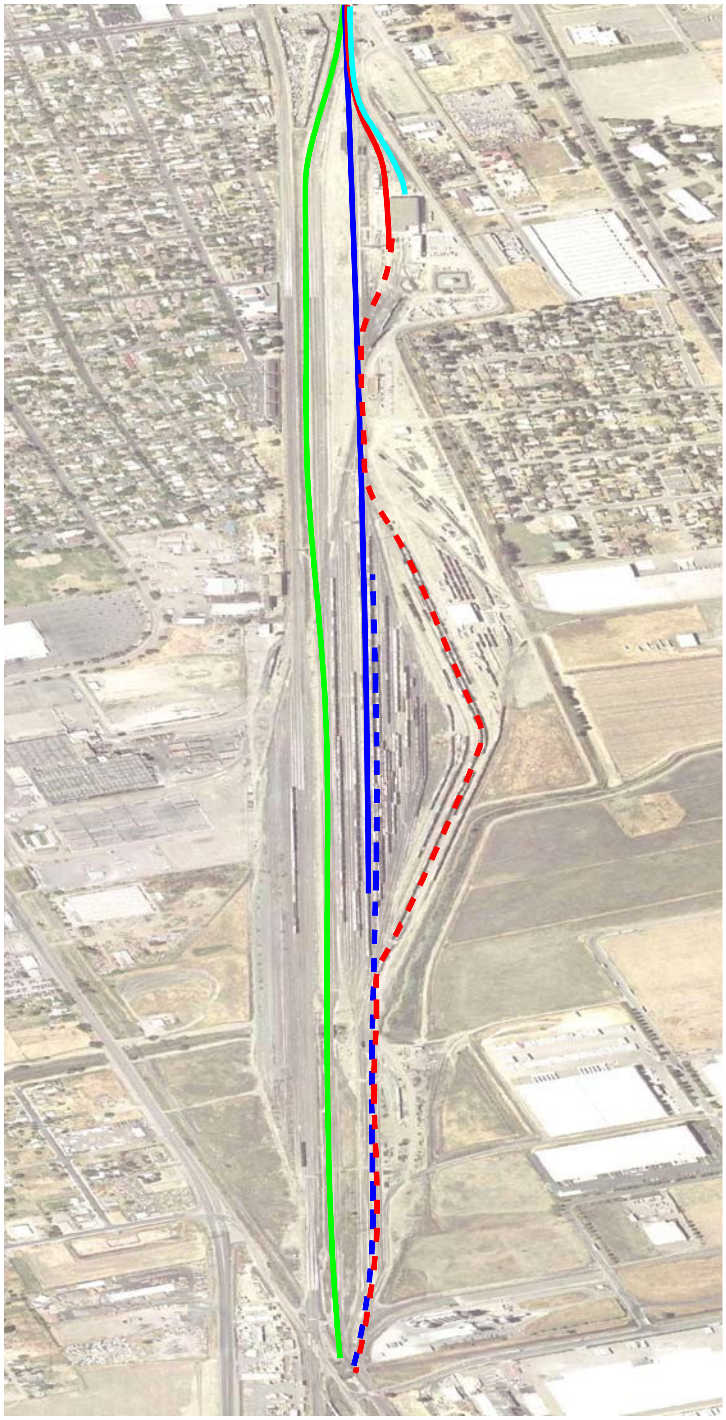
Yard Switcher Operations

Yard switcher operations are allocated to areas within the yard based on the estimated time spent working in each area. As for locomotive movements, yard switcher emissions for a specific area are allocated uniformly to a number of volume sources on defined segments. Day and night operations are handled similarly to train and consist movements, with EMISFACT HROFDY records used to switch day and night volume source release parameters. Depending on their magnitude and distance from yard boundaries, the "working idling" emissions for yard switching may be added to the non-idle emissions from volume sources, or treated as a series of point sources, using stack parameters for the specific model group being used. If treated as point sources, building downwash inputs are prepared as for other locomotive idling and load testing.

APPENDIX A-5

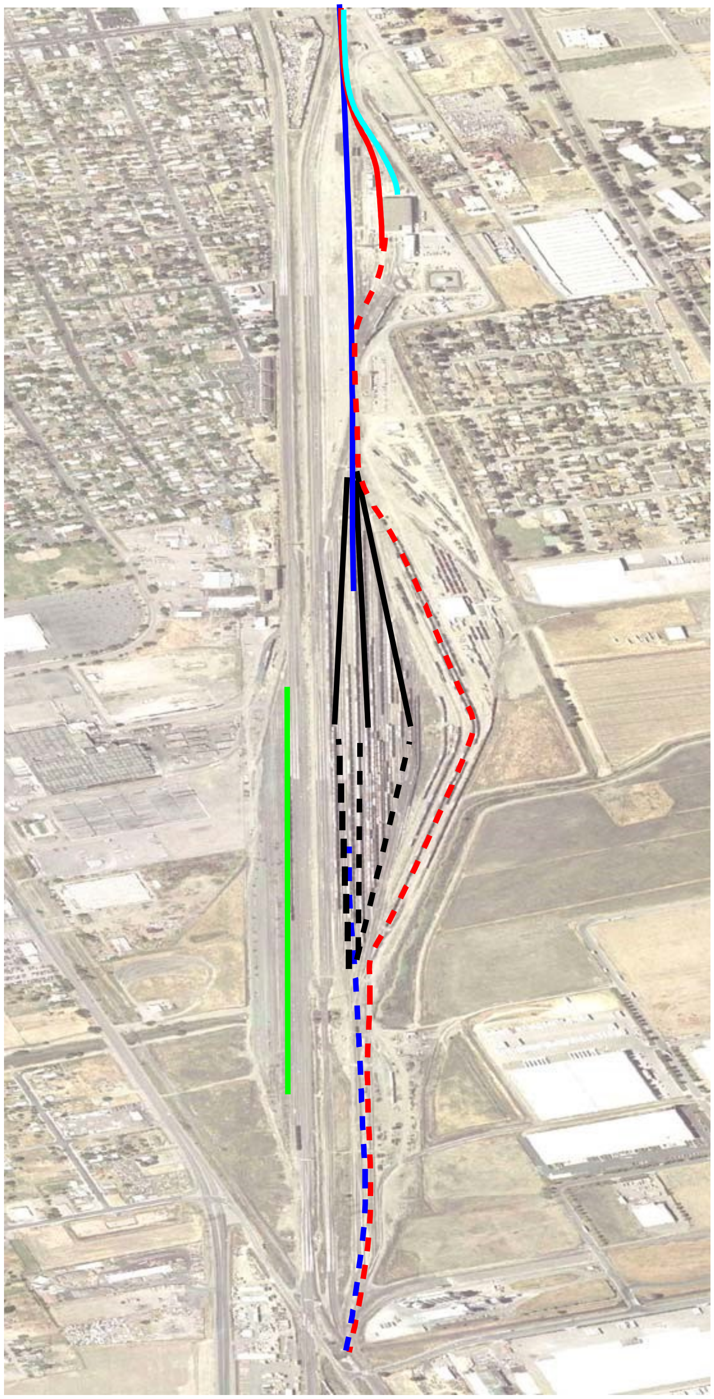
PRINCIPLE LOCOMOTIVE ROUTES

UPRR Stockton Through and Arriving Train Routes
[Note - Horizontal Scale Expanded]



Through Trains North and Southbound (Green)
Freight Train Northbound Arrivals (Dashed Blue)
Freight Train Southbound Arrivals (Solid Blue)
Power Moves Northbound Arrivals (Dashed Red)
Power Moves Southbound Arrivals (Solid Red)
ACE Train Arrivals (Light Blue)

UPRR Stockton Departing Train Routes and Yard Operations Areas



Freight Train Northbound Departures (Solid Blue)
Freight Train Southbound Departures (Dashed Blue)
Power Moves Northbound Departures (Solid Red)
Power Moves Southbound Departures (Dashed Red)
ACE Trains (Light Blue)
SP Yard Switch Operations (Green)
East Yard South End Switch Operations (Black Dashed)
East Yard North End Switch Operations (Black Solid)

APPENDIX A-6

IRESON ET AL

Development of Detailed Railyard Emissions to Capture Activity, Technology and Operational Changes

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ABSTRACT

Railyard operations involve a variety of complex activities, including inbound and outbound train movements, classification (i.e., separating cars from inbound trains for redirection to multiple destinations, and building new trains), and servicing locomotives. Standard locomotive duty cycles provide long-term average activity patterns for locomotive operations, but they are not appropriate for the specialized activities that occur within railyards or at locations such as ports, and emission densities in such areas can be high relative to those of line haul activities. There are significant emission rate differences between locomotive models, and differences in the types of service for which specific models are used. Data for throttle-specific emissions, activity levels, and locomotive models and operating practices can be used to provide more accurate emissions estimates for such operations. Such data are needed to quantify actual emissions changes in these high activity areas. A calculation scheme has been developed to generate detailed emission inventories based on the types of data that are collected for managing rail operations. This scheme allows improved accuracy in emissions estimation, and also provides a more reliable basis for bottom-up tracking of emissions changes over time. Factors that can be addressed include: changes in the distribution of locomotive models and control technology levels (e.g., increasing fractions of Tier 0, 1, and 2 locomotives) for both line haul and local operations; actual in-yard idling duration and reductions associated with auto-start-stop technologies; fuel quality effects; and detailed operating practices for switching and train-building operations. By providing detailed disaggregation of activity and emissions data, the method also makes it possible to quantify and evaluate the effects of specific emission reduction alternatives.

INTRODUCTION

Freight movement by rail is a key component of the U.S. transportation infrastructure. The combination of rail's low rolling resistance and the fuel-efficient turbocharged diesel engines used in modern locomotives make rail the most efficient mode of transport from both an emissions and economic perspective. Railyards located strategically through the nation's rail network are used to assemble and direct goods movement to their destinations. Railyards may handle dozens of trains per day, each powered by a "consist" of several locomotives. While in railyards, these locomotives are serviced and regrouped into new consists as needed for specific departing trains. In addition to train arrivals and departures and locomotive servicing, so-called "classification" yards separate rail cars in inbound trains into segments with different destinations, and build new trains with a common destination. This work is accomplished by switcher locomotives (typically of lower horsepower than the locomotives used for "line-haul" operations). Some railyards also have major locomotive repair facilities whose activities include load testing of locomotives prior to or after maintenance. Collectively, the locomotive operations associated with these activities can result in relatively high localized emission densities.

The Union Pacific Railroad (UPRR) is the largest railroad in North America, operating throughout the western two-thirds of the United States. It operates a number of railyards throughout its system, including the J. R. Davis Yard in Roseville, California. The Davis Yard is UPRR's largest classification yard in the western U.S. It is approximately one-quarter mile wide and four miles long, and is visited by over 40,000 locomotives per year. The California Air Resources Board (CARB) recently completed a detailed dispersion modeling study to estimate concentrations of diesel particulate matter in the vicinity of the railyard.[1] UPRR cooperated closely with CARB in this study, including the identification, retrieval and analysis of data needed to assemble a detailed emission inventory for railyard operations. This effort produced the most detailed emission inventory for railyard operations to-date, including empirically developed train counts, locomotive model distributions, locomotive service and maintenance activities, and dedicated on-site switching operations. The results of this effort have been further adapted to allow UPRR to track the effect of locomotive fleet modernization, freight volume, and operational changes on emissions, and to identify opportunities for further emission reductions at the Davis Yard.

RAILYARD ACTIVITY ESTIMATION

At state and national levels, locomotive emissions have been estimated using locomotive fleet population data and average locomotive emission factors, expressed in g/bhp-hr, in conjunction with fuel efficiency estimates and fuel consumption. For freight locomotives, the emission factors are typically derived using both a switching duty cycle and a line haul duty cycle, each of which gives the fraction of operating time locomotives spend at different throttle settings, referred to as notch positions.[2] These throttle settings (see Table 1) include idle, notches 1 through 8, and dynamic braking (in which the locomotive traction motors are used to generate power which is dissipated through resistor grids). While this approach can provide reasonable estimates for larger regions, neither the overall locomotive fleet composition nor the standard duty cycles accurately reflect the specific activities that occur within an individual railyard. The g/bhp-hr emission factors vary substantially between throttle settings and between locomotive models. Other confounding factors include: speed limits within yards (which preclude the high throttle settings used for line-haul activity outside of yards); locomotive load (consists commonly move within yards with only one locomotive pulling and no trailing cars); and time spent either shut down or idling. Classification activities are carried out with duty cycles that are unique to yard operations and may vary from yard to yard. To develop more accurate emissions estimates, it is necessary to explicitly identify railyard activities at the level of individual locomotives.

Table 1. Locomotive Duty Cycles.

	Throttle Position (Percent Time in Notch)									
Duty Cycle	**D.B.**	**Idle**	**N1**	**N2**	**N3**	**N4**	**N5**	**N6**	**N7**	**N8**
EPA Line-Haul	12.5	38.0	6.5	6.5	5.2	4.4	3.8	3.9	3.0	16.2
EPA Switch	0.0	59.8	12.4	12.3	5.8	3.6	3.6	1.5	0.2	0.8
Trim Operations	0.0	44.2	5.0	25.0	2.3	21.5	1.5	0.6	0.0	0.0
Hump Pull-Back	0.0	60.4	12.5	12.4	5.9	3.6	3.6	1.5	0.0	0.0
Hump Push	0.0	0.0	0.0	100	0.0	0.0	0.0	0.0	0.0	0.0
Consist Movement	0.0	0.0	50.0	50.0	0.0	0.0	0.0	0.0	0.0	0.0
Load Tests:										
10-Minute	0.0	20.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	80.0
15-Minute	0.0	33.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	66.7
30-Minute	0.0	33.3	33.3	0.0	0.0	0.0	0.0	0.0	0.0	33.3

To accomplish this, UPRR reviewed the types of databases available for its operations to identify where explicit emission-related activity information could be generated for the Davis Yard. UPRR operates approximately 7000 locomotives over a network spanning 23 states. Large amounts of data are generated and retained by UPRR for management purposes. These include tracking the location and status of capital assets (e.g., locomotives and rail cars), tracking performance of specific activities, and managing operations. These databases can be queried for data records specific to the Davis Yard, but their content does not directly relate to emissions. Where possible, data providing a complete record of emissions-related events (e.g., locomotive arrivals and departures) were identified and retrieved. Where 100 percent data for an activity could not be obtained (e.g., locomotive model number for each arriving locomotive), distributions were developed based on available data. In some cases, data are not available for specific types of emission events (e.g., the duration of idling for individual trains prior to departure). In these cases, UPRR yard personnel were consulted to derive estimates of averages or typical operating practices.

Railyard Operations - Inbound and Outbound Trains

The majority of locomotive activity in a railyard arises from inbound and outbound freight traffic. Following arrival, consists are decoupled from their trains in receiving areas and are either taken directly to outbound trains, or more commonly, are sent through servicing which can include washing, sanding, oiling, and minor maintenance prior to connecting to outbound trains. Some fraction of trains arriving at a yard simply pass through, possibly stopping briefly for a crew change. UPRR maintains a database that, when properly queried, can produce detailed information regarding both arriving and departing trains. Table 2 lists some of the key parameters that are available in this database. In this study, 12 months of data were obtained for all trains passing through the Davis Yard. The extracted data (over 60,000 records) included at least one record for every arriving and departing train, and each record contained specific information about a single locomotive, as well as other data for the train as a whole. The data were processed using a commercial relational database program and special purpose FORTRAN code to identify individual train arrivals and departures and train and consist characteristics.

Table 2. Selected Train Database Parameters.

	Used to Identify				
Parameter	Identification of Train Events	Location in Railyard	Consist Composition	Temporal Profile	Train Characteristics
Train Symbol	X	X			
Train Section	X				
Train Date	X				
Arrival or Departure	X	X			
Originating or Terminating	X	X			
Direction		X			
Crew Change?		X			
Arrival & Departure Times				X	
# of Locomotives			X		
# of Working Locomotives			X		
Trailing Tons					X
Locomotive ID #			X		
Locomotive Model			X		

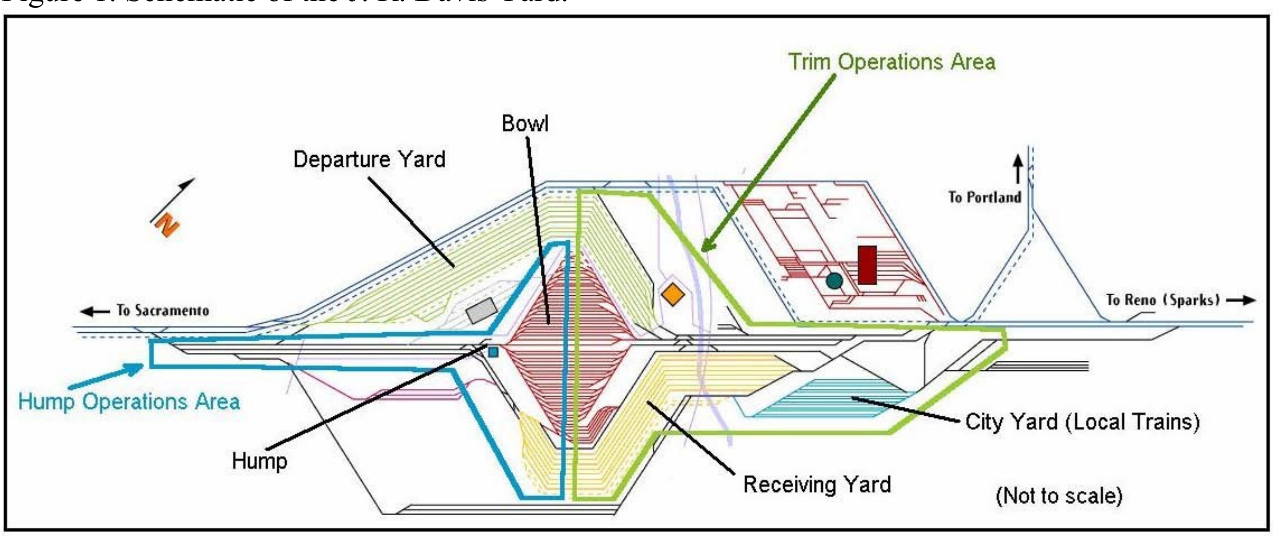
The parameters listed in Table 2 were used to calculate the number of trains by time of day arriving or departing from each area of the yard, as well as average composition of their consists (number of locomotives and distribution of locomotive models). The combination of train symbol, train segment, and train date provided a unique identifier for a single arrival or departure, and the individual locomotive models were tabulated to generate model distributions. Where necessary, working horsepower and total horsepower were used to estimate the number of working locomotives in the consist.

Emission calculations associated with inbound and outbound trains included both periods of movement within the yard boundaries and locomotive idling while consists we connected to their trains. Based on train direction and the location of its arrival or departure, moving emissions were based on calculations of time at different throttle settings based on distance traveled and estimated speed profiles, considering speed limits on different tracks. Yard operators provided estimates for the average duration of such idling for both inbound and outbound trains.

Railyard Operations - Classification

On arrival, inbound trains are "broken" into sections of rail cars destined for different outgoing trains. Figure 1 shows a schematic diagram of the Davis Yard including a large central "bowl" consisting of a large number of parallel tracks connected by automated switching controls to a single track to the west. Trains are pulled back to the west and then pushed to the "hump," a slightly elevated portion of track just west of the bowl. As cars pass over the hump, they are disconnected and roll by gravity into the appropriate track in the bowl. Dedicated special purpose locomotives, known as "hump sets," are used in this operation. Unlike most locomotives, these units have continuously variable throttles, rather than discrete throttle notch settings, to allow precise control of speed approaching the hump. Switching locomotives, known as "trim sets" are responsible for retrieving the train segments or trains being "built" in the bowl and moving them to the appropriate outbound track. The Davis Yard operates a fixed number of hump sets and trim sets at any given time, with backup sets standing by for shift changes and possible breakdowns.

Figure 1. Schematic of the J. R. Davis Yard.



Emission calculations for hump and trim operations were based on the number of working hump and trim sets at any given time, plus assumed idling times of standby units. For the hump sets, yard operators provided estimates of average pull-back and pushing times, and the duty cycles associated with these operations. For pull-back, based on distance and speed limits, the EPA switcher duty cycle, excluding notch 7 and 8 was used. Pushing is conducted at the equivalent of notch 2. For the trim sets, speed limits within the Yard preclude any high throttle setting operation, but there is a greater time spent in mid-throttle settings than reflected in the EPA switcher cycle. A revised duty cycle was developed for these units based on the EPA switcher duty cycle, with high throttle fractions (notches 7 and 8) excluded, but with increased notch 1 and notch 4 operating time. These duty cycles are also shown in Table 1.

Railyard Operations - Consist Movement, Service, Repair and Testing

After disconnecting from inbound trains, consists move to one of several servicing locations for refueling and other maintenance, following designated routes in the yard. Typically, one locomotive in each consist will pull the others, with throttle settings at notch 1 or 2. Based on distance and speed limits, movement times were estimated for each route, and emissions calculated using the number of locomotives following each route.

While being serviced, locomotives may be either idling or shut down. Locomotives must be idling while oil and other routine checks are performed. In addition, since locomotive engines are water-cooled and do not use antifreeze, they are commonly left idling during cold weather conditions. New idling reduction technologies known as SmartStart and AESS provide computer-controlled engine shut down and restart as necessary, considering temperature, air pressure, battery charge, and other parameters. Yard personnel provided estimates of the average potential duration of idling associated with different servicing events. Databases for service and maintenance activities maintained by UPRR provide details on the number and types of service events at different locations in the yard. As for train activity, these data were processed with a commercial relational database program and special purpose FORTRAN code to characterize and tabulate service events. These results were used in conjunction with data for the number of inbound and outbound consists to estimate total idling emissions for different service event types and locations. Following service, consists are dispatched to outbound trains. The same procedures were followed for estimating idle time, number of locomotives moving to each outbound area of the yard, and the duration of each movement for emission calculations.

In addition to routine service, the databases include service codes indicating periodic inspections of various types, as well as major maintenance activities requiring load testing of stationary locomotives. Several types of load tests are conducted, including planned maintenance pre- and post-tests, quarterly maintenance tests, and unscheduled maintenance diagnostic and post-repair tests. Depending on the test type and locomotive model, these tests include some period of idling, notch 1 operation, and notch 8 operation. Data are not collected on the exact duration of individual tests, so estimates of average duration for each throttle setting were provided by shop personnel, as shown in Table 1. The number of tests of each type for each locomotive model group were tabulated based on the service codes in the database for each service event.

Trends in Activity and Technology

The initial study was based on data from December 1999 through November 2000. Since that time, UPRR's locomotive fleet modernization program as well as changes in freight volumes have occurred. A subsequent data retrieval for the period from May 2003 through April 2004 was made, and emission calculations updated. A number of significant changes occurred over this 40-month period. The distribution of locomotive models in line-haul operation showed a substantial shift from older, lower horsepower units to new high horsepower units. The average number of locomotives per consist remained the same at about 3, but the higher horsepower allowed an increase in train capacity (trailing tons per train). The decrease in older units also resulted in a decrease in the frequency of major maintenance load testing. In addition to updating activity inputs (number of locomotives by model) for emission calculations, calculations were modified to reflect the penetration of new and retrofit technologies in the locomotive fleet, including SmartStart and AESS idling controls and Tier 0 and Tier 1 locomotives. UPRR data identifying the specific technologies installed on individual locomotives were matched with locomotive ID numbers in the train and servicing data retrievals to obtain a specific count of the number of locomotives of each model for which emissions reductions were achieved by these technologies. Historical temperature data for the Roseville area were used to estimate the fraction of time computer controls would require idling when the locomotive would otherwise be shut down.

EMISSION FACTORS

Data Sources

The study of the J. R. Davis Yard focused on diesel exhaust particulate matter emissions. At present, there is no unified database of emission test results for in-use locomotives. Appendix B of the USEPA's Regulatory Support Document for setting new emission standards for locomotives[2] contains a compilation of notch-specific emission factors. These data were supplemented by test data reported by Southwest Research Institute[3,4], as well as test data provided by locomotive manufacturers to assemble emission factors for each of 11 locomotive model groups.

There are dozens of specific locomotive model designations, and emissions tests are not available for all of them. However many models are expected to have nearly identical emission characteristics. Depending on their intended use, locomotives of different models may have different configurations (e.g., number of axles), but share a common diesel engine. For this project, 11 locomotive model groups were defined based on their engine models (manufacturer, horsepower, number of cylinders, and turbo- or super-charging of intake air). Table 3 lists these model groups and some of the typical locomotive models assigned to each group.

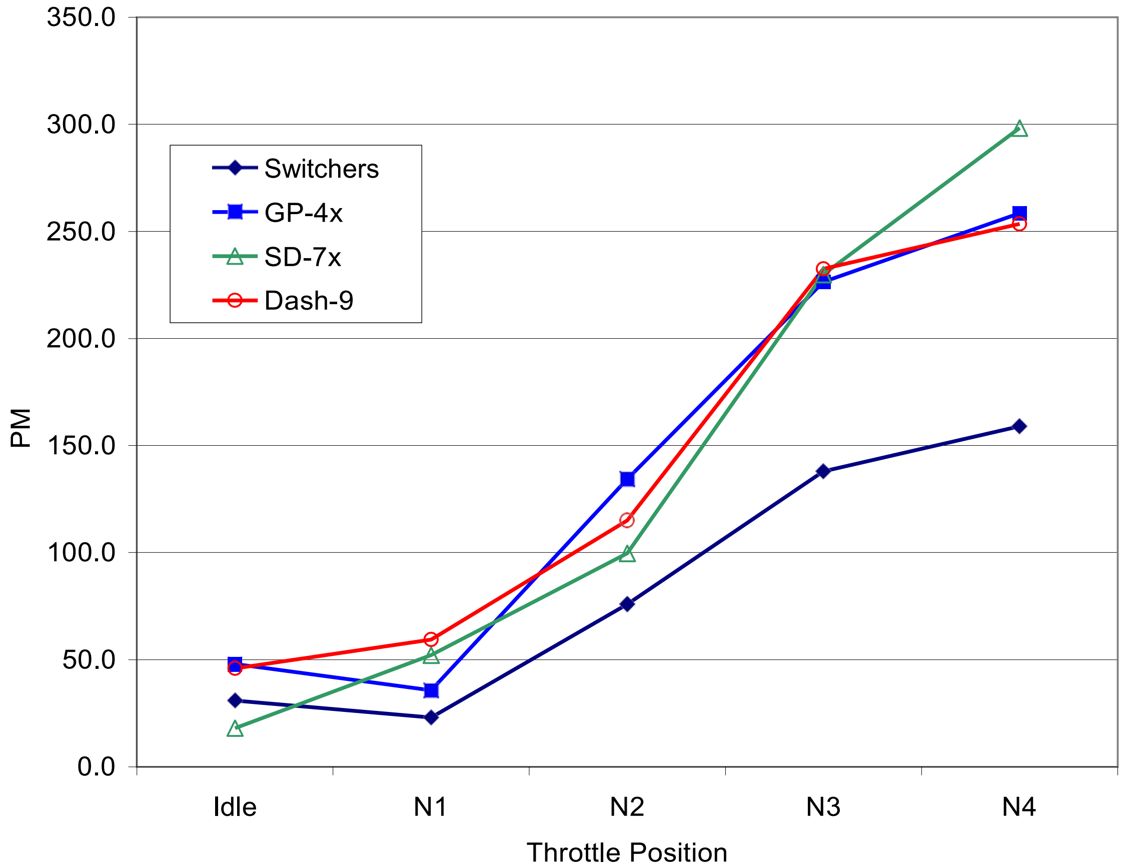
Table 3. Locomotive Model Groups

Model Group	Engine Family	Representative Models
Switchers	EMD 12-645E	GP-15, SW1500
GP-3x	EMD 16-645E	GP-30, GP-38
GP-4x	EMD 16-645E3B	GP-40, SD-40-2, SD-45-2
GP-50	EMD 16-645F3B	GP-50, SD-50M
GP-60	EMD 16-710G3A	GP-60, SD-60M
SD-7x	EMD 16-710G3B	SD-70MAC, SD-75
SD-90	EMD 16V265H	SD-90AC, SD-90-43AC
Dash-7	GE7FDL (12 cyl)	B23-7, B30-7, C36-7
Dash-8	GE7FDL (12 or 16 cyl)	B39-8, B40-8, C41-8
Dash-9	GE7FDL (16 cyl)	C44-9, C44AC
C60-A	GE7HDL	C60AC

Emission Factors and Fuel Effects

Figure 2 shows particulate matter (PM) emission factors for several of the more common locomotive model groups at the low to intermediate throttle settings typical of yard operations. As shown in the figure, emission rates generally increase with throttle setting. However, the older 3000 hp GP-4x series shows emissions comparable to (and in some cases, higher than) the newer 4000 to 4500 hp SD-7x and Dash-9 models. Due to the relatively large fraction of time locomotives spend at low throttle settings while in railyards, the relative differences in emission rates between models at these settings can significantly affect emissions estimates if locomotive model distributions change over time.

Figure 2. Locomotive PM Emission Factors (g/hr).

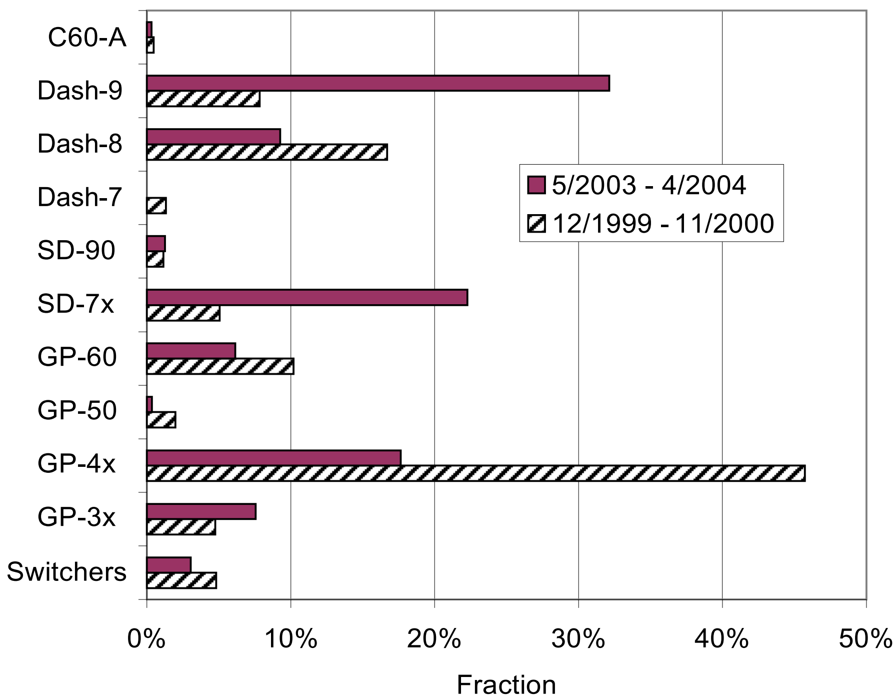


The emission factors used were based on tests using fuel typical of national off-road diesel. Initial emission estimates were derived by multiplying model-specific g/hr emission rates by the total hours of operation and locomotive model fraction for each activity within the yard. At the Davis Yard, over half of the diesel fuel dispensed to locomotives meets California on-road diesel fuel specifications (so-called "CARB diesel"). To account for the effect of fuel quality on emissions, estimates of the fraction of locally dispensed fuel burned by locomotives in different yard activities were developed. These ranged from 100 percent for hump and trim sets to zero percent for inbound line-haul units prior to refueling. These fractions were multiplied by the fraction of CARB diesel dispensed at the yard and an estimate of 14 percent reduction in PM emissions for locomotives burning CARB diesel to develop fuel effects adjustments for individual activities.

EMISSION TRENDS

Using the procedures described in the preceding sections, emissions estimates were developed for the December 1999 to November 2000 period, and the May 2003 to April 2004 period. During this period, significant changes in the UPRR locomotive fleet occurred, with the addition of new locomotives and the retirement of older units. Figure 3 shows the locomotive model distributions for all servicing events at the Davis Yard during these two periods. Service events include both the line-haul and local units arriving and departing on trains (which make up the bulk of these events), as well as the hump and trim sets. A significant increase in the relative fraction of high horsepower SD-7x and Dash-9 units is seen, and a corresponding decrease in the fraction of older GP-4x, GP-50, GP-60, Dash-7 and Dash-8 models. In addition to the fleet modernization, tabulations of specific emission control technologies on units serviced at the Davis Yard showed substantial penetration of new and retrofit technologies. Approximately 31 percent of locomotives serviced at the yard were equipped with computer-controlled shut-down and restart technology, resulting in reduced idling times. Also, approximately 27 percent of servicings were for Tier 0 locomotives, and approximately 25 percent were Tier 1 units. Although the Tier 0 and Tier 1 technologies are not expected to substantially reduce PM emissions, their nitrogen oxides emissions are lower. A few prototype Tier 2 units were observed in 2003 - 2004 data, and their reduced PM emissions will show benefits in the future.

Figure 3. Changes in Locomotive Model Distributions.



The freight volume passing through the yard also changed between these periods. Table 4 lists the percent change in the number of arriving and departing trains, locomotives, and trailing tons (a measure of freight volume). The number of trains and locomotives showed little change, however the trailing tons increased by approximately 15 percent, implying that the average train weight (and correspondingly, the required consist horsepower) increased. This is a result of the increased availability of high horsepower units in the UPRR fleet. A higher fraction of trains bypass the yard, either not stopping, or stopping only for crew changes.

Table 4. Percent Change in Yard Activity Levels from 12/1999 - 11/2000 to 5/2003 - 4/2004.

	Trains	Locomotives	Trailing Tons
Arrivals	-5.2%	-3.5%	--
Departures	-7.0%	-7.3%	--
Throughs (Bypassing the yard)	8.0%	6.8%	--
Total Arrivals and Departures	-0.3%	-0.9%	15.1%

The newer locomotive fleet also affected the level of load testing activity required. Table 5 lists the percent change in the number of load tests of different types, and the corresponding change in total locomotive testing time at idle, notch 1, and notch 8. The extended 30-minute post-maintenance tests were substantially reduced, and total hours of testing were reduced for the various throttle settings between 12 and 43 percent.

Table 5. Percent Change in Load Test Activity from 12/1999 - 11/2000 to 5/2003 - 4/2004.

10-Minute Tests	-18.9%
15-Minute Tests	14.6%
30-Minute Tests	-43.2%
Total Tests	-12.3%
Idling Hours	-20.6%
Notch 1 Hours	-43.2%
Notch 8 Hours	-12.0%

The combined net result of these changes is shown in Table 6. Between November 2000 and April 2003, total estimated PM emissions in the yard decreased by approximately 15 percent. Reductions in idling and movement emissions of about 20 percent were calculated, due to the combination of a newer, lower emitting locomotive fleet and the computer-controlled shutdown technologies (both retrofits and standard equipment on newer units). Hump and trim emissions were reduced by about 6 percent, and load testing emissions by about 14 percent.

Table 6. Emissions Changes from 12/1999 - 11/2000 to 5/2003 - 4/2004.

	Estimated Emissions (tons per year)		**Percent Change**
	12/1999 - 11/2000	**5/2003 -4/2004**	
Idling and Movement of Trains	5.2	4.2	-20.3%
Idling and Movement of Consists	8.5	6.8	-20.2%
Testing	1.5	1.3	-14.1%
Hump and Trim	7.0	6.6	-5.7%
Total	22.3	18.9	-15.3%

CONCLUSIONS

Because of the unique features of each individual railyard, top-down methods (e.g., based only on tons of freight handled or number of arriving locomotives) cannot provide reliable estimates of railyard emissions. Yard-specific data are needed. In-yard activity patterns (and emissions) will vary between yards depending on factors such as: the type of yard (e.g., hump or flat switching classification yards, or intermodal facilities); the presence and capabilities of service tracks or locomotive repair shops; the types of freight handled; the location of the yard in the rail network; and yard configuration. The development of procedures for retrieving and analyzing activity data and locomotive characteristics for a specific railyard is a substantial improvement of alternatives based on top-down estimation. By obtaining disaggregate data for the range of specific activities occurring within railyards, it is possible to reliably estimate historical trends in emissions, as well as to evaluate the potential effects of operational changes and new technologies. Railyard operations cannot be treated in isolation, since these yards are only one component of complex national level systems. Nevertheless, the ability to assess the details of yard operations and their emissions provides an improved basis for environmental management decisions at both local and larger scales.

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2. U. S. Environmental Protection Agency. *Locomotive Emission Standards - Regulatory Support Document*, U. S. Environmental Protection Agency, Office of Mobile Sources, April 1998.

3. Fritz, S. "Emissions Measurements - Locomotives", SwRI Project No. 08-5374-024, Prepared for the U.S. Environmental Protection Agency by Southwest Research Institute, San Antonio, TX, August 1995.

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KEY WORDS

Emission inventories
Locomotives
Railyards
Diesel

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APPENDIX A-7

SULFUR ADJUSTMENT CALCULATIONS

Appendix A-7

Development of Adjustment Factors for Locomotive DPM Emissions Based on Sulfur Content

Wong (undated) provides equations for estimating g/bhp-hr emission rates for 4-Stroke (GE) and 2-Stroke (EMD) locomotives. Rather than using these statistically derived estimates for absolute emissions when model- and notch-specific emission factors are available, we used these equations to develop *relative* emission rate changes for different sulfur levels. The basic form of the equation is

$$q = a \cdot S + b$$

Where,

q is the predicted g/bhp-hr emission rate of a locomotive at a specific throttle setting and sulfur content;

a and b are coefficients specific to a locomotive type (2- or 4-stroke) and throttle notch; and

S is the fuel sulfur content in ppm.

Thus, to calculate the emission adjustment factor for a specific fuel sulfur content, it is necessary to calculate the nominal emission rate q_0 for the baseline fuel sulfur content S_0, and the emission rate q_i for the fuel of interest with sulfur content S_i. This adjustment factor k_i is simply

$$k_i = 1 - \frac{(q_0 - q_i)}{q_0},$$

Where, q_0 and q_i are calculated using the equation above. Tables 1 and 2 give the values of the a and b coefficients for 4-stroke and 2-stroke locomotives. For throttle settings below notch 3, sulfur content is not expected to affect emission rates. The baseline emission rates from which actual emissions are estimated were derived from emission tests of different locomotive models. Although full documentation of fuels is not available for all of these tests, they are assumed to be representative of actual emissions of the different models running on 3,000 ppm sulfur EPA non-road Diesel fuel. For the purposes of modeling 2005 emissions, these factors are needed to adjust the baseline emission factors to emission factors representative of two fuels - 221 ppm and 2639 ppm. Table 3 shows the resulting correction factors for these two fuels by notch and engine type. To generate locomotive model-, throttle-, tier-, and fuel-specific emission factors, the base case (nominal 3,000 ppm S) emission factors in Table 4 were multiplied by the corresponding correction factors for throttle settings between notch 3 and notch 8.

Table 1 Sulfur Correction Coefficients for 4-Stroke Engines		
Throttle Setting	***a***	***b***
Notch 8	0.00001308	0.0967
Notch 7	0.00001102	0.0845
Notch 6	0.00000654	0.1037
Notch 5	0.00000548	0.1320
Notch 4	0.00000663	0.1513
Notch 3	0.00000979	0.1565

Table 2 Sulfur Correction Coefficients for 2-Stroke Engines		
Throttle Setting	***a***	***b***
Notch 8	0.0000123	0.3563
Notch 7	0.0000096	0.2840
Notch 6	0.0000134	0.2843
Notch 5	0.0000150	0.2572
Notch 4	0.0000125	0.2629
Notch 3	0.0000065	0.2635

Table 3 DPM Emission Adjustment Factors for Different Fuel Sulfur Levels				
Throttle Setting	**4-Stroke (GE)**		**2-Stroke (EMD)**	
	2,639 ppm S	**221 ppm S**	**2,639 ppm S**	**221 ppm S**
Notch 8	0.9653	0.7326	0.9887	0.9131
Notch 7	0.9662	0.7395	0.9889	0.9147
Notch 6	0.9809	0.8526	0.9851	0.8852
Notch 5	0.9867	0.8974	0.9821	0.8621
Notch 4	0.9860	0.8924	0.9850	0.8844
Notch 3	0.9810	0.8536	0.9917	0.9362

Table 4
Base Case Locomotive Diesel Particulate Matter Emission Factors (g/hr)
(3,000 PPM Sulfur Assumed)

Model Group	Tier	Throttle Setting										Source
		Idle	DB	N1	N2	N3	N4	N5	N6	N7	N8	
Switchers	N	31.0	56.0	23.0	76.0	138.0	159.0	201.0	308.0	345.0	448.0	EPA RSD[1]
GP-3x	N	38.0	72.0	31.0	110.0	186.0	212.0	267.0	417.0	463.0	608.0	EPA RSD[1]
GP-4x	N	47.9	80.0	35.7	134.3	226.4	258.5	336.0	551.9	638.6	821.3	EPA RSD[1]
GP-50	N	26.0	64.1	51.3	142.5	301.5	311.2	394.0	663.8	725.3	927.8	EPA RSD[1]
GP-60	N	48.6	98.5	48.7	131.7	284.5	299.4	375.3	645.7	743.6	941.6	EPA RSD[1]
GP-60	0	21.1	25.4	37.6	75.5	239.4	352.2	517.8	724.8	1125.9	1319.8	SwRI[2] (KCS733)
SD-7x	N	24.0	4.8	41.0	65.7	156.8	243.1	321.1	374.8	475.2	589.2	SwRI[3]
SD-7x	0	14.8	15.1	36.8	61.1	230.4	379.8	450.8	866.2	1019.1	1105.7	GM EMD[4]
SD-7x	1	29.2	31.8	37.1	66.2	219.3	295.9	436.7	713.2	783.2	847.7	SwRI[5] (NS2630)
SD-7x	2	55.4	59.5	38.3	134.2	271.7	300.4	335.2	551.5	672.0	704.2	SwRI[5] (UP8353)
SD-90	0	61.1	108.5	50.1	99.1	255.9	423.7	561.6	329.3	258.2	933.6	GM EMD[4]
Dash 7	N	65.0	180.5	108.2	121.2	359.5	327.7	331.5	299.4	336.7	420.0	EPA RSD[1]
Dash 8	0	37.0	147.5	86.0	133.1	291.4	293.2	327.7	373.5	469.4	615.2	GE[4]
Dash 9	N	32.1	53.9	54.2	108.1	219.9	289.1	370.6	437.7	486.1	705.7	SWRI 2000
Dash 9	0	33.8	50.7	56.1	117.4	229.2	263.8	615.9	573.9	608.0	566.6	Average of GE & SwRI[6]
Dash 9	1	16.9	88.4	62.1	140.2	304.0	383.5	423.9	520.2	544.6	778.1	SwRI[2] (CSXT595)
Dash 9	2	7.7	42.0	69.3	145.8	304.3	365.0	405.2	418.4	513.5	607.5	SwRI[2] (BNSF 7736)
C60-A	0	71.0	83.9	68.6	78.6	277.9	234.1	276.0	311.4	228.0	362.7	GE[4] (UP7555)

Notes:

1. EPA Regulatory Support Document, "Locomotive Emissions Regulation," Appendix B, 12/17/97, as tabulated by ARB and ENVIRON
2. Base emission rates provided by ENVIRON as part of the BNSF analyses for the Railyard MOU (Personal communication from Chris Lindhjem to R. Ireson, 2006) based on data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to C. Lindhjem, 2006).
3. SwRI final report "Emissions Measurments - Locomotives" by Steve Fritz, August 1995.
4. Manufacturers' emissions test data as tabulated by ARB.
5. Base SD-70 emission rates taken from data produced in the AAR/SwRI Exhaust Plume Study (Personal communication from Steve Fritz to R. Ireson, 2006).
6. Average of manufacturer's emissions test data as tabulated by ARB and data from the AAR/SwRI Exhaust Plume Study, tabulated and calculated by ENVIRON..

OFFROAD Modeling Change Technical Memo

SUBJECT: Changes to the Locomotive Inventory

LEAD: Walter Wong

Summary

The statewide locomotive emission inventory has not been updated since 2002. Using the Booz-Allen Hamilton's (BAH) study (Locomotive Emission Study) published in 1992 as a guideline (summary of inventory methodology can be found in Appendix A), staff updated the locomotive inventory.

The history of locomotive emission inventory updates began in 1992 using the results from the BAH report as the baseline inventory. In 2003, staff began updating the emissions inventory by revising the growth assumptions used in the inventory. The revised growth factors were incorporated into the ARB's 2003 Almanac Emission Inventory. With additional data, staff is proposing further update to the locomotive inventory to incorporate fuel correction factors, add passenger train data and Class III locomotives. Changes from updated locomotive activity data have made a significant impact on the total inventory (see Table 1).

Table 1. Impact of Changes on Statewide Locomotive Inventory

	Pre 2003 ARB Almanac Inventory (tons/day)			Revised Inventory (tons/day)			Difference (tons/day)		
Year	HC	NOx	PM	HC	NOx	PM	HC	NOx	PM
1987	7.2	158.8	3.6	7.2	158.8	3.6	0.0	0.0	0.0
2000	7.2	144.8	2.8	9.8	207.2	4.7	2.6	62.4	1.9
2010	7.2	77.8	2.8	9.5	131.9	4.2	2.3	54.1	1.4
2020	7.2	77.8	2.8	9.4	134.6	4.1	2.2	56.8	1.3

Reasons For Change

During the 2003 South Coast's State Implementation Plan (SIP) development process, industry consultants approached Air Resources Board (ARB) staff to refine the locomotive emissions inventory. Specifically, their concerns were related to the growth factors and fuel correction factors used in the inventory calculations. This document outlines how the locomotive emissions inventory was updated and the subsequent changes made to address industry's concerns.

Background : Baseline 1987 Locomotive Emissions Inventory (BAH report)

Locomotive operations can be characterized by the type of service performed. For emission inventory purposes, locomotives are classified into five different service types as defined in BAH's report.

Line-haul/intermodal - Intermodal locomotives generally operate at higher speeds and with higher power than other types and incorporate modern, high-speed engines.

Mixed/bulk – Mixed locomotives are the most common and operate with a wide range of power. They also perform line-haul duties.

Local/Short Haul – Local locomotives perform services that are a mixture of mixed freight and yard service. They operate with lower power and use older horsepower engines.

Yard/Switcher – Yard operations are used in switching locomotives and characterized by stop and start type movements. They operate with smaller engines and have the oldest locomotive engines.

Passenger – Passenger locomotives are generally high speed line haul type operations.

Categories of railroads are further explained by a precise revenue-based definition found in the regulations of the Surface Transportation Board (STB). Rail carriers are grouped into three classes for the purposes of accounting and reporting:

Class I -Carriers with annual operating revenues of $250 million or more

Class II – Carriers with annual operating revenues of less than $250 million but in excess of $20 million

Class III – Carriers with annual operating revenues of less than $20 million or less, and all switching companies regardless of operating revenues.

The threshold figures are adjusted annually for inflation using the base year of 1991.

The 1987 locomotive inventory as shown in Table 2 is taken from the BAH report prepared for the ARB entitled "Locomotive Emission Study" completed in 1992 (http://www.arb.ca.gov/app/library/libcc.php). Information was gathered from many sources including ARB, the South Coast Air Quality Management District, the California Energy Commission, the Association of American Railroads (AAR), locomotive and large engine manufacturers, and Southwest Research Institute. Railroad companies, such as Southern Pacific, Union Pacific, and Atchison, Topeka and Santa Fe (ATSF), provided emission factors, train operation data, and throttle position profiles for trains operating in their respective territories. Southwest Research Institute provided emission test data.

Table 2. 1987 Locomotive Inventory in Tons Per Day, Statewide, BAH report

TYPE	HC	CO	NOX	PM	SOX
Line-Haul/Intermodal	3.97	12.89	86.21	1.97	6.36
Short-Haul/Local	0.96	3.06	21.30	0.46	1.59
Mixed	1.51	4.85	37.34	0.81	2.76
Passenger	0.10	0.22	3.24	0.07	0.30
Yard/Switcher	0.62	1.57	10.69	0.24	0.58
Total	7.16	22.59	158.78	3.55	11.59

The assumed average fuel sulfur content is 2700 parts per million (ppm) obtained from the BAH report.

Current Growth Estimates

Prior to the 2003 South Coast SIP update, growth factors were based on employment data in the railroad industry. Staff believes that the use of historic employment data, which translates to a decline in emissions in future years, may be masking actual positive growth in locomotive operations. It may be assumed that the number of employees is declining due to increased efficiency.

Changes to the Locomotive Inventory

Summary of Growth in Emission Based on BAH Report

Growth is estimated based on train operation type and by several operating characteristics.

> Increased Rail Lube and Aerodynamics – this arises from reduction in friction and will help reduce power requirements.

<u>Introduction of New Locomotives</u> – older locomotive units will be replaced by newer models.

<u>Changes in Traffic Level</u> – the increase or decrease in railroad activity

In the BAH report, projected emission estimates for years 2000 and 2010 were based on the factors shown in Tables 3 and 4. A substantial part of the locomotive emission inventory forecast is based upon projections of rail traffic levels. BAH projected future rail traffic level as a function of population and economic growth in the state. BAH also projected growth in emission only to 2010.

Table 3. Changes in Emissions from 1987-2000 (Exhibit 4 p. 11 of the 8/92 Locomotive Emission Study Supplement) (1987 Base Year)

Train Operation Type	Increased Rail Lube and Aerodynamics	Introduction of New Locomotive	Changes in Traffic Levels	Cumulative Net Growth in Emissions
Intermodal	-7.0%	-8.0%	17.0%	2.0%
Mixed & Bulk	-7.0%	-8.0%	2.0%	-13.0%
Local	-3.0%	-3.0%	-2.0%	-8.0%
Yard	0.0%	-1.0%	-25.0%	-26.0%
Passenger	-7.0%	-8.0%	10.0%	-5.0%

Table 4. Changes in Emissions from 2001-2010 (Exhibit 4 p. 11 of the 8/92 Locomotive Emission Study Supplement) (2000 Base Year)

Train Operation Type	Increased Rail Lube and Aerodynamics	Improved Dispatching and Train Control	Introduction of New Locomotive	Changes in Traffic Levels	Cumulative Net Growthin Emissions
Intermodal	-2.0%	-3.0%	-8.0%	25.0%	12.0%
Mixed & Bulk	-2.0%	-3.0%	-8.0%	0.0%	-13.0%
Local	-1.0%	0.0%	-12.0%	-10.0%	-23.0%
Yard	0.0%	0.0%	-10.0%	-15.0%	-25.0%
Passenger	-2.0%	-3.0%	-8.0%	15.0%	2.0%

BAH added "Improved Dispatching and Train Control" to differentiate these impacts from the "Increased Rail Lubing" which helps to improve fuel efficiency from locomotive engines. Since train control techniques are emerging from the signal company research work, these assumed changes will not impact emission until year 2000.

Based on industry's input, staff recommends several changes to the locomotive emissions inventory. These include modifying growth factors, making adjustments to control factors reflecting the U. S. EPA regulations that went into effect in year 2000, incorporating fuel correction factors, adding smaller class III railroad and industrial locomotive, and updating passenger data.

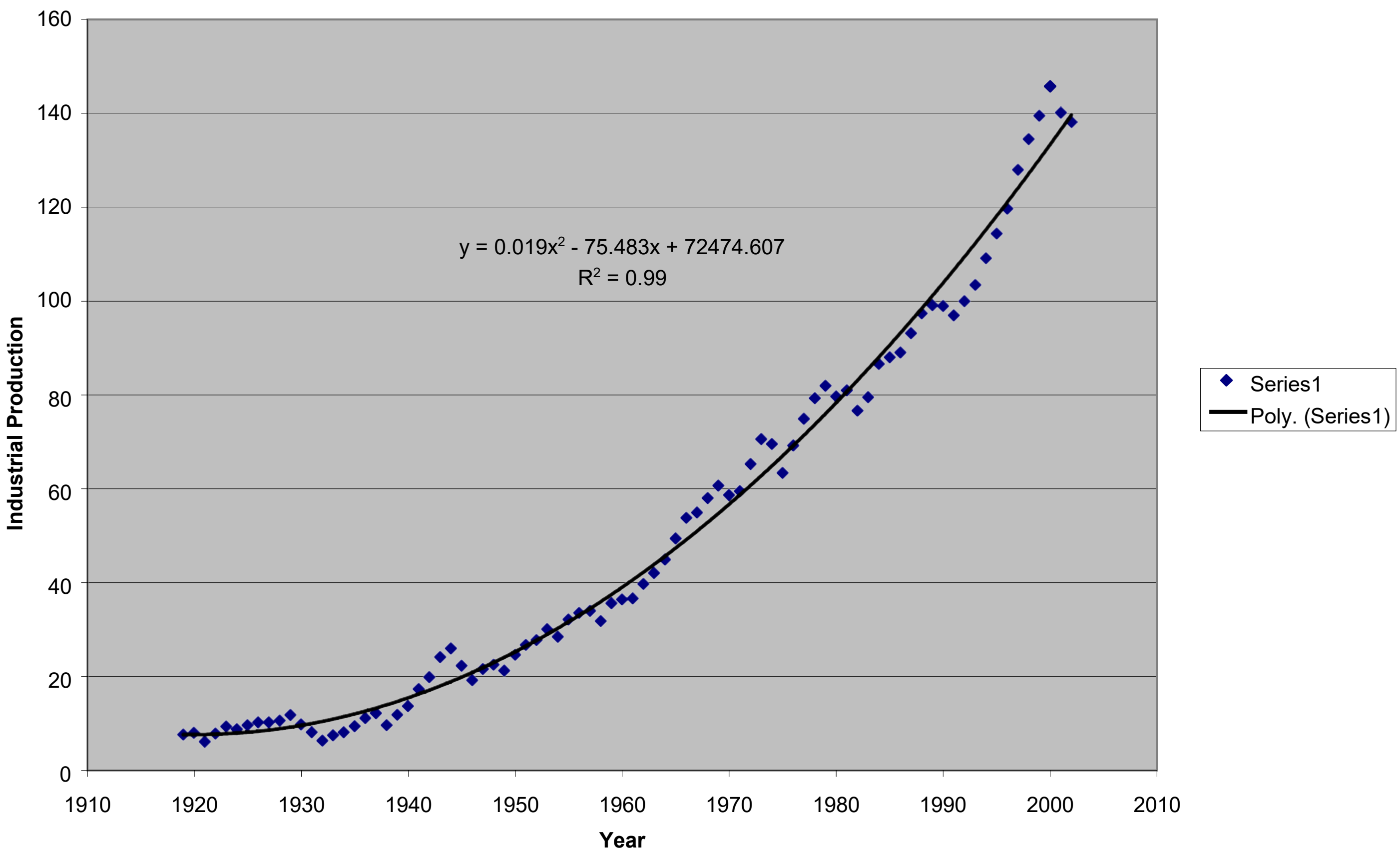
Revised Growth in Emissions

Staff revised the growth factors for locomotives based on new data that better reflect locomotive operations. This includes U.S. industrial production and various railroad statistics available from the AAR.

Based on historic data recently obtained from U.S. industrial productions and the AAR, the changes in traffic levels were revised. A better estimate for changes in traffic levels for locomotives can be made to the line-haul class of railroad, which are the intermodal and mixed and bulk type of locomotives, using industrial production and AAR's data.

Industrial production data is considered to be a surrogate for changes in traffic levels of the line-haul locomotive. It is assumed that railroad activity would increase in order to accommodate the need to move more product. Industrial production is the total output of U.S. factories and mines, and is a key economic indicator released monthly by the Federal Reserve Board. U.S. industrial production historical data from 1920 to 2002 was obtained and analyzed from government sources. Figure 1 shows the historical industrial production trend (Source : http://www.research.stlouisfed.org/fred2/series/INDPRO/3/Max). Statistical analysis was used to derive a polynomial equation to fit the data.

Figure 1. Long-term Industrial Production



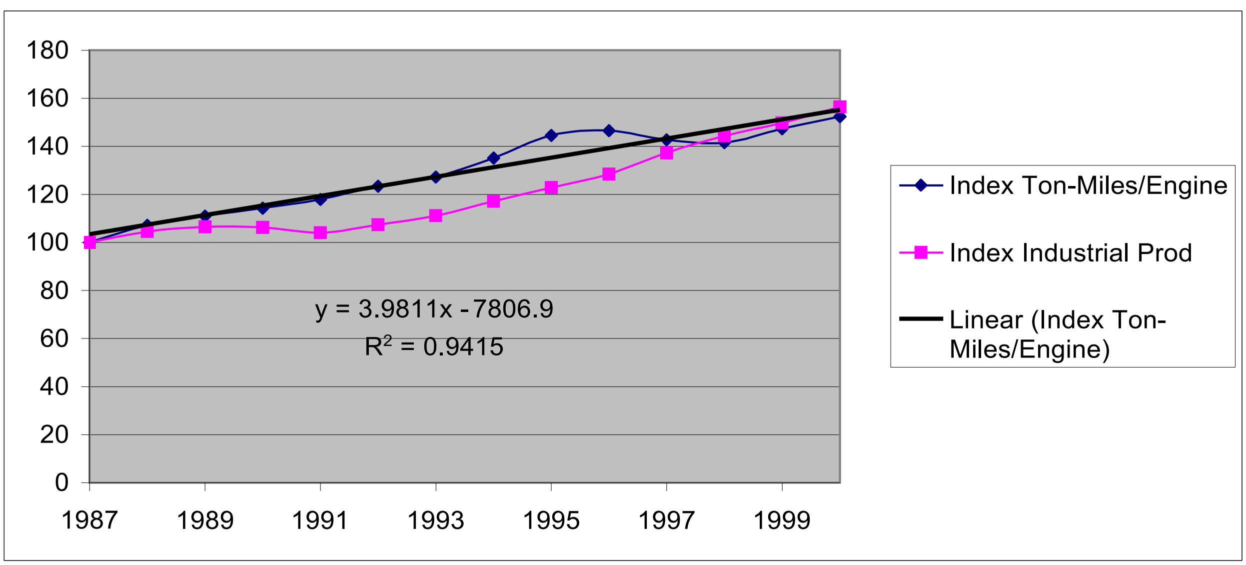
Another surrogate for growth is net ton-miles per engine. Consequently, staff analyzed railroad data from the AAR's Railroad Facts booklet (2001 edition). The booklet contains line-haul railroad statistics including financial status, operation and employment data, and usage profiles. Revenue ton-mile and locomotives in service data from the booklet were used to compute the net ton-miles per engine as shown in Table 5.

Table 5. Revenue Ton-Miles and Ton-Miles/Engine (AAR Railroad Facts 2001 edition)

Year	Locomotive Diesel in Service (US)	Revenue Ton-Miles	Ton-Miles/Engine
1987	19,647	943,747	48.04
1988	19,364	996,182	51.45
1989	19,015	1,013,841	53.32
1990	18,835	1,033,969	54.90
1991	18,344	1,038,875	56.63
1992	18,004	1,066,781	59.25
1993	18,161	1,109,309	61.08
1994	18,496	1,200,701	64.92
1995	18,810	1,305,688	69.41
1996	19,267	1,355,975	70.38
1997	19,682	1,348,926	68.54
1998	20,259	1,376,802	67.96
1999	20,254	1,433,461	70.77
2000	20,026	1,465,960	73.20

As shown in Figure 2, there is a relatively good correlation between net ton-miles per engine growth and industrial production. Because net ton-miles per engine data are compiled by the railroad industry and pertains directly to the railroad segment, staff believes that net ton-miles per engine will better characterize future traffic level changes.

Figure 2. Ton-miles/Engine vs. Industrial Production (index base year = 1987)



The ton-miles/engine data were projected to calculate the future growth rate of traffic level using a linear equation.

Staff also made changes to the "Increased Rail Lube and Aerodynamics" assumption shown in Tables 3 and 4. Rail lubing does not benefit the idling portion of locomotive activity. Since idling contributes 20% of the weighting in the line-haul duty cycle, staff reduced the rail lubing benefit by 20%. Meanwhile, improved dispatching and train control is assumed only to reduce engine idling. Therefore, staff reduced the improved dispatching benefit by 80%.

The benefit of the introduction of new locomotives to the fleet was decreased from the original BAH assumption. BAH assumed 50% penetration of the new engines by 2000. Literature research suggests that the new engines accounted for only about 34% of the fleet in 2000 (www.railwatch.com, http://utahrails.net/all-time/modern-index.php). These new engines are assumed to be 15% cleaner. Therefore, the benefit from new locomotive engines has been reduced to 5% (34% x 15% = 5% reduction).

Tables 6, 7, and 8 present the revised growth factors to be used to project the baseline (1987) locomotive emissions inventory into the future.

Table 6. ARB Revised Growth 1987-2000, ARB's 2003 Almanac Emission Inventory

Train Operation Type	Increased Rail Lube and Aerodynamics	Introduction of New Locos	Population Increase	Changes in Traffic Levels	Cumulative Net Growth in Emissions	Annual Growth
Intermodal	-5.6%	-5.1%	1.9%	50.0%	41.2%	2.69%
Mixed & Bulk	-5.6%	-5.1%	1.9%	50.0%	41.2%	2.69%
Local	-2.4%	0%	0%	-2.0%	-4.4%	-0.35%
Yard	0.0%	0%	0%	-25.0%	-25.0%	-2.19%
Passenger	-5.6%	0%	1.9%	10.0%	6.3%	0.47%

The benefit of new locomotives with cleaner burning engines is accounted for in the control factor from EPA's regulation beginning in 2001, which takes into account introduction of new locomotive engines meeting Tier I and Tier II standards.

Table 7. ARB Revised Growth 2001-2010 (2000 Base Year, ARB's 2003 Almanac Emission Inventory)

Train Operation Type	Increased Rail Lube and Aerodynamics	Improved Dispatching and Train Control	Changes in Traffic Levels	Cumulative Net Growth in Emissions	Annual Growth
Intermodal	-1.6%	-0.6%	22.5%	20.3%	1.87%
Mixed & Bulk	-1.6%	-0.6%	22.5%	20.3%	1.87%
Local	-0.8%	-0.6%	-10.0%	-11.4%	-1.20%
Yard	0.0%	0.0%	-15.0%	-15.0%	-1.61%
Passenger	-1.6%	0.0%	15.0%	13.4%	1.27%

Table 8. ARB Revised Growth 2010-2020 (2010 Base Year, ARB's 2003 Almanac Emission Inventory)

Train Operation Type	Increased Rail Lube and Aerodynamics	Improved Dispatching and Train Control	Changes in Traffic Levels	Cumulative Net Growth	Annual Growth
Intermodal	0.0%	0.0%	18.0%	18.0%	1.67%
Mixed & Bulk	0.0%	0.0%	18.0%	18.0%	1.67%
Local	0.0%	0.0%	0.0%	0.0%	0.00%
Yard	0.0%	0.0%	0.0%	0.0%	0.00%
Passenger	0.0%	0.0%	0.0%	0.0%	0.00%

In Table 8, staff assumes no benefit from aerodynamics and improved train controls. Staff seeks guidance from industry as to their input regarding future benefits.

Table 9. Revised Growth in Emissions (Base Year 1987)

Year	Intermodal	Mixed & Bulk	Local	Yard	Passenger
1987	1.00	1.00	1.00	1.00	1.00
1988	1.03	1.03	1.00	0.98	1.00
1989	1.05	1.05	0.99	0.96	1.01
1990	1.08	1.08	0.99	0.94	1.01
1991	1.11	1.11	0.99	0.92	1.02
1992	1.14	1.14	0.98	0.90	1.02
1993	1.17	1.17	0.98	0.88	1.03
1994	1.20	1.20	0.98	0.86	1.03
1995	1.24	1.24	0.97	0.84	1.04
1996	1.27	1.27	0.97	0.82	1.04
1997	1.30	1.30	0.97	0.80	1.05
1998	1.34	1.34	0.96	0.78	1.05
1999	1.38	1.38	0.96	0.77	1.06
2000	1.41	1.41	0.96	0.75	1.06
2001	1.44	1.44	0.94	0.74	1.08
2002	1.47	1.47	0.93	0.73	1.09
2003	1.49	1.49	0.92	0.71	1.10
2004	1.52	1.52	0.91	0.70	1.12
2005	1.55	1.55	0.90	0.69	1.13
2006	1.58	1.58	0.89	0.68	1.15
2007	1.61	1.61	0.88	0.67	1.16
2008	1.64	1.64	0.87	0.66	1.18
2009	1.67	1.67	0.86	0.65	1.19
2010	1.70	1.70	0.85	0.64	1.21
2011	1.73	1.73	0.85	0.64	1.21
2012	1.76	1.76	0.85	0.64	1.21
2013	1.79	1.79	0.85	0.64	1.21
2014	1.81	1.81	0.85	0.64	1.21
2015	1.85	1.85	0.85	0.64	1.21
2016	1.88	1.88	0.85	0.64	1.21
2017	1.91	1.91	0.85	0.64	1.21
2018	1.94	1.94	0.85	0.64	1.21
2019	1.97	1.97	0.85	0.64	1.21
2020	2.00	2.00	0.85	0.64	1.21

Control Factors for U.S. EPA regulation

In December 1997, the U.S. EPA finalized the locomotive emission standard regulation. The regulatory support document lists the control factors used (http://www.epa.gov/otaq/regs/nonroad/locomotv/frm/locorsd.pdf). Staff modified the control factors to incorporate the existing memorandum of understanding (http://www.arb.ca.gov/msprog/offroad/loco/loco.htm) between the South Coast AQMD and the railroads that operate in the region. Previously, one control factor was applied statewide. In the revised emissions inventory starting in 2010, a lower control factor reflecting the introduction of lower emitting locomotive engines in the SCAB region was applied. Tables 10 and 11 show the revised control factors. Road hauling definition as used by U.S. EPA applies to the line-haul/intermodal, mixed, and local/short haul train type in the emissions inventory.

Table 10. Revised Statewide Control Factors

Year	State Road Hauling HC	State Road Hauling NOx	State Road Hauling PM	State Switcher HC	State Switcher NOx	State Switcher PM	State Passenger HC	State Passenger NOx	State Passenger PM
1999	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2000	1.00	0.99	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2001	1.00	0.95	1.00	1.00	1.00	1.00	1.00	1.00	1.00
2002	1.00	0.88	1.00	1.00	0.98	1.00	1.00	0.98	1.00
2003	1.00	0.82	1.00	1.00	0.97	1.00	1.00	0.96	1.00
2004	1.00	0.75	1.00	1.00	0.95	1.00	1.00	0.94	1.00
2005	0.96	0.68	0.96	0.99	0.93	0.99	0.98	0.92	0.98
2006	0.92	0.62	0.92	0.99	0.91	0.99	0.96	0.90	0.96
2007	0.89	0.59	0.89	0.98	0.89	0.98	0.94	0.83	0.94
2008	0.87	0.57	0.86	0.98	0.87	0.97	0.92	0.76	0.92
2009	0.84	0.55	0.84	0.97	0.85	0.97	0.91	0.69	0.90
2010	0.82	0.54	0.81	0.96	0.83	0.96	0.89	0.62	0.88
2011	0.81	0.53	0.80	0.96	0.81	0.95	0.87	0.57	0.87
2012	0.80	0.53	0.79	0.95	0.79	0.94	0.85	0.56	0.85
2013	0.79	0.52	0.78	0.94	0.77	0.93	0.83	0.54	0.83
2014	0.77	0.51	0.76	0.94	0.75	0.93	0.82	0.53	0.81
2015	0.76	0.50	0.75	0.93	0.73	0.92	0.80	0.52	0.79
2016	0.75	0.50	0.74	0.92	0.71	0.91	0.78	0.51	0.77
2017	0.74	0.49	0.72	0.91	0.70	0.90	0.76	0.50	0.75
2018	0.73	0.48	0.71	0.90	0.69	0.89	0.74	0.49	0.73
2019	0.71	0.48	0.70	0.89	0.68	0.88	0.73	0.48	0.71
2020+	0.70	0.47	0.69	0.89	0.67	0.87	0.71	0.47	0.69

Table 11. Revised SCAB Control Factors

Year	SCAB Road Hauling HC	SCAB Road Hauling NOx	SCAB Road Hauling PM	SCAB Switcher HC	SCAB Switcher NOx	SCAB Switcher PM
1999	1.00	1.00	1.00	1.00	1.00	1.00
2000	1.00	0.99	1.00	1.00	1.00	1.00
2001	1.00	0.95	1.00	1.00	1.00	1.00
2002	1.00	0.88	1.00	1.00	0.98	1.00
2003	1.00	0.82	1.00	1.00	0.97	1.00
2004	1.00	0.75	1.00	1.00	0.95	1.00
2005	0.96	0.68	0.96	0.99	0.93	0.99
2006	0.92	0.62	0.92	0.99	0.91	0.99
2007	0.89	0.59	0.89	0.98	0.89	0.98
2008	0.87	0.57	0.86	0.98	0.87	0.97
2009	0.84	0.55	0.84	0.97	0.85	0.97
2010	0.82	0.36	0.81	0.96	0.36	0.96
2011	0.81	0.36	0.80	0.96	0.36	0.95
2012	0.80	0.36	0.79	0.95	0.36	0.94
2013	0.79	0.36	0.78	0.94	0.36	0.93
2014	0.77	0.36	0.76	0.94	0.36	0.93
2015	0.76	0.36	0.75	0.93	0.36	0.92
2016	0.75	0.36	0.74	0.92	0.36	0.91
2017	0.74	0.36	0.72	0.91	0.36	0.90
2018	0.73	0.36	0.71	0.90	0.36	0.89
2019	0.71	0.36	0.70	0.89	0.36	0.88
2020+	0.70	0.36	0.69	0.89	0.36	0.87

Addition of Class III Locomotive and Industrial/Military Locomotive

The annual hours operated by the class III railroads are shown in Table 12. The results were tabulated from ARB Stationary Source Division's (SSD) survey (http://www.arb.ca.gov/regact/carblohc/carblohc.htm) conducted to support regulation with regards to ARB ultra-clean diesel fuel.

Table 12. Short-Haul and Switcher Annual Hours for Class III Railroads

Air Basin	Operations	Population	Annual Hours Operated
Mountain Counties	SW	2	10214
Mojave Desert	L	10	27440
North Coast	L	3	5700
North Central Coast	L	1	1332
	SW	3	3996
Northeast Plateau	L	5	9892
South Coast	SW	21	75379
South Central Coast	L	5	3200
San Diego	L	4	5000
San Francisco	L	8	31600
	SW	4	5059
San Joaquin Valley	L	29	68780
	SW	19	72248
Sacramento Valley	L	6	11400
Total		120	331240

L = local short-haul, SW = switcher

The short-haul and switcher emission rate are derived from BAH report. The report cites studies from testing done at EPA and Southwest Research Institute.

Table 13. Short-Haul and Switcher Emission Rate

Emission Rate	Short-Haul (g/bhp-hr)	Switcher (g/bhp-hr)
HC	0.38	0.44
CO	1.61	1.45
NOx	12.86	15.82
PM	0.26	0.28
SOx	0.89	0.90
Fuel Rate (lb/hr)	120.00	60.00

Table 14. Statewide Summary of Industrial Locomotives

Air Basin	Number of Locomotives	Avg. HP	Avg. Age
Mojave Desert	9	1,138	56
Others	11	587	54
San Francisco	11	525	54
San Joaquin Valley	38	1,176	54
South Coast	24	1,290	55
TOTALS	93	1,055	55

Table 15. Statewide Summary of Military Locomotives

Air Basin	Number of Locomotives	Avg. HP	Avg. Age
Mojave Desert	7	900	50
Northeast Plateau	2	1,850	50
Sacramento Valley	1	500	50
San Diego	7	835	50
San Francisco	4	1525	47.5
San Joaquin Valley	2	400	50
South Central Coast	1	500	50
TOTALS	24	930	49.6

The data from the survey provides a reasonable depiction of railroad activities in 2003. To forecast and backcast, an assumption was made to keep the data constant and have no growth. More research is needed to quantify the growth projections of smaller, local railroad activities.

Update to Passenger Trains

ARB's survey of intrastate locomotives included passenger agency trains that operated within the state. Staff attempted to reconcile the survey results by calculating the operation schedules posted by the operating agency to obtain hours of operation and mileage information. The results of the survey and calculated operating hours were comparable. Table 16 lists the calculated annual hours operated and miles traveled used to estimate emissions.

Table 16. Passenger Trains Annual Miles and Hours

Air Basin	Annual Miles Operated	Annual Hours Operated
South Coast	3,700,795	92,392
South Central Coast	151,864	4,020
San Diego	914,893	25,278
San Francisco	2,578,862	77,944
San Joaquin Valley	674,824	17,313
Sacramento Valley	635,384	20,058
Total	8,656,621	237,006

The passenger train emission rate is derived from testing done at SWRI on several passenger locomotives.

Table 17. Passenger Train Emission Rate

Emission Rate	Passenger Train (g/bhp-hr)
HC	0.50
CO	0.69
Nox	12.83
PM	0.36
Sox	0.90
Fuel Rate (lb/hr)	455.00

Fuel Correction Factors

Aromatics

Previous studies quantifying the effects of lowering aromatic content are listed in Table 18. These studies tested four-stroke heavy-duty diesel engines (HDD). Although staff would have preferred to analyze data from tests performed on various locomotive engines to determine the effects of lower aromatics, these HDD tests are the best available resources to determine the fuel corrections factors due to lower aromatics.

Table 18. Effect of Lowering Aromatic Volume on PM Emission

STUDY	**Sulfur (ppm)**	**Aromatics (Volume %)**	**PM Reduction (%)**
Chevron (1984)	2,800	31	Baseline
Chevron (1984)	500	31	23.8
Chevron (1984)	500	20	32.2
Chevron (1984)	500	15	36.0
Chevron (1984)	500	10	39.9
CRC-SWRI (1988)	500	31	Baseline
CRC-SWRI (1988)	500	20	9
CRC-SWRI (1988)	500	15	13
CRC-SWRI (1988)	500	10	17

Source : http://www.arb.ca.gov/fuels/diesel/diesel.htm

Using a linear regression of the data from the Table 18, the PM reduction from a change in aromatic content can be described as :

<u>4-Stroke Engine</u>
PM reduction = [(Difference in Aromatic Volume) * 0.785 + 0.05666]/100

For 2-Stroke engines, staff used test data from SWRI's report published in 2000 entitled "Diesel Fuel Effects on Locomotive Exhaust Emissions" to estimate indirectly the potential PM reduction for 2-Stroke engines due to lower aromatics. Table 19 lists the summary of the test results.

Table 19. SWRI 2000 Study Summary Results

Locomotive Engine	Aromatic Changes (Volume %)	PM Difference (g/bhp-hr)	PM % Difference
4 Stroke	28.35 to 21.84	0.080	37.6%
2 Stroke	28.35 to 21.84	0.056	14.1%

Staff assumes that PM emission reduction from 2-Stroke engine will have a factor of 0.38 (14.1%/37.6%) to the 4-Stroke engine PM emission reduction.

Currently, the baseline locomotive emissions inventory assumes an aromatic total volume percent of 31%. Table 21 describes the changes in PM emission due to changes in total volume percent of aromatics.

Table 20. Examples of PM Reductions Due to Changes in Aromatic Total Volume Percent

Aromatic Volume Percent		PM Reduction	PM Reduction	PM Reduction
From	To	2 Stroke	4 Stroke	Composite
31	28	0.9%	2.4%	1.3%
31	19	3.6%	9.5%	5.1%
31	10	6.3%	16.5%	8.9%

*composite is 75% 2 Stroke Engine and 25% 4 Stroke Engine

Table 21,Table 22, and Table 23 show the PM emission reduction for the different type of fuels used in the state.

Table 21. PM Emission Percent Change of Line-Haul Due to Aromatics, Statewide

Calendar Year	CARB Aromatic Volume (%)	EPA Aromatic Volume (%)	Off-road Aromatic Volume (%)	Weighted Aromatic Volume (%)	PM Emission Percent Change
1992	31	31	31	31.00	0.00
1993	10	31	31	31.00	0.00
1994	10	31	31	31.00	0.00
1995	10	31	31	31.00	0.00
1996	10	31	31	31.00	0.00
1997	10	31	31	31.00	0.00
1998-2001	10	31	31	30.18	-0.004
2002-2006	10	31	31	29.05	-0.009
2007+	10	31	31	29.05	-0.009

Table 22. Class I Line Haul Weighted Aromatic Volume Percent by Air Basin

Interstate Locomotive	Air Basin	1993-2001 Weighted Aromatic	2002+ Weighted Aromatic
		Volume Percent	Volume Percent
Class I Line Haul	SCC	31.0	31.0
	MC	31.0	26.6
	MD	30.0	29.8
	NEP	31.0	27.9
	SC	31.0	31.0
	SF	28.6	23.1
	SJV	29.1	29.4
	SS	31.0	31.0
	SV	31.0	27.4

Table 23. PM Emission Reduction from Intrastate Locomotives Due to Aromatics by Air Basin, 1993+

Intrastate Locomotive	Air Basin	CARB Aromatic	EPA Aromatic	Nonroad Aromatic	Weighted Aromatic	PM Emission Reduction
		Volume Percent	Volume Percent	Volume Percent	Volume Percent	Percent
Class I Local/Switcher	SC	10	31	31	29.0	-0.9%
	SJV	10	31	31	25.2	-2.4%
	MD	10	31	31	31.0	0.0%
	BA	10	31	31	13.9	-7.2%
	SD	10	31	31	13.2	-7.5%
	SV	10	31	31	13.2	-7.5%
	SCC	10	31	31	13.2	-7.5%
Class III Local/Switcher	SC	10	31	31	31.0	0.0%
	SJV	10	31	31	18.6	-5.2%
	MD	10	31	31	10.0	-8.8%
	BA	10	31	31	10.0	-8.8%
	SD	10	31	31	10.0	-8.8%
	SV	10	31	31	10.0	-8.8%
	SCC	10	31	31	10.0	-8.8%
	NEP	10	31	31	26.6	-1.9%
	MC	10	31	31	31.0	0.0%
	NC	10	31	31	10.0	-8.8%
	NCC	10	31	31	10.0	-8.8%
Industrial/Military	SC	10	31	31	24.0	-3.0%
	SJV	10	31	31	24.0	-3.0%
	MD	10	31	31	24.0	-3.0%
	BA	10	31	31	24.0	-3.0%
	NEP	10	31	31	24.0	-3.0%
	SD	10	31	31	24.0	-3.0%
	SV	10	31	31	24.0	-3.0%
	SCC	10	31	31	24.0	-3.0%
Passenger	SC	10	31	31	10.8	-8.5%
	SJV	10	31	31	10.0	-8.8%
	BA	10	31	31	10.0	-8.8%
	SD	10	31	31	10.0	-8.8%
	SV	10	31	31	10.0	-8.8%
	SCC	10	31	31	12.1	-8.0%

Source : Fuel Estimate from http://www.arb.ca.gov/regact/carblohc/carblohc.htm

Sulfur

Currently, the baseline locomotive emissions inventory assumes an average fuel sulfur content of 2700 ppm. Industry has provided information on the sulfur content of the fuel that is currently being used by intrastate locomotives. Together with industry data and prior locomotive tests, staff believes a fuel correction factor should be incorporated into the model.

Table 24 shows the test data collected by the ARB, U.S. EPA, and others, where locomotive engines were tested on different fuel sulfur levels.

Table 24. Locomotive Engine Test with Different Sulfur Levels

Locomotive Engine	Fuel Properties Sulfur Content	Percent Change PM	Percent Change NOX	Percent Change CO	Percent Change HC	Source
EMD 12-645E3B	100/3300ppm	-0.29	-0.06	0.17	0.07	Fritz, 1991
GE DASH9-40C	330/3150ppm	-0.43	-0.07	-0.05	-0.18	Fritz (1995, EPA/SWRI)
MK 5000C	330/3150ppm	-0.71	-0.03	-0.03	-0.07	Fritz (1995, EPA/SWRI)
EMD 16-710G3B, SD70MAC	330/3150ppm	-0.38	-0.08	-0.30	-0.01	Fritz (1995, EPA/SWRI)
EMD SD70MAC	50/330ppm	-0.03	-0.04	0.07	0.01	Fritz (ARB/AAR, 2000)
EMD SD70MAC	50/4760ppm	-0.16	-0.06	0.08	0.03	Fritz (ARB/AAR, 2000)
EMD SD70MAC	330/4760ppm	-0.13	-0.03	0.01	0.01	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	50/330ppm	-0.03	-0.03	-0.01	-0.04	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	50/4760ppm	-0.39	-0.07	-0.02	0.02	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	330/4760ppm	-0.38	-0.04	-0.02	0.06	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	50/3190ppm	-0.27	-0.05	-0.03	0.01	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	330/3190ppm	-0.25	-0.02	-0.02	0.04	Fritz (ARB/AAR, 2000)
GE DASH9-44CW	3190/4760ppm	-0.17	-.02	0.00	0.02	Fritz (ARB/AAR, 2000)
Average		-0.28	-0.05	-0.01	0.00	

From the above table, staff concluded that HC and CO emissions are not affected by different sulfur levels in the fuel. From these tests, staff computed the changes in PM emissions associated with changes in sulfur level. Staff corrected the PM emissions to account for the aromatic differences because the test data were not tested at the same aromatic volume percent. Because the locomotive engine testing was performed at various fuel sulfur levels (some at 330 ppm vs. 3190 ppm and some at 50 ppm vs. 3190 ppm), staff cannot assume the average percent change in PM emission is characteristics over the whole range of sulfur levels. From previous studies that staff has analyzed, it is possible to generate estimates of the percent change at various sulfur levels and throttle positions. Locomotive engines have 8 throttle positions plus dynamic braking and idle. During idle, braking, and throttle positions 1 and 2, there are no significant differences in emissions attributable to sulfur level. For the GE 4-

stroke engine, effect of sulfur on PM for throttle positions 3 to 8 can be defined by using the following equations:

Equations to correct for PM for GE (4-Stroke) engines

Notch 8 : PM (g/bhp-hr) = 0.00001308 * (sulfur level,ppm) + 0.0967
Notch 7 : PM (g/bhp-hr) = 0.00001102 * (sulfur level,ppm) + 0.0845
Notch 6 : PM (g/bhp-hr) = 0.00000654 * (sulfur level,ppm) + 0.1037
Notch 5 : PM (g/bhp-hr) = 0.00000548 * (sulfur level,ppm) + 0.1320
Notch 4 : PM (g/bhp-hr) = 0.00000663 * (sulfur level,ppm) + 0.1513
Notch 3 : PM (g/bhp-hr) = 0.00000979 * (sulfur level,ppm) + 0.1565

For the EMD 2-stroke engine, throttle positions 3 to 8 can be defined by using the following equations:

Equations to correct for PM for EMD (2-Stroke) engines

Notch 8 : PM (g/bhp-hr) = 0.0000123 * (sulfur level,ppm) + 0.3563
Notch 7 : PM (g/bhp-hr) = 0.0000096 * (sulfur level,ppm) + 0.2840
Notch 6 : PM (g/bhp-hr) = 0.0000134 * (sulfur level,ppm) + 0.2843
Notch 5 : PM (g/bhp-hr) = 0.0000150 * (sulfur level,ppm) + 0.2572
Notch 4 : PM (g/bhp-hr) = 0.0000125 * (sulfur level,ppm) + 0.2629
Notch 3 : PM (g/bhp-hr) = 0.0000065 * (sulfur level,ppm) + 0.2635

Table 25. Examples of PM Reductions Due to Changes in Sulfur Level

Sulfur Level (ppm)		PM Reduction	PM Reduction	PM Reduction
From	To	2 Stroke	4 Stroke	Composite
3100	1900	4.1%	8.4%	5.2%
3100	1300	6.1%	12.6%	7.7%
1300	330	3.5%	7.9%	4.6%
1300	140	4.2%	9.5%	5.5%
140	15	1.8%	4.0%	2.4%

*composite is 75% 2 Stroke Engine and 25% 4 Stroke Engine

Data provided by industry show that when operating in California, the three main types of diesel fuel used in locomotive engines consists of CARB diesel, EPA On-Highway diesel fuel, and EPA Off-road or High Sulfur diesel fuel. Four-stroke engines and two-stroke engines show different characteristics with respect to sulfur content. From the BAH report, 4-stroke engines make up about 25%, and 2-stroke engines make up about 75% of the locomotive engine fleet. Combining industry data, 4-stroke/2-stroke engine percent change and fleet makeup, Table 26 shows the percent change in PM emissions by year for the line-haul segment of the fleet.

Table 26. PM Emission Percent Change of Line-Haul Due to Sulfur, Statewide

Calendar Year	CARB Sulfur Content	EPA On-Highway Sulfur Content	EPA Off-road Sulfur Content	Weighted Fuel Sulfur Content	4-Stroke Engines PM Percent Change	2-Stroke Engines PM Percent Change	Weighted PM Emission Percent Change
1992	3100	3100	3100	3100	0.03	0.01	0.015
1993	500	330	3100	2919	0.02	0.01	0.009
1994	150	330	3100	2740	0.01	0.00	0.003
1995	140	330	3100	2557	-0.01	0.00	-0.006
1996	140	330	3100	2377	-0.02	-0.01	-0.014
1997	140	330	3100	2196	-0.04	-0.02	-0.022
1998-2001	140	330	3100	1899	-0.06	-0.03	-0.035
2002-2006	140	330	3100	1312	-0.10	-0.05	-0.061
2007+	15	15	330	129	-0.19	-0.09	-0.113

Table 27 and Table 28 provide further details of weighted fuel sulfur level by air basin. Weighted sulfur levels vary significantly from one air basin to another.

Table 27. Class I Line Haul Weighted Fuel Sulfur by Air Basin

Interstate Locomotive	Air Basin	1998 Weighted Sulfur	2002-2006 Weighted Sulfur	2007+ Weighted Sulfur
		ppm	ppm	ppm
Class I Line Haul	SCC	1023	467	31
	MC	2333	1149	113
	MD	2352	1767	180
	NEP	2560	1632	166
	SC	1985	1472	145
	SF	1711	899	88
	SJV	1600	868	78
	SS	2425	1328	129
	SV	2473	1456	147

Table 28. Intrastate Locomotives Weighted Fuel Sulfur by Air Basin

Intrastate Locomotive	Air Basin	1993 Weighted Sulfur	1994-2006 Weighted Sulfur	2007+ Weighted Sulfur
		ppm	ppm	ppm
Class I Local/Switcher	SC	346	312	15
	SJV	377	278	15
	MD	330	330	15
	BA	468	175	15
	SD	475	169	15
	SV	475	169	15
	SCC	475	169	15
Class III Local/Switcher	SC	388	388	21
	SJV	1016	804	80
	MD	500	140	15
	BA	500	140	15
	SD	500	140	15
	SV	500	140	15
	SCC	500	140	15
	NEP	2628	2553	264
	MC	1573	1573	152
	NC	500	140	15
	NCC	500	140	15
Industrial/Military	SC	1340	1220	120
	SJV	1340	1220	120
	MD	1340	1220	120
	BA	1340	1220	120
	NEP	1340	1220	120
	SD	1340	1220	120
	SV	1340	1220	120
	SCC	1340	1220	120
Passenger	SC	493	147	15
	SJV	500	140	15
	BA	500	140	15
	SD	500	140	15
	SV	500	140	15
	SCC	483	159	15

Appendix B,C, and D contains the fuel correction factors for PM, NOx, and SOx emissions by air basin.

Revised Locomotive Emission Inventory

Tables 29-31 shows the revised locomotive emission inventory for calendar years 2000,2010 and 2020.

Table 29. 2000 Statewide Locomotive Emission Inventory, tons/day

TYPE	HC	CO	NOx	PM	SOx
Intermodal/Line-Haul	5.61	18.21	113.03	2.68	6.22
Local/Short-Run	1.01	3.33	22.58	0.41	0.22
Mixed/Bulk	2.13	6.85	48.95	1.09	2.20
Passenger/Amtrak	0.53	1.01	12.21	0.29	0.05
Yard/Switcher	0.55	1.46	10.43	0.20	0.09
Total	9.83	30.86	207.20	4.67	8.78

Table 30. 2010 Statewide Locomotive Emission Inventory, tons/day

TYPE	HC	CO	NOx	PM	SOx
Intermodal/Line-Haul	5.56	21.90	71.35	2.40	0.60
Local/Short-Run	0.77	2.99	12.03	0.30	0.01
Mixed/Bulk	2.11	8.24	29.46	0.99	0.19
Passenger/Amtrak	0.58	1.14	12.29	0.31	0.02
Yard/Switcher	0.47	1.29	6.78	0.17	0.01
Total	9.49	35.56	131.91	4.17	0.83

Table 31. 2020 Statewide Locomotive Emission Inventory, tons/day

TYPE	HC	CO	NOx	PM	SOx
Intermodal/Line-Haul	5.60	25.84	74.33	2.38	0.71
Local/Short-Run	0.67	2.99	11.17	0.26	0.01
Mixed/Bulk	2.13	9.72	31.14	0.98	0.23
Passenger/Amtrak	0.56	1.14	11.72	0.30	0.02
Yard/Switcher	0.44	1.29	6.22	0.16	0.01
Total	9.40	40.98	134.58	4.08	0.98

Appendix A

Methodology to Calculate Locomotive Inventory

Methodology

The methodology and assumptions used for estimating locomotive emissions consists of several steps taken from the Booz-Allen Hamilton's Locomotive Emission Study report (http://www.arb.ca.gov/app/library/libcc.php). First, emission factor data from various engine manufacturers such as EMD and General Electric (GE) must be gathered to calculate average emission factors for locomotives operated by the railroad companies. Second, train operations data, including throttle position profiles and time spent on various types of operations from different railroad companies needs to be estimated. Finally, the locomotive emission inventory can be calculated using train operations data, emission factors, and throttle position profiles.

Step 1 - Average Emission Factors

Engine emission factors are required for the different locomotive engines manufactured by the major locomotive suppliers EMD or GE. Emission factors are obtained from testing done by either the engine manufacturers or by Southwest Research Institute, a consulting company that has performed many tests on locomotive engines. Table A-1 lists the available emission factors.

Table A-1. Available Emission Factors for Different Locomotive Engines

Engine Manufacturer	Engine Model	Locomotive Model
EMD	12-567BC	SW10
EMD	12-645E	SW1500,MP15,GP15-1
EMD	16-567C	GP9
EMD	16-645E	GP38,GP38-2, GP28
EMD	12-645E3B	GP39-2
EMD	12-645E3	GP39-2, SD39
EMD	16-645E3	GP40, SD40, F40PH
EMD	16-645E3B	GP40-2, SD40-2, SDF40-2, F40PH
EMD	16-645F3	GP40X, GP50, SD45
EMD	16-645F3B	SD50
EMD	20-645E3	SD45,SD45-2, F45, FP45
EMD	16-710G3	GP60, SD60, SD60M
GE	127FDL2500	B23-7
GE	127FDL3000	SF30B
GE	167FDL3000	C30-7, SF30C
GE	167FDL4000	B40-8

Source: BAH report, 1992

Next, the locomotive roster from the largest railroad companies operating in the state were obtained. Table A-2 lists the locomotive roster for railroad companies in 1987.

Table A-2. Locomotive Roster 1987

					Type of Service		
Railroad Company	Engine Manufacturer	Engine Model	Horspower Rating	Units	Line Haul	Local	Yard/Switcher
ATSF	EMD	16-567BC	1500	211			X
ATSF	EMD	16-567C	1750	53			X
ATSF	EMD	16-567D2	2000	71		X	X
ATSF	EMD	16-645E	2000	69		X	X
ATSF	EMD	12-645E3	2300	62		X	
ATSF	EMD	12-645E3B	2300	60		X	
ATSF	EMD	16-645E3	2500	231	X	X	
ATSF	EMD	16-645E3	3000	18	X	X	
ATSF	EMD	16-645E3B	3000	203	X	X	
ATSF	EMD	16-645F3	3500	52	X		
ATSF	EMD	16-645F3B	3600	15	X		
ATSF	EMD	20-645E3	3600	243	X		
ATSF	EMD	16-710G3	3800	20	X		
ATSF	GE	GE-12	2350	60		X	
ATSF	GE	GE-12	3000	10	X	X	
ATSF	GE	GE-16	3000	226	X	X	

ATSF	GE	GE-16	3600	43	X		
ATSF	GE	GE-16	3900	3	X		
ATSF	GE	GE-16	4000	20	X		
Union Pacific	EMD	16-645BC	1200	56			X
Union Pacific	EMD	12-567A	1200	12			X
Union Pacific	EMD	12-645E	1500	281			X
Union Pacific	EMD	16-567CE	1500	35			X
Union Pacific	EMD	16-645E	2000	365		X	X
Union Pacific	EMD	12-645E3C	2300	24		X	
Union Pacific	EMD	16-567D3A	2500	16		X	
Union Pacific	EMD	16-645E3	3000	828	X	X	
Union Pacific	EMD	16-645E3B	3000	446	X	X	
Union Pacific	EMD	16-645F3	3500	36	X		
Union Pacific	EMD	16-645F3B	3600	60	X		
Union Pacific	EMD	16-710G3	3800	227	X		
Union Pacific	GE	GE-12	2300	106		X	
Union Pacific	GE	GE-12	3000	57	X	X	
Union Pacific	GE	GE-16	3000	156	X	X	
Union Pacific	GE	GE-16	3750	60	X		
Union Pacific	GE	GE-16	3800	256	X		
Southern Pacific	EMD	12-567C	1200	11			X
Southern Pacific	EMD	12-645E	1500	286			X
Southern Pacific	EMD	16-567BC	1500	37			X
Southern Pacific	EMD	16-567C	1750	326		X	
Southern Pacific	EMD	16-567D2	2000	145		X	
Southern Pacific	EMD	16-645E	2000	84		X	
Southern Pacific	EMD	12-645E3	2300	12		X	
Southern Pacific	EMD	16-645E3	2500	137	X	X	
Southern Pacific	EMD	16-645E3	3000	92	X		
Southern Pacific	EMD	16-645E3B	3000	353	X		
Southern Pacific	EMD	16-645F3	3500	4	X		
Southern Pacific	EMD	20-645E3	3600	425	X		
Southern Pacific	EMD	16-710G3	3800	65	X		
Southern Pacific	GE	GE-12	2300	15		X	
Southern Pacific	GE	GE-12	3000	107	X		
Southern Pacific	GE	GE-16	3600	20	X		
Southern Pacific	GE	GE-16	3900	92	X		

Source : BAH report, 1992

Using the available emission factors and the locomotive rosters, the average emission factors for each class of service can be calculated. Emission factors for models that were not available were assigned an emission factor based on horsepower rating and the number of cylinders from similar engine models.

Step 2 – Throttle Position Profiles and Train Operations Data

The railroad companies provided throttle position profiles. Locomotive engines operate at eight different constant loads and speeds called throttle notches. In addition, several other settings (idle and dynamic brake) are also common. For line haul and local operations, profiles were obtained from Train Performance Calculation (TPC) data and actual event recorder data, which are summarized in the BAH report.

For line haul operations, the data was modified to account for additional idle time between dispatch. Data supplied by Atchison, Topeka and Santa Fe (ATSF) indicates that the turnaround time for line haul locomotives in yards is approximately eight hours.

For local operations, several assumptions were used to develop throttle profiles. First, ten hours was used as an average hours per assignment. Second, the additional average idle time per day per locomotive was assumed to be ten hours.

The switch engine duty cycle is based upon actual tape data supplied by the ATSF railroad company on a switch engine that operated over a 2-day period. Yard engines are assumed to operate 350 days per year, with 2 weeks off for inspections and maintenance.

Train operations data provided by the railroad companies included :

Line Haul	**Local**	**Yard/Switcher**
Train type	Average trailing tons	Number of units assigned
Number of runs per year	Number of runs per year	Number of assignments
Average horsepower	Average horsepower	Average horsepower
Average units	Average units	
Origin/destination	Origin/destination	
Link miles		

Step 3 – Calculate Locomotive Emission Inventory

Emission inventories are calculated on a train-by-train basis using train operations data, average emission factor, and throttle position profiles.

Emission Inventory = Emission factor x average horsepower x time in notch per train x number of runs per year

Appendix B
PM Fuel Correction Factor by Air Basin

Interstate Loc	Air Basin	PM Fuel Correction Factor														
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Line	SCC	1.000	0.991	0.982	0.973	0.964	0.955	0.937	0.931	0.925	0.919	0.913	0.913	0.913	0.913	0.913	0.883
	MC	1.000	0.998	0.996	0.994	0.992	0.990	0.987	0.971	0.955	0.939	0.923	0.923	0.923	0.923	0.923	0.867
	MD	1.000	0.998	0.995	0.993	0.991	0.988	0.984	0.978	0.973	0.967	0.962	0.962	0.962	0.962	0.962	0.884
	NEP	1.000	0.999	0.998	0.998	0.997	0.996	0.995	0.983	0.971	0.959	0.947	0.947	0.947	0.947	0.947	0.875
	SC	1.000	0.996	0.993	0.989	0.986	0.982	0.975	0.970	0.965	0.960	0.955	0.955	0.955	0.955	0.955	0.888
	SF	1.000	0.993	0.987	0.980	0.974	0.967	0.954	0.940	0.926	0.912	0.898	0.898	0.898	0.898	0.898	0.851
	SJV	1.000	0.993	0.986	0.979	0.972	0.965	0.952	0.944	0.937	0.930	0.923	0.923	0.923	0.923	0.923	0.878
	SS	1.000	0.999	0.997	0.996	0.995	0.993	0.991	0.980	0.970	0.959	0.949	0.949	0.949	0.949	0.949	0.887
	SV	1.000	0.993	0.986	0.979	0.972	0.965	0.952	0.948	0.945	0.942	0.939	0.939	0.939	0.939	0.939	0.873

Intrastate Loc	Air Basin	PM Fuel Correction Factor														
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Local/	SC	1.000	0.890	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.865
	SJV	1.000	0.863	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.858	0.836
	MD	1.000	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.906	0.882
	BA	1.000	0.778	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.764	0.747
	SD	1.000	0.772	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.741
	SV	1.000	0.772	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.741
	SCC	1.000	0.772	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.758	0.741
Class III Loca	SC	1.000	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.909	0.882
	SJV	1.000	0.839	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.830	0.787
	MD	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	BA	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SD	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SV	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SCC	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	NEP	1.000	0.963	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.960	0.858
	MC	1.000	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.959	0.888
	NC	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	NCC	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.722
Industrial/Milit	SC	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SJV	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	MD	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	BA	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	NEP	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SD	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SV	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
	SCC	1.000	0.894	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.889	0.831
Passenger	SC	1.000	0.754	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.739	0.723
	SJV	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	BA	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SD	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SV	1.000	0.749	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.733	0.717
	SCC	1.000	0.764	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.749	0.733

Appendix C
NOx Fuel Correction Factor by Air Basin

Interstate Loc	Air Basin	NOx Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Line	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NEP	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SF	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SS	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940

Intrastate Loc	Air Basin	NOx Fuel Correction Factor															
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Local/	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
Class III Loca	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NEP	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
Industrial/Milit	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	MD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	NEP	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
Passenger	SC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SJV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	BA	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SD	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SV	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940
	SCC	1.000	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940	0.940

Appendix D
SOx Fuel Correction Factor by Air Basin

Interstate Loc	Air Basin	SOx Fuel Correction Factor														
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Line	SCC	1.000	0.896	0.793	0.689	0.586	0.482	0.379	0.327	0.276	0.225	0.173	0.173	0.173	0.173	0.173	0.011
	MC	1.000	0.977	0.955	0.932	0.909	0.887	0.864	0.755	0.645	0.535	0.426	0.426	0.426	0.426	0.426	0.042
	MD	1.000	0.979	0.957	0.936	0.914	0.893	0.871	0.817	0.763	0.709	0.654	0.654	0.654	0.654	0.654	0.067
	NEP	1.000	0.991	0.983	0.974	0.965	0.957	0.948	0.862	0.776	0.690	0.605	0.605	0.605	0.605	0.605	0.062
	SC	1.000	0.956	0.912	0.868	0.823	0.779	0.735	0.688	0.640	0.593	0.545	0.545	0.545	0.545	0.545	0.054
	SF	1.000	0.939	0.878	0.817	0.756	0.695	0.634	0.559	0.483	0.408	0.333	0.333	0.333	0.333	0.333	0.033
	SJV	1.000	0.932	0.864	0.796	0.728	0.660	0.593	0.525	0.457	0.389	0.322	0.322	0.322	0.322	0.322	0.029
	SS	1.000	0.983	0.966	0.949	0.932	0.915	0.898	0.797	0.695	0.594	0.492	0.492	0.492	0.492	0.492	0.048
	SV	1.000	0.986	0.972	0.958	0.944	0.930	0.916	0.822	0.728	0.634	0.539	0.539	0.539	0.539	0.539	0.054

Intrastate Loc	Air Basin	SOx Fuel Correction Factor														
		pre 1993	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007+
Class I Local/	SC	1.000	0.128	0.127	0.126	0.125	0.124	0.122	0.121	0.120	0.119	0.118	0.117	0.115	0.115	0.115	0.006
	SJV	1.000	0.139	0.136	0.133	0.130	0.126	0.123	0.120	0.116	0.113	0.110	0.106	0.103	0.103	0.103	0.006
	MD	1.000	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.122	0.006
	BA	1.000	0.173	0.164	0.154	0.144	0.134	0.124	0.114	0.104	0.095	0.085	0.075	0.065	0.065	0.065	0.006
	SD	1.000	0.176	0.165	0.155	0.145	0.135	0.124	0.114	0.104	0.093	0.083	0.073	0.062	0.062	0.062	0.006
	SV	1.000	0.176	0.165	0.155	0.145	0.135	0.124	0.114	0.104	0.093	0.083	0.073	0.062	0.062	0.062	0.006
	SCC	1.000	0.176	0.165	0.155	0.145	0.135	0.124	0.114	0.104	0.093	0.083	0.073	0.062	0.062	0.062	0.006
Class III Loca	SC	1.000	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.144	0.008
	SJV	1.000	0.376	0.369	0.362	0.355	0.348	0.341	0.333	0.326	0.319	0.312	0.305	0.298	0.298	0.298	0.029
	MD	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	BA	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SD	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SV	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SCC	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	NEP	1.000	0.973	0.971	0.968	0.966	0.963	0.961	0.958	0.956	0.953	0.951	0.948	0.946	0.946	0.946	0.098
	MC	1.000	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.583	0.056
	NC	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	NCC	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
Industrial/Milit	SC	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SJV	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	MD	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	BA	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	NEP	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SD	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SV	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
	SCC	1.000	0.496	0.492	0.488	0.484	0.480	0.476	0.472	0.468	0.464	0.460	0.456	0.452	0.452	0.452	0.044
Passenger	SC	1.000	0.183	0.171	0.159	0.148	0.136	0.124	0.113	0.101	0.090	0.078	0.066	0.055	0.055	0.055	0.006
	SJV	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	BA	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SD	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SV	1.000	0.185	0.173	0.161	0.149	0.137	0.125	0.112	0.100	0.088	0.076	0.064	0.052	0.052	0.052	0.006
	SCC	1.000	0.179	0.168	0.157	0.146	0.135	0.124	0.113	0.103	0.092	0.081	0.070	0.059	0.059	0.059	0.006

APPENDIX B

EMISSION FACTOR DERIVATION AND EMFAC-WD 2006 OUTPUT FOR HHD DIESEL-FUELED TRUCKS

Calculation of Fleet Average Emission Factors - Running Exhaust
Stockton Rail Yard, Stockton, CA

Model Year	San Joaquin County, CY 2005 Annual Average HHDD Emission Factors (g/mi)					Model Yr Distribution (vehicles)
	ROG	CO	NOx	DPM	SOx	
1997	5.02	12.31	29.48	1.78	0.32	2
1998	4.69	11.49	29.03	1.66	0.30	1
1999	4.30	10.58	28.61	1.28	0.23	1
2000	3.87	9.63	28.43	1.55	0.22	1
2005	0.81	1.30	14.74	0.49	0.32	3
Fleet Avg.	***3.17***	***7.53***	***23.66***	***1.19***	***0.30***	8

Notes:
1. Model year distribution provided by Marv Hoagland of UPRR.
2. Running exhaust emission factors calculated from EMFAC-WD 2006 with the BURDEN output option.
3. Emission factor calculations assumed an average speed of 15 mph.

Calculation of Fleet Average Emission Factors - Idling Exhaust
Stockton Rail Yard, Stockton, CA

Model Year	San Joaquin County, CY 2005 Annual Average HHDD Emission Factors (g/hr)					Model Yr Distribution (vehicles)
	ROG	CO	NOx	PM10	SOx	
1997	12.56	52.23	109.49	1.99	0.58	2
1998	9.43	46.94	118.24	1.38	0.58	1
1999	9.43	46.94	118.24	1.38	0.58	1
2000	9.43	46.94	118.24	1.38	0.58	1
2005	7.74	43.69	122.65	1.07	0.58	3
Fleet Avg.	***9.5***	***7.0***	***117.70***	***1. 1***	***0.5***	8

Notes:
1. Model year distribution provided by Marv Hoagland of UPRR.
2. Idling exhaust emission factors calculated from the EMFAC-WD 2006 model with the EMFAC output option.

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+Accr+IMDlg
Run Date : 2006/08/23 08:37:39
Scen Year: 2005 Model year 1997 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	338
VMT/1000	56
Trips	1711
Reactive Organic Gas Emissions	
Run Exh	0 31
Idle Exh	0 01
Start Ex	0
Total Ex	0 32
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 32
Carbon Monoxide Emissions	
Run Exh	0 76
Idle Exh	0 03
Start Ex	0
Total Ex	0 8
Oxides of Nitrogen Emissions	
Run Exh	1 82
Idle Exh	0 07
Start Ex	0
Total Ex	1 89
Carbon Dioxide Emissions (000)	
Run Exh	0 18
Idle Exh	0
Start Ex	0
Total Ex	0 18
PM10 Emissions	
Run Exh	0 11
Idle Exh	0
Start Ex	0
Total Ex	0 11
TireWear	0
BrakeWr	0
Total	0 11
Lead	0
SOx	0 02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	16 32

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/27 14:39:20
Scen Year: 2005 -- Model year 1997 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1997 to 1997 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	12.562	12.329

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	52.228	51.263

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	109.488	107.465

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.572

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.988	1.951

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+Accr+IMDl
Run Date : 2006/08/23 08:37:52
Scen Year: 2005 Model year 1998 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	333
VMT/1000	60
Trips	1684
Reactive Organic Gas Emissions	
Run Exh	0 31
Idle Exh	0 01
Start Ex	0
Total Ex	0 31
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 31
Carbon Monoxide Emissions	
Run Exh	0 76
Idle Exh	0 03
Start Ex	0
Total Ex	0 79
Oxides of Nitrogen Emissions	
Run Exh	1 92
Idle Exh	0 07
Start Ex	0
Total Ex	2
Carbon Dioxide Emissions (000)	
Run Exh	0 19
Idle Exh	0
Start Ex	0
Total Ex	0 19
PM10 Emissions	
Run Exh	0 11
Idle Exh	0
Start Ex	0
Total Ex	0 11
TireWear	0
BrakeWr	0
Total	0 12
Lead	0
SOx	0 02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	17 4

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/30 09:16:13
Scen Year: 2005 -- Model year 1998 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1998 to 1998 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	9.426	9.274

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	46.943	46.185

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	118.235	116.326

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.573

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.375	1.353

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+Accr+IMDl
Run Date : 2006/08/23 08:38:04
Scen Year: 2005 Model year 1999 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	402
VMT/1000	78
Trips	2032
Reactive Organic Gas Emissions	
Run Exh	0 37
Idle Exh	0 01
Start Ex	0
Total Ex	0 38
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 38
Carbon Monoxide Emissions	
Run Exh	0 91
Idle Exh	0 04
Start Ex	0
Total Ex	0 94
Oxides of Nitrogen Emissions	
Run Exh	2 46
Idle Exh	0 09
Start Ex	0
Total Ex	2 55
Carbon Dioxide Emissions (000)	
Run Exh	0 25
Idle Exh	0
Start Ex	0
Total Ex	0 25
PM10 Emissions	
Run Exh	0 14
Idle Exh	0
Start Ex	0
Total Ex	0 14
TireWear	0
BrakeWr	0
Total	0 14
Lead	0
SOx	0 02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	22 56

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/27 14:40:15
Scen Year: 2005 -- Model year 1999 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1999 to 1999 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	9.426	9.362

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	46.943	46.623

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	11S.235	117.43

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.5S3	0.579

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.375	1.366

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+A
Run Date : 2006/08/23 08:38:27
Scen Year: 2005 Model year 2000 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	399
VMT/1000	82
Trips	2019
Reactive Organic Gas Emissions	
Run Exh	0 35
Idle Exh	0 01
Start Ex	0
Total Ex	0 36
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 36
Carbon Monoxide Emissions	
Run Exh	0 87
Idle Exh	0 03
Start Ex	0
Total Ex	0 91
Oxides of Nitrogen Emissions	
Run Exh	2 57
Idle Exh	0 09
Start Ex	0
Total Ex	2 65
Carbon Dioxide Emissions (000)	
Run Exh	0 26
Idle Exh	0
Start Ex	0
Total Ex	0 26
PM10 Emissions	
Run Exh	0 14
Idle Exh	0
Start Ex	0
Total Ex	0 14
TireWear	0
BrakeWr	0
Total	0 14
Lead	0
SOx	0 02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	23 84

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/27 14:40:50
Scen Year: 2005 -- Model year 2000 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 2000 to 2000 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	9.426	9.231

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	46.943	45.974

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	11S.235	115.793

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.5S3	0.571

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.375	1.347

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+A
Run Date : 2006/08/23 08:38:34
Scen Year: 2005 Model year 2005 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	264
VMT/1000	56
Trips	1335
Reactive Organic Gas Emissions	
Run Exh	0 05
Idle Exh	0
Start Ex	0
Total Ex	0 06
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 06
Carbon Monoxide Emissions	
Run Exh	0 08
Idle Exh	0 02
Start Ex	0
Total Ex	0 1
Oxides of Nitrogen Emissions	
Run Exh	0 91
Idle Exh	0 06
Start Ex	0
Total Ex	0 97
Carbon Dioxide Emissions (000)	
Run Exh	0 18
Idle Exh	0
Start Ex	0
Total Ex	0 18
PM10 Emissions	
Run Exh	0 03
Idle Exh	0
Start Ex	0
Total Ex	0 03
TireWear	0
BrakeWr	0
Total	0 03
Lead	0
SOx	0 02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	16 18

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/25 10:23:33
Scen Year: 2005 -- Model year 2005 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 2005 to 2005 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	7.744	7.665

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	43.6S9	43.247

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	122.647	121.404

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.5S3	0.577

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.066	1.056

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

APPENDIX C

EMISSION FACTOR DERIVATION AND EMFAC-WD 2006
OUTPUT FOR ON-ROAD DIESEL-FUELED TRUCKS

Emission Factors for On-Road Diesel-Fueled Trucks
Stockton Rail Yard, Stockton, CA

Running Exhaust Emissions

Equipment Type	Make	Model	Model Year	Vehicle Class	Emission Factors (g/mi)				
					ROG	CO	NOx	DPM	SOx
Dump Truck	Ford	Unk.	1985	HHD	9.07	29.94	28.12	4.54	0.00
Sweeper Truck	Unk.	Unk.	1990	HHD	8.72	29.31	28.61	4.19	0.35
Pickup Truck	Ford	F800	1992	MHD	0.00	9.07	18.14	1.81	0.00
Boom Truck	Ford	F800	1993	MHD	1.51	7.56	18.14	1.51	0.00
Boom Truck	GMC	C7500	1998	MHD	0.70	4.88	12.56	0.70	0.00
Boom Truck	International	Unk.	1998	MHD	0.70	4.88	12.56	0.70	0.00
Pickup Truck	Ford	F550	2005	LHD	0.30	1.51	5.44	0.00	0.00
Pickup Truck	Ford	F550	2005	LHD	0.30	1.51	5.44	0.00	0.00
Boom Truck	Sterling	Unk.	2005	HHD	0.81	1.30	14.74	0.49	0.32
Pickup Truck	GMC	550	2005	LHD	0.30	1.51	5.44	0.00	0.00
Total									

Idling Exhaust Emissions

Equipment Type	Make	Model	Model Year	Vehicle Class	Emission Factors (g/hr)				
					ROG	CO	NOx	DPM	SOx
Dump Truck	Ford	Unk.	1985	HHD	33.61	74.81	58.65	7.10	0.58
Sweeper Truck	Unk.	Unk.	1990	HHD	19.68	61.68	84.93	3.54	0.58
Pickup Truck	Ford	F800	1992	MHD	3.17	26.30	75.05	1.40	0.37
Boom Truck	Ford	F800	1993	MHD	3.17	26.30	75.05	1.40	0.37
Boom Truck	GMC	C7500	1998	MHD	3.17	26.30	75.05	0.75	0.37
Boom Truck	International	Unk.	1998	MHD	3.17	26.30	75.05	0.75	0.37
Pickup Truck	Ford	F550	2005	LHD	3.17	26.30	75.05	0.75	0.37
Pickup Truck	Ford	F550	2005	LHD	3.17	26.30	75.05	0.75	0.37
Boom Truck	Sterling	Unk.	2005	HHD	7.74	43.69	122.65	1.07	0.58
Pickup Truck	GMC	550	2005	LHD	3.17	26.30	75.05	0.75	0.37
Total									

Notes:
1. Running exhaust emissions calculated using the EMFAC-WD 2006 model with the BURDEN output option.
2. Running exhaust emission factor calculations assumed an average speed of 15 mph.
3. Idling exhaust emissions factors calculated using the EMFAC-WD 2006 model with the EMFAC output option.

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+A
Run Date : 2006/08/23 09:12:16
Scen Year: 2005 Model year 1985 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	163
VMT/1000	10
Trips	826
Reactive Organic Gas Emissions	
Run Exh	0 1
Idle Exh	0 01
Start Ex	0
Total Ex	0 11
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 11
Carbon Monoxide Emissions	
Run Exh	0 33
Idle Exh	0 02
Start Ex	0
Total Ex	0 35
Oxides of Nitrogen Emissions	
Run Exh	0 31
Idle Exh	0 02
Start Ex	0
Total Ex	0 33
Carbon Dioxide Emissions (000)	
Run Exh	0 03
Idle Exh	0
Start Ex	0
Total Ex	0 03
PM10 Emissions	
Run Exh	0 05
Idle Exh	0
Start Ex	0
Total Ex	0 05
TireWear	0
BrakeWr	0
Total	0 05
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	2 95

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/27 14:38:03
Scen Year: 2005 -- Model year 1985 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1985 to 1985 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	33.611	33.22

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	74.81	73.94

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	58.647	57.965

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.576

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	7.099	7.016

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER
Run Date : 2006/08/23 09:12:24
Scen Year: 2005 Model year 1990 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	296
VMT/1000	26
Trips	1496
Reactive Organic Gas Emissions	
Run Exh	0 25
Idle Exh	0 01
Start Ex	0
Total Ex	0 26
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 26
Carbon Monoxide Emissions	
Run Exh	0 84
Idle Exh	0 03
Start Ex	0
Total Ex	0 87
Oxides of Nitrogen Emissions	
Run Exh	0 82
Idle Exh	0 05
Start Ex	0
Total Ex	0 87
Carbon Dioxide Emissions (000)	
Run Exh	0 08
Idle Exh	0
Start Ex	0
Total Ex	0 09
PM10 Emissions	
Run Exh	0 12
Idle Exh	0
Start Ex	0
Total Ex	0 12
TireWear	0
BrakeWr	0
Total	0 12
Lead	0
SOx	0 01
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	7 71

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/27 14:38:49
Scen Year: 2005 -- Model year 1990 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1990 to 1990 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	19.683	19.429

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	61.676	60.881

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	84.929	83.833

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.583	0.575

Pollutant Name: PM10 Temperature: 65F

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	3.54	3.495

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+Accr+IMDl
Run Date : 2006/08/23 09:12:34
Scen Year: 2005 Model year 1992 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	MHDT DSL
Vehicles	117
VMT/1000	5
Trips	3282
Reactive Organic Gas Emissions	
Run Exh	0
Idle Exh	0
Start Ex	0
Total Ex	0
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0
Carbon Monoxide Emissions	
Run Exh	0 05
Idle Exh	0
Start Ex	0
Total Ex	0 05
Oxides of Nitrogen Emissions	
Run Exh	0 1
Idle Exh	0
Start Ex	0
Total Ex	0 11
Carbon Dioxide Emissions (000)	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
PM10 Emissions	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
TireWear	0
BrakeWr	0
Total	0 01
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	0 79

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/25 07:48:17
Scen Year: 2005 -- Model year 1992 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1992 to 1992 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	23.103	3.173	7.868

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	141.992	26.3	53.556

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	1.561	75.051	57.737

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0.049	0.365	0.291

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	1.395	1.066

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 S+FCF+IM+Bugs+BER+Accr+IM
Run Date : 2006/0S/23 09:12:40
Scen Year: 2005 Model year 1993 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	MHDT DSL
Vehicles	130
VMT/1000	6
Trips	3646
Reactive Organic Gas Emissions	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 01
Carbon Monoxide Emissions	
Run Exh	0 05
Idle Exh	0
Start Ex	0
Total Ex	0 06
Oxides of Nitrogen Emissions	
Run Exh	0 12
Idle Exh	0
Start Ex	0
Total Ex	0 12
Carbon Dioxide Emissions (000)	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
PM10 Emissions	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
TireWear	0
BrakeWr	0
Total	0 01
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	0 93

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/25 07:4S:23
Scen Year: 2005 -- Model year 1993 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 1993 to 1993 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	23.103	3.173	6.002

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	141.992	26.3	42.722

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	1.561	75.051	64.619

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0.049	0.365	0.32

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	1.395	1.197

Pollutant Name: PM10 - Tire Wear Temperature: 65F

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+Ac
Run Date : 2006/08/23 09:12:49
Scen Year: 2005 Model year 1998 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	MHDT TOT
Vehicles	213
VMT/1000	13
Trips	6255
Reactive Organic Gas Emissions	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 01
Carbon Monoxide Emissions	
Run Exh	0 07
Idle Exh	0
Start Ex	0 02
Total Ex	0 09
Oxides of Nitrogen Emissions	
Run Exh	0 18
Idle Exh	0
Start Ex	0
Total Ex	0 19
Carbon Dioxide Emissions (000)	
Run Exh	0 02
Idle Exh	0
Start Ex	0
Total Ex	0 02
PM10 Emissions	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
TireWear	0
BrakeWr	0
Total	0 01
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0 13
Diesel	1 85

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/25 07:48:28
Scen Year: 2005 -- Model year 1998 selected
Season : Annual
Area : San Joaquin
****

Year: 2005 -- Model Years 1998 to 1998 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.8+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	23.103	3.173	4.369

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	141.992	26.3	33.24

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	1.561	75.051	70.642

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0.049	0.365	0.346

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0.753	0.708

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	MHD NCAT	MHD CAT	MHD DSL	MHD ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 S+FCF+IM+Bugs+BER+
Run Date : 2006/0S/23 09:12:59
Scen Year: 2005 Model year 2005 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	LHDT1 DSL
Vehicles	566
VMT/1000	30
Trips	7120
Reactive Organic Gas Emissions	
Run Exh	0 01
Idle Exh	0
Start Ex	0
Total Ex	0 01
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 01
Carbon Monoxide Emissions	
Run Exh	0 05
Idle Exh	0
Start Ex	0
Total Ex	0 05
Oxides of Nitrogen Emissions	
Run Exh	0 1S
Idle Exh	0
Start Ex	0
Total Ex	0 1S
Carbon Dioxide Emissions (000)	
Run Exh	0 02
Idle Exh	0
Start Ex	0
Total Ex	0 02
PM10 Emissions	
Run Exh	0
Idle Exh	0
Start Ex	0
Total Ex	0
TireWear	0
BrakeWr	0
Total	0
Lead	0
SOx	0
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	1 53

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/25 07:4S:11
Scen Year: 2005 -- Model year 2005 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 2005 to 2005 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	27.137	3.173	12.979

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	155.23	26.3	79.059

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	1.79	75.051	45.072

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0.049	0.365	0.236

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	0.753	0.445

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	LHD1 NCAT	LHD1 CAT	LHD1 DSL	LHD1 ALL
0	0	0	0	0

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2 23 7 60616 Sp: 2 20 8+FCF+IM+Bugs+BER+A
Run Date : 2006/08/23 08:38:34
Scen Year: 2005 Model year 2005 selected
Season : Annual
Area : San Joaquin County
I/M Stat : Enhanced Interim (2005)
Emissions: Tons Per Day
****

	HHDT DSL
Vehicles	264
VMT/1000	56
Trips	1335
Reactive Organic Gas Emissions	
Run Exh	0 05
Idle Exh	0
Start Ex	0
Total Ex	0 06
Diurnal	0
Hot Soak	0
Running	0
Resting	0
Total	0 06
Carbon Monoxide Emissions	
Run Exh	0 08
Idle Exh	0 02
Start Ex	0
Total Ex	0 1
Oxides of Nitrogen Emissions	
Run Exh	0 91
Idle Exh	0 06
Start Ex	0
Total Ex	0 97
Carbon Dioxide Emissions (000)	
Run Exh	0 18
Idle Exh	0
Start Ex	0
Total Ex	0 18
PM10 Emissions	
Run Exh	0 03
Idle Exh	0
Start Ex	0
Total Ex	0 03
TireWear	0
BrakeWr	0
Total	0 03
Lead	0
SOx	0 02
Fuel Consumption (000 gallons)	
Gasoline	0
Diesel	16 18

Title : San Joaquin County Subarea Annual CYr 2005 Default Title
Version : Emfac working draft V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg +FCF2+Po
Run Date : 2006/10/25 10:23:33
Scen Year: 2005 -- Model year 2005 selected
Season : Annual
Area : San Joaquin
****
Year: 2005 -- Model Years 2005 to 2005 Inclusive --
Emfac working draft Emission Factors: V2.23.7.60616 Sp: 2.20.S+FCF+IM+Bugs+BER+Accr+IMDlg

County Average San Joaquin

Table 1: Running Exhaust Emissions (grams/mile; grams/idle-hour)

Pollutant Name: Reactive Org Gases Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	7.744	7.665

Pollutant Name: Carbon Monoxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	43.6S9	43.247

Pollutant Name: Oxides of Nitrogen Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	122.647	121.404

Pollutant Name: Sulfur Dioxide Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0.5S3	0.577

Pollutant Name: PM10 Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	1.066	1.056

Pollutant Name: PM10 - Tire Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

Pollutant Name: PM10 - Break Wear Temperature: 65F Relative Humidity: 60%

Speed MPH	HHD NCAT	HHD CAT	HHD DSL	HHD ALL
0	0	0	0	0

APPENDIX D

EMISSION FACTOR DERIVATION AND OFFROAD2006 OUTPUT FOR HEAVY EQUIPMENT

Emission Factors for Heavy Equipment
Stockton Rail Yard, Stockton, CA

Equipment Type	Make	Model	Year	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions	
				VOC	CO	NOX	DPM	SOx	Part 1 (g/hr)	Part 2 (g/yr)
Backhoe	John Deere	610C	1992	1.87	4.64	10.47	0.98	0.06	-	-
Backhoe	Case	480C	pre-1990	1.93	5.72	13.73	0.90	0.06	-	-
Trackmobile	Trackmobile	TM4000	1990	2.41	5.53	12.29	1.35	0.06	-	-
Fork Lift	Clark	Unknown	pre-1985	13.41	25.33	10.38	2.32	0.07	-	-
Crane	Pettibone	25RS	1970	1.65	4.26	11.45	0.74	0.06	-	-
Crane	Century	6CT8-3-C	1980	1.65	4.26	11.45	0.74	0.06	-	-
Fork Lift	JCB930	YPKXL04.2ARI	2000	1.74	4.40	8.04	0.98	0.06	-	-
Total										

Notes:
1. Emission factors and load factors from CARB s OFFROAD2006 model.
2. Assumes a Diesel fuel sulfur content of 130 ppm.
3. VOC evaporative emissions are negligible.

Cnty	SCC	HP	TechType	MYr	ROG-Exhaust	CO-Exhaus	NOx-Exhau	CO2-Exha	SO2-Exhau	PM-Exhaus	Crankcase	FuelCons.	Activity	LF	HPAvg	ROG/ROG	ROG (lb/hp-hr)	CO (lb/hp-hr)	NOx (lb/hp-hr)	SOx (lb/hp-hr)	PM (lb/hp-hr)
6077	2270002045	175		1988	2.19928E-06	5.69E-06	1.53E-05	0.000758	7.87E-08	9.86E-07			0.018896	0.43	149	1	0.003633246	0.009401333	0.025241215	0.000130035	0.001628195
6077	2270002045	250		1988	5.95245E-06	1.54E-05	4.14E-05	0.002053	2.13E-07	2.67E-06			0.036635	0.43	208	1	0.003633245	0.009401337	0.025241213	0.000130035	0.001628195
6077	2270002066	120		1992	0.001803845	0.004461	0.010075	0.546967	5.92E-05	0.000948			21.16679	0.55	75	1	0.004131904	0.010218695	0.023078417	0.000135569	0.002170682
6077	2270002066	250		1989	9.31325E-05	0.000253	0.000686	0.038011	3.95E-06	4.01E-05			0.443067								
6077	2270002066	250		1988	6.4795E-05	0.000175	0.000473	0.0258	2.68E-06	2.81E-05			0.300735								
6077	2270002066	250		1987	7.40434E-05	0.000238	0.000558	0.022255	2.31E-06	3.61E-05			0.259413								
6077	2270002066	250		1986	6.77551E-05	0.000217	0.000506	0.019892	2.06E-06	3.33E-05			0.231864								
6077	2270002066	250		1985	6.31519E-05	0.000201	0.000468	0.018119	1.88E-06	3.12E-05			0.211203								
6077	2270002066	250		1984	5.85075E-05	0.000177	0.000403	0.015362	1.59E-06	2.72E-05			0.179064								
6077	2270002066	250		1983	5.29064E-05	0.000159	0.000361	0.01359	1.41E-06	2.47E-05			0.158402								
6077	2270002066	250		1982	4.77889E-05	0.000143	0.000324	0.012014	1.25E-06	2.24E-05			0.140037								
6077	2270002066	250		1981	4.16045E-05	0.000124	0.00028	0.010241	1.06E-06	1.96E-05			0.119376								
6077	2270002066	250		1980	3.43035E-05	0.000101	0.000229	0.008272	8.59E-07	1.62E-05			0.096419								
6077	2270002066	250		1979	3.01529E-05	8.51E-05	0.000206	0.006696	6.95E-07	1.35E-05			0.078053								
6077	2270002066	250		1978	2.26146E-05	6.35E-05	0.000153	0.004924	5.11E-07	1.01E-05			0.057392								
6077	2270002066	250		1977	1.84464E-05	5.16E-05	0.000124	0.003939	4.09E-07	8.31E-06			0.045914								
6077	2270002066	250		1976	1.31608E-05	3.66E-05	8.82E-05	0.002757	2.86E-07	5.95E-06			0.03214								
6077	2270002066	250		1975	7.18346E-06	1.99E-05	4.78E-05	0.001477	1.53E-07	3.26E-06			0.017218								
6077	2270002066	250		1974	2.43883E-06	6.72E-06	1.62E-05	0.000492	5.11E-08	1.11E-06			0.005739								
			total		0.000691986	0.002051	0.004925	0.203843	2.12E-05	0.000321			2.376035	0.55	249	1	0.004253165	0.012607541	0.030272545	0.000130035	0.001973156
6077	2270003020	50		1984	2.33315E-05	4.41E-05	1.83E-05	0.001008	1.2E-07	4.04E-06			0.137552								
6077	2270003020	50		1983	1.27548E-05	2.41E-05	9.77E-06	0.000531	6.33E-08	2.2E-06			0.072396								
6077	2270003020	50		1982	4.40994E-06	8.31E-06	3.31E-06	0.000177	2.11E-08	7.59E-07			0.024132								
			total		4.04962E-05	7.65E-05	3.13E-05	0.001716	2.05E-07	7.01E-06			0.234079	0.3	39	1	0.029573012	0.055841045	0.022883225	0.000149402	0.005115957
6077	2270003020	120		2000	0.000299224	0.000759	0.001386	0.097947	1.06E-05	0.000168			6.279312	0.3	83	1	0.003827493	0.009708647	0.017731408	0.000135568	0.002151044
6077	2270003040	120		1990	0.000235746	0.000541	0.001203	0.055649	6.02E-06	0.000132			1.795694	0.51	97	1	0.00530763	0.01218864	0.027087867	0.000135568	0.002974242
6077	2270006005	750		1998	5.73E-05	1.32E-04	8.45E-04	7.78E-02	7.21E-06	1.91E-05			2.86E-01	0.74	586	1	0.000923825	0.002129967	0.01361339	0.000116202	0.000308398

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2005	1	2.194628	8.004401	3.28275E-05	0.000425416	0.000658338	0.08808409	9.1421E-06	2.13262E-05	0	2.96197E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2004	1	2.046133	7.470732	4.68235E-05	0.000409549	0.000665958	0.08212405	8.52352E-06	2.55809E-05	0	4.22481E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2003	1	1.88094	6.878171	6.66804E-05	0.00038836	0.00070041	0.07549386	7.83538E-06	3.20173E-05	0	6.01646E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2002	0	1.657318	6.083153	0.000115166	0.000352651	0.000843433	0.06651846	6.90384E-06	4.81975E-05	0	1.03912E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2001	0	1.587829	5.83152	0.000115656	0.00034789	0.000829365	0.06372947	6.61438E-06	4.9362E-05	0	1.04355E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2000	1	1.796177	6.600576	0.00013685	0.000404879	0.000962281	0.07209177	7.48229E-06	5.94423E-05	0	1.23477E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1999	1	1.853527	6.815318	0.000147429	0.000429508	0.001017865	0.07439356	7.72119E-06	6.50585E-05	0	1.33023E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1998	1	1.776576	6.536201	0.00014726	0.000422893	0.000999434	0.07130504	7.40063E-06	6.59215E-05	0	1.3287E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1997	0	1.60354	5.90304	0.000138289	0.000391827	0.000923598	0.06436004	6.67982E-06	6.27176E-05	0	1.24776E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1996	0	0.684461	2.521149	6.13208E-05	0.00017157	0.000468353	0.02747166	2.85124E-06	2.56785E-05	0	5.53288E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1995	0	0.456092	1.680955	4.23892E-05	0.000117206	0.000319176	0.01830579	1.89993E-06	1.79457E-05	0	3.82471E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1994	0	0.337554	1.244805	3.25032E-05	8.88751E-05	0.000241469	0.01354815	1.40614E-06	1.38995E-05	0	2.93271E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1993	0	0.189058	0.6975989	1.88378E-05	5.09709E-05	0.000138181	0.007588059	7.87552E-07	8.13089E-06	0	1.6997E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1992	0	0.149834	0.5531911	1.54315E-05	4.13419E-05	0.000111841	0.006013766	6.24159E-07	6.71823E-06	0	1.39236E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1991	0	0.107055	0.3954802	1.13843E-05	3.02143E-05	8.15732E-05	0.004296776	4.45955E-07	4.99605E-06	0	1.02719E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1990	0	0.094447	0.3491062	1.03599E-05	2.72521E-05	7.34338E-05	0.003790725	3.93433E-07	4.58052E-06	0	9.34758E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1989	0	0.056687	0.2096554	6.40791E-06	1.67145E-05	4.49559E-05	0.00227519	2.36138E-07	2.85298E-06	0	5.78176E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1988	0	0.018896	0.06992591	2.19928E-06	5.69081E-06	1.5279E-05	0.000758397	7.87128E-08	9.85579E-07	0	1.98437E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2005	1	4.255011	21.54913	6.81295E-05	0.000392326	0.001757642	0.2384044	2.47436E-05	3.91815E-05	0	6.14722E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2004	1	3.967103	20.10126	8.61804E-05	0.000377679	0.001748523	0.2222732	2.30694E-05	3.90058E-05	0	7.77592E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2003	1	3.646825	18.49172	0.000110456	0.000358126	0.001800783	0.2043282	2.12069E-05	4.14874E-05	0	9.96624E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2002	1	3.213255	16.31318	0.000146644	0.000325187	0.002067845	0.1800358	1.86856E-05	4.81443E-05	0	1.32315E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2001	1	3.078529	15.63305	0.00014726	0.000320786	0.002033379	0.1724872	1.79022E-05	4.86121E-05	0	1.3287E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2000	1	3.482484	17.68872	0.000174235	0.000373324	0.002359279	0.1951202	2.02512E-05	5.78034E-05	0	1.57209E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1999	1	3.593673	18.258	0.000187694	0.000396023	0.002495584	0.2013502	2.08978E-05	6.25514E-05	0	1.69354E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1998	1	3.44448	17.50433	0.000187471	0.000389914	0.002450423	0.1929911	2.00302E-05	6.27365E-05	0	1.69152E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1997	1	3.108992	15.80331	0.000176043	0.000361262	0.002264506	0.1741939	1.80793E-05	5.9137E-05	0	1.58841E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1996	0	1.327053	6.747201	7.80586E-05	0.000158183	0.000989106	0.07435355	7.71703E-06	2.63141E-05	0	7.0431E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1995	0	0.884284	4.549594	0.000114729	0.000317223	0.000863868	0.0495456	5.14226E-06	4.85711E-05	0	1.03518E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1994	0	0.65446	3.369134	8.79716E-05	0.000240545	0.00065355	0.03666881	3.8058E-06	3.76198E-05	0	7.93754E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1993	0	0.36655	1.888088	5.09854E-05	0.000137955	0.000373993	0.02053748	2.13155E-06	2.20067E-05	0	4.60033E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1992	0	0.290502	1.497241	4.17661E-05	0.000111894	0.000302704	0.01627658	1.68932E-06	1.81832E-05	0	3.76849E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1991	0	0.207561	1.07039	3.08122E-05	8.17766E-05	0.000220782	0.01162947	1.207E-06	1.35221E-05	0	2.78013E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1990	0	0.183116	0.9448746	2.80396E-05	7.37591E-05	0.000198753	0.0102598	1.06485E-06	1.23974E-05	0	2.52997E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1989	0	0.109906	0.5674436	1.73434E-05	4.52388E-05	0.000121676	0.006157924	6.39121E-07	7.72174E-06	0	1.56486E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1988	0	0.036635	0.1892581	5.95245E-06	1.54025E-05	4.13534E-05	0.002052642	2.1304E-07	2.66752E-06	0	5.3708E-07
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2005	21	52.83642	124.3461	0.000847881	0.007635774	0.01197677	1.365334	0.000147736	0.000591943	0	7.65029E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2004	21	52.63005	124.1481	0.001456189	0.008011786	0.01311738	1.360002	0.000147159	0.000844465	0	0.00013139
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2003	21	51.94328	123.2769	0.003111349	0.008743813	0.0162726	1.342255	0.000145239	0.001563528	0	0.000280732
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2002	20	51.20804	121.6043	0.003185188	0.008817556	0.01636684	1.323256	0.000143183	0.001629696	0	0.000287394
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2001	20	50.31062	119.5442	0.003245178	0.00885707	0.01639888	1.300066	0.000140674	0.001687887	0	0.000292807
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2000	24	61.50771	146.2368	0.004109012	0.01106553	0.02043847	1.589408	0.000171982	0.002169602	0	0.00037075
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1999	24	60.23257	143.2902	0.004162481	0.01106844	0.02039653	1.556458	0.000168416	0.002228484	0	0.000375574
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1998	23	58.78019	139.918	0.004197417	0.01102826	0.02027726	1.518926	0.000164355	0.002276103	0	0.000378726
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1997	23	57.50322	136.9596	0.004238601	0.01101046	0.02511401	1.485928	0.000160785	0.00212209	0	0.000382442
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1996	23	56.77089	135.2955	0.004315304	0.0110892	0.02523983	1.467004	0.000158737	0.002184381	0	0.000389363
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1995	18	44.84735	106.9429	0.003512201	0.008933119	0.02029079	1.15889	0.000125398	0.001796155	0	0.0003169
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1994	12	30.95396	73.85647	0.002495401	0.006285092	0.01424784	0.7998745	8.65504E-05	0.001288419	0	0.000225156
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1993	8	21.19232	50.59505	0.001757236	0.004384765	0.00992101	0.5476264	5.92559E-05	0.000915445	0	0.000158553
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1992	8	21.16679	50.56401	0.001803845	0.004461125	0.01007523	0.5469669	5.91845E-05	0.000947644	0	0.000162758
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1991	8	19.90047	47.56706	0.001741737	0.004270986	0.009628681	0.5142437	5.56437E-05	0.000922259	0	0.000157154
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1990	12	30.7187	73.46871	0.002759288	0.006711248	0.01510414	0.7937954	8.58926E-05	0.001471944	0	0.000248966
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1989	7	18.16577	43.47201	0.001673545	0.004038819	0.009074569	0.4694177	5.07933E-05	0.000899027	0	0.000151001
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1988	5	12.33014	29.52433	0.001164313	0.002788932	0.006256216	0.3186203	3.44763E-05	0.000629619	0	0.000105054
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1987	4	10.63592	25.7886	0.001496278	0.003365593	0.008148599	0.2748404	2.97391E-05	0.000681464	0	0.000135007
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1986	4	9.506438	23.06911	0.001369203	0.003058636	0.007394464	0.2456538	2.6581E-05	0.0006273	0	0.000123541
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1985	3	8.659329	21.03087	0.001276181	0.00283204	0.006836845	0.2237639	2.42124E-05	0.000587984	0	0.000115148
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1984	3	7.341607	17.84528	0.001106554	0.002440038	0.005882333	0.1897128	2.05279E-05	0.000512566	0	9.98426E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1983	3	6.494499	15.79928	0.001000615	0.002192962	0.005279572	0.1678229	1.81593E-05	0.00046586	0	9.02839E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1982	2	5.74151	13.97902	0.00090382	0.001969174	0.004734607	0.1483651	1.60538E-05	0.000422842	0	8.15502E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1981	2	4.894406	11.92639	0.000786853	0.001704616	0.004093314	0.1264753	1.36852E-05	0.000369828	0	7.09965E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1980	2	3.953171	9.640799	0.000648768	0.001397784	0.003352378	0.102153	1.10535E-05	0.000306277	0	5.85373E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1979	1	3.200188	7.810897	0.000535906	0.001148523	0.002751265	0.08269535	8.94804E-06	0.000254067	0	4.83539E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1978	1	2.353078	5.748039	0.000401925	0.00085699	0.002050514	0.0608054	6.57944E-06	0.00019132	0	3.6265E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1977	1	1.882463	4.602217	0.000327841	0.000695582	0.001662431	0.04864432	5.26355E-06	0.00015666	0	2.95806E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1976	1	1.317723	3.224203	0.0002339	0.000493901	0.001179116	0.03405103	3.68449E-06	0.000112186	0	2.11044E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1975	0	0.705924	1.728671	0.000127666	0.000268336	0.000639927	0.01824162	1.97383E-06	6.14512E-05	0	1.15191E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1974	0	0.235308	0.5766972	4.33432E-05	9.06941E-05	0.000216062	0.006080542	6.57944E-07	2.09343E-05	0	3.91078E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2005	1	1.288692	9.992829	3.06597E-05	0.000181152	0.000813153	0.1105588	1.14747E-05	1.8016E-05	0	2.76637E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2004	1	1.283659	9.957986	0.000040021	0.000184772	0.000859685	0.110127	1.14299E-05	1.8846E-05	0	3.61103E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2003	1	1.266909	9.834395	5.47531E-05	0.000186632	0.000944245	0.10869	1.12808E-05	2.12167E-05	0	4.94028E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2002	0	1.248976	9.706854	8.3366E-05	0.000188201	0.001200508	0.1071515	1.11211E-05	2.72161E-05	0	7.52198E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2001	0	1.227088	9.538467	8.49354E-05	0.000189039	0.00120287	0.1052737	1.09262E-05	2.7853E-05	0	7.66358E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2000	1	1.500188	11.66345	0.000107543	0.000236169	0.001499189	0.1287033	1.33579E-05	3.54137E-05	0	9.70347E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1999	1	1.469088	11.42372	0.000108942	0.000236226	0.001496125	0.1260351	1.3081E-05	3.60131E-05	0	9.82967E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1998	1	1.433663	11.15027	0.000109856	0.000235363	0.001487388	0.1229959	1.27656E-05	3.64461E-05	0	9.9121E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1997	1	1.402518	10.91002	0.000110933	0.000234978	0.001481823	0.120324	1.24882E-05	3.69275E-05	0	1.00093E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1996	1	1.384655	10.77301	0.00011294	0.000236653	0.001489356	0.1187915	1.23292E-05	3.77141E-05	0	1.01904E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1995	0	1.093836	8.603083	0.000195426	0.000559612	0.001534724	0.09384177	9.73968E-06	8.00445E-05	0	1.7633E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1994	0	0.754976	5.940477	0.000138853	0.000393728	0.00107769	0.06477043	6.72242E-06	5.74156E-05	0	1.25285E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1993	0	0.516886	4.068829	9.77814E-05	0.000274681	0.000750433	0.04434435	4.60243E-06	4.07933E-05	0	8.82266E-06

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1992	0	0.516264	4.065677	0.000100377	0.000279464	0.000762119	0.04429097	4.59689E-06	4.22268E-05	0	9.05688E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1991	0	0.485377	3.824084	9.69234E-05	0.000267553	0.00072836	0.04164121	4.32187E-06	4.10944E-05	0	8.74524E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1990	0	0.749236	5.90545	0.000153551	0.000420421	0.001142579	0.06427805	6.67131E-06	6.55857E-05	0	1.38546E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1989	0	0.443067	3.493737	9.31325E-05	0.000253008	0.000686478	0.03801138	3.94514E-06	4.00571E-05	0	8.40319E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.300735	2.372413	6.4795E-05	0.00017471	0.000473285	0.02580047	2.67779E-06	2.80526E-05	0	5.84635E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.259413	2.065674	7.40434E-05	0.000238381	0.000557896	0.02225537	2.30985E-06	3.61281E-05	0	6.68082E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.231864	1.847409	6.77551E-05	0.000216637	0.000506249	0.01989197	2.06456E-06	3.32565E-05	0	6.11344E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.211203	1.683789	6.31519E-05	0.000200585	0.000468059	0.01811942	1.88058E-06	3.11721E-05	0	5.6981E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.179064	1.43043	5.85075E-05	0.000177125	0.000402701	0.01536212	1.59441E-06	2.71738E-05	0	5.27904E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.158402	1.266167	5.29064E-05	0.000159192	0.000361426	0.01358956	1.41044E-06	2.46976E-05	0	4.77366E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.140037	1.120062	4.77889E-05	0.00014295	0.000324111	0.01201397	1.24691E-06	2.24169E-05	0	4.31191E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1981	0	0.119376	0.9553999	4.16045E-05	0.000123747	0.000280204	0.01024141	1.06294E-06	1.96064E-05	0	3.75391E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1980	0	0.096419	0.772148	3.43035E-05	0.000101474	0.000229478	0.008271906	8.58528E-07	1.62372E-05	0	3.09515E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1979	0	0.078053	0.6263924	3.01529E-05	8.51326E-05	0.000205689	0.006696306	6.94999E-07	1.34693E-05	0	2.72064E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1978	0	0.057392	0.4608803	2.26146E-05	6.35211E-05	0.000153301	0.004923755	5.11028E-07	1.01427E-05	0	2.04048E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1977	0	0.045914	0.3689424	1.84464E-05	5.15558E-05	0.000124287	0.003939004	4.08823E-07	8.30528E-06	0	1.66439E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1976	0	0.03214	0.2584263	1.31608E-05	3.66063E-05	8.81539E-05	0.002757302	2.86176E-07	5.94746E-06	0	1.18748E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1975	0	0.017218	0.138532	7.18346E-06	1.98876E-05	4.78429E-05	0.001477126	1.53309E-07	3.2578E-06	0	6.48152E-07
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1974	0	0.005739	0.04620709	2.43883E-06	6.72156E-06	1.61535E-05	0.000492376	5.11029E-08	1.10982E-06	0	2.20051E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2005	1	5.150716	7.318703	5.20808E-05	0.000454515	0.000709732	0.0803431	8.69352E-06	3.59181E-05	0	4.69916E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2004	1	5.029932	7.167117	9.13156E-05	0.000477802	0.000774562	0.07845908	8.48966E-06	5.29917E-05	0	8.23926E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2003	1	5.095717	7.310581	0.000201217	0.000546221	0.00101035	0.07948521	8.60069E-06	0.0001053	0	1.81555E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2002	1	5.718499	8.213609	0.000241372	0.000639056	0.001176686	0.08919966	9.65184E-06	0.000129828	0	2.17786E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2001	1	5.631436	8.097967	0.000253024	0.000655007	0.001200973	0.08784165	9.5049E-06	0.000139332	0	2.283E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2000	1	6.279312	9.04009	0.000299224	0.000758997	0.001386196	0.09794746	1.05984E-05	0.000168163	0	2.69985E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1999	1	6.088161	8.775064	0.000306685	0.000763655	0.001389622	0.09496579	1.02758E-05	0.000175456	0	2.76717E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1998	1	5.947677	8.582513	0.000315795	0.000773156	0.001402127	0.09277447	1.00387E-05	0.000183533	0	2.84937E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1997	1	5.684893	8.212811	0.000317315	0.00076492	0.001718235	0.08867546	9.59512E-06	0.000170633	0	2.86308E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1996	1	5.569162	8.054917	0.000326012	0.000774744	0.001734945	0.08687024	9.39979E-06	0.000177518	0	2.94156E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1995	1	4.839629	7.007844	0.000296478	0.000695326	0.001552593	0.07549065	8.16846E-06	0.000163267	0	2.67507E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1994	1	3.911213	5.670019	0.000250248	0.000579773	0.001291051	0.06100882	6.60145E-06	0.000139222	0	2.25794E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1993	0	1.077971	1.564517	7.19047E-05	0.000164707	0.000365832	0.01681468	1.81943E-06	4.03761E-05	0	6.48785E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1992	0	0.764966	1.111513	5.3108E-05	0.00012037	0.000266707	0.01193228	1.29113E-06	3.00752E-05	0	4.79185E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1991	0	0.667375	0.9708257	4.81491E-05	0.000108057	0.000238876	0.01041001	1.12641E-06	2.74797E-05	0	4.34441E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1990	0	1.035729	1.508398	7.75436E-05	0.000172422	0.000380336	0.01615576	1.74813E-06	4.45736E-05	0	6.99664E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1989	0	0.818524	1.193435	6.35095E-05	0.000139996	0.000308171	0.0127677	1.38153E-06	3.67485E-05	0	5.73036E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.716208	1.045452	5.752E-05	0.000125762	0.000276297	0.01117173	1.20884E-06	3.34872E-05	0	5.18994E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.579788	0.8610737	7.00129E-05	0.000143687	0.00034074	0.009043789	9.78582E-07	3.43096E-05	0	6.31715E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.420631	0.6257008	5.24584E-05	0.000106883	0.000253021	0.00656118	7.09952E-07	2.58436E-05	0	4.73324E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.312631	0.4657914	4.02266E-05	8.14015E-05	0.00019238	0.004876553	5.27667E-07	1.99159E-05	0	3.62958E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.215999	0.3223329	2.86478E-05	5.75963E-05	0.000135904	0.003369253	3.6457E-07	1.42491E-05	0	2.58484E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.113684	0.1699193	1.55277E-05	3.10271E-05	7.31008E-05	0.001773291	1.91879E-07	7.7569E-06	0	1.40104E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.037895	0.05672988	5.32587E-06	1.05802E-05	2.4891E-05	0.000591097	6.39596E-08	2.67143E-06	0	4.80545E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2005	1	3.280057	2.192719	2.19859E-05	0.000138521	0.000202001	0.02404081	2.86678E-06	1.41307E-05	0	1.98375E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2004	1	3.20314	2.155385	4.4948E-05	0.000172341	0.000209596	0.02347706	2.79955E-06	1.76824E-05	0	4.05558E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2003	1	3.245034	2.220459	0.000114897	0.000250689	0.000238586	0.02378411	2.83617E-06	2.78397E-05	0	1.0367E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2002	1	3.641633	2.503944	0.00014775	0.000316835	0.000276	0.02669093	3.18279E-06	3.44735E-05	0	1.33313E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2001	1	3.586192	2.477747	0.000164026	0.000346977	0.000279927	0.02628459	3.13434E-06	3.71308E-05	0	1.47998E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2000	1	3.998765	2.776094	0.000203552	0.000425884	0.000321196	0.0293085	3.49493E-06	4.49508E-05	0	1.83662E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1999	1	3.877036	2.704475	0.000217383	0.000450721	0.000320207	0.02841631	3.38854E-06	4.70226E-05	0	1.96141E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1998	1	3.787572	2.690743	0.000288189	0.000582543	0.000377243	0.02776059	3.31035E-06	5.6975E-05	0	2.60029E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1997	1	3.620229	2.586714	0.000298706	0.000599918	0.000368704	0.02653406	3.16409E-06	5.81703E-05	0	2.69517E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1996	1	3.546533	2.548609	0.000315401	0.000629942	0.000369162	0.02599391	3.09968E-06	6.06232E-05	0	2.84582E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1995	1	3.081953	2.227399	0.000293878	0.000584126	0.000327723	0.02258882	2.69363E-06	5.58424E-05	0	2.65161E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1994	1	2.490721	1.810322	0.000253497	0.000501731	0.000270446	0.01825546	2.17689E-06	4.7684E-05	0	2.28726E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1993	0	0.68647	0.5017614	7.42751E-05	0.000146458	7.60793E-05	0.005031405	5.99976E-07	1.38462E-05	0	6.70173E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1992	0	0.487143	0.358066	5.58367E-05	0.000109733	5.50823E-05	0.003570457	4.25764E-07	1.03253E-05	0	5.03805E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1991	0	0.424996	0.3141299	5.14427E-05	0.000100795	4.90095E-05	0.003114959	3.71447E-07	9.44391E-06	0	4.64159E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1990	0	0.659569	0.490218	8.4072E-05	0.000164283	7.75408E-05	0.004834238	5.76465E-07	1.53328E-05	0	7.58568E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1989	0	0.521249	0.389552	6.97886E-05	0.000136039	6.24499E-05	0.003820438	4.55573E-07	1.26519E-05	0	6.29691E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.456093	0.3427294	6.39941E-05	0.000124466	5.56677E-05	0.003342882	3.98626E-07	1.15381E-05	0	5.77408E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.369218	0.279408	5.53586E-05	0.000105155	4.64837E-05	0.002706144	3.22697E-07	9.71901E-06	0	4.99492E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.267864	0.2038209	4.19198E-05	7.94788E-05	3.43307E-05	0.001963279	2.34114E-07	7.32574E-06	0	3.78235E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.199088	0.1523158	3.24629E-05	6.1443E-05	2.59674E-05	0.001459194	1.74003E-07	5.64897E-06	0	2.92908E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.137552	0.105808	2.33315E-05	4.40897E-05	1.82529E-05	0.001008171	1.20221E-07	4.04399E-06	0	2.10517E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.072396	0.05598931	1.27548E-05	2.40673E-05	9.7709E-06	0.000530616	6.3274E-08	2.20266E-06	0	1.15084E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.024132	0.0187634	4.40994E-06	8.30981E-06	3.31167E-06	0.000176872	2.10913E-08	7.58967E-07	0	3.97902E-07
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2005	1	3.036863	8.572254	5.99162E-05	0.000529826	0.000828898	0.09411284	1.01835E-05	4.15329E-05	0	5.40614E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2004	1	3.03056	8.576696	0.000105584	0.000563994	0.000918094	0.09391753	1.01623E-05	6.12547E-05	0	9.52666E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2003	1	2.994957	8.531324	0.000226524	0.000623686	0.001156553	0.09281416	1.0043E-05	0.00011664	0	2.04389E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2002	1	2.954822	8.42476	0.000236137	0.000636521	0.001175882	0.09157038	9.90836E-06	0.000124552	0	2.13063E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2001	1	2.906122	8.293538	0.000244686	0.000646874	0.001190754	0.09006114	9.74506E-06	0.000131817	0	2.20776E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2000	1	3.372694	9.633912	0.000298407	0.000774918	0.001421681	0.1045203	1.13096E-05	0.000163795	0	2.69248E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1999	1	3.306452	9.453377	0.0003067	0.000783413	0.001432729	0.1024674	1.10875E-05	0.00017118	0	2.7673E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1998	1	3.228275	9.238346	0.000313268	0.000788045	0.001436905	0.1000447	1.08253E-05	0.000177485	0	2.82656E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1997	1	3.162095	9.057262	0.000320382	0.000794569	0.001795539	0.09799379	1.06034E-05	0.00016787	0	2.89075E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1996	1	3.137023	8.99369	0.00033127	0.000810769	0.001827097	0.09721684	1.05193E-05	0.000175717	0	2.989E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1995	1	2.734734	7.847529	0.000300495	0.000726411	0.001632713	0.08474981	9.17034E-06	0.000161184	0	2.71132E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1994	0	1.757671	5.048391	0.000200658	0.000479487	0.001075038	0.05447051	5.89398E-06	0.000108739	0	1.81051E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1993	0	1.071558	3.080547	0.000126918	0.000300003	0.000671036	0.03320774	3.59324E-06	6.94272E-05	0	1.14516E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1992	0	1.076445	3.097425	0.000132104	0.000309092	0.00068981	0.0333592	3.60963E-06	7.28932E-05	0	1.19196E-05

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1991	0	1.010994	2.911749	0.0001284	0.000297549	0.000662627	0.03133087	3.39015E-06	7.14189E-05	0	1.15853E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1990	0	1.795694	5.176466	0.000235746	0.000541377	0.001203148	0.05564883	6.02148E-06	0.000132105	0	2.1271E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1989	0	1.061901	3.063945	0.000143957	0.000327765	0.000726996	0.03290849	3.56086E-06	8.12287E-05	0	1.2989E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.720772	2.081565	0.000100797	0.000227642	0.000503975	0.02233685	2.41696E-06	5.72432E-05	0	9.09474E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.621735	1.823184	0.00013032	0.000276251	0.0006601	0.01926767	2.08486E-06	6.23177E-05	0	1.17586E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.55571	1.631651	0.00011994	0.000252399	0.000602089	0.01722154	1.86346E-06	5.76788E-05	0	1.0822E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.506192	1.488149	0.000112403	0.000234904	0.000559448	0.01568695	1.69741E-06	5.43416E-05	0	1.0142E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.429163	1.263297	9.79697E-05	0.000203393	0.000483651	0.01329981	1.4391E-06	4.76004E-05	0	8.83965E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.379643	1.118951	8.90286E-05	0.000183671	0.000436102	0.0117652	1.27305E-06	4.34599E-05	0	8.03291E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.335627	0.9904735	8.07957E-05	0.000165688	0.000392841	0.01040113	1.12545E-06	3.96163E-05	0	7.29007E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1981	0	0.286108	0.8454075	7.06559E-05	0.000144066	0.000341104	0.00886653	9.59402E-07	3.479E-05	0	6.37517E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1980	0	0.231087	0.6836933	5.85067E-05	0.000118641	0.000280534	0.007161426	7.74901E-07	2.89225E-05	0	5.27897E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1979	0	0.187071	0.5541662	4.85271E-05	9.78892E-05	0.000231168	0.00579735	6.27302E-07	2.40796E-05	0	4.37852E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1978	0	0.137552	0.4079896	3.65379E-05	7.33348E-05	0.000172969	0.004262757	4.61251E-07	1.81954E-05	0	3.29676E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1977	0	0.110042	0.3268033	2.99153E-05	5.97538E-05	0.000140769	0.003410206	3.69001E-07	1.49482E-05	0	2.69921E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1976	0	0.077029	0.2290504	2.14202E-05	4.25879E-05	0.000100214	0.002387144	2.58301E-07	1.0738E-05	0	1.93271E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1975	0	0.041266	0.1228599	1.1732E-05	2.32222E-05	5.45835E-05	0.001278827	1.38375E-07	5.89946E-06	0	1.05856E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1974	0	0.013755	0.04100475	3.99628E-06	7.87647E-06	1.84937E-05	0.000426276	4.61251E-08	2.01547E-06	0	3.60578E-07
2005	Annual	Mon-Sun	2270006005	Generator Sets	D	750	Light Commercial Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1998	0	2.86E-01	7.04E+00	5.73E-05	1.32E-04	8.45E-04	7.78E-02	7.21E-06	1.91E-05	0.00E+00	5.17E-06

APPENDIX E

EMISSION FACTOR DERIVATION AND OFFROAD2006
OUTPUT FOR AUXILIARY GENERATOR SETS

Emission Factors for Auxiliary Generator Sets
Stockton Rail Yard, Stockton, CA

Equipment Type	Model Year	Fuel Type	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions	
				ROG	CO	NOx	DPM	SOx	Part 1 (g/hr)	Part 2 (g/yr)
Aux. Gen Set	1998	Diesel	0.25	0.42	0.97	6.17	0.14	0.05	-	-

Notes:
1. Emission factors from OFFROAD2006 model.
2. Load factor was estimated at 25% due to the nature of the operations.
3. VOC evaporative emissions are negligible.

Cnty	SCC	HP	TechType	MYr	Population	ROG-Exhaust	CO-Exhau	NOx-Exhau	CO2-Exha	SO2-Exhau	PM-Exhau	Crankcase	FuelCons.	Activity	LF	HPAvg	ROG/ROG	ROG (lb/hp-hr)	CO (lb/hp-hr)	NOx (lb/hp-hr)	SOx (lb/hp-hr)	PM (lb/hp-hr)
6077	2270002045	175		1988		2.19928E-06	5.69E-06	1.53E-05	0.000758	7.87E-08	9.86E-07			0.018896	0.43	149	1	0.003633246	0.009401333	0.025241215	0.000130035	0.001628195
6077	2270002045	250		1988		5.95245E-06	1.54E-05	4.14E-05	0.002053	2.13E-07	2.67E-06			0.036635	0.43	208	1	0.003633245	0.009401337	0.025241213	0.000130035	0.001628195
6077	2270002066	120		1992		0.001803845	0.004461	0.010075	0.546967	5.92E-05	0.000948			21.16679	0.55	75	1	0.004131904	0.010218695	0.023078417	0.000135569	0.002170682
6077	2270002066	250		1989		9.31325E-05	0.000253	0.000686	0.038011	3.95E-06	4.01E-05			0.443067								
6077	2270002066	250		1988		6.4795E-05	0.000175	0.000473	0.0258	2.68E-06	2.81E-05			0.300735								
6077	2270002066	250		1987		7.40434E-05	0.000238	0.000558	0.022255	2.31E-06	3.61E-05			0.259413								
6077	2270002066	250		1986		6.77551E-05	0.000217	0.000506	0.019892	2.06E-06	3.33E-05			0.231864								
6077	2270002066	250		1985		6.31519E-05	0.000201	0.000468	0.018119	1.88E-06	3.12E-05			0.211203								
6077	2270002066	250		1984		5.85075E-05	0.000177	0.000403	0.015362	1.59E-06	2.72E-05			0.179064								
6077	2270002066	250		1983		5.29064E-05	0.000159	0.000361	0.01359	1.41E-06	2.47E-05			0.158402								
6077	2270002066	250		1982		4.77889E-05	0.000143	0.000324	0.012014	1.25E-06	2.24E-05			0.140037								
6077	2270002066	250		1981		4.16045E-05	0.000124	0.00028	0.010241	1.06E-06	1.96E-05			0.119376								
6077	2270002066	250		1980		3.43035E-05	0.000101	0.000229	0.008272	8.59E-07	1.62E-05			0.096419								
6077	2270002066	250		1979		3.01529E-05	8.51E-05	0.000206	0.006696	6.95E-07	1.35E-05			0.078053								
6077	2270002066	250		1978		2.26146E-05	6.35E-05	0.000153	0.004924	5.11E-07	1.01E-05			0.057392								
6077	2270002066	250		1977		1.84464E-05	5.16E-05	0.000124	0.003939	4.09E-07	8.31E-06			0.045914								
6077	2270002066	250		1976		1.31608E-05	3.66E-05	8.82E-05	0.002757	2.86E-07	5.95E-06			0.03214								
6077	2270002066	250		1975		7.18346E-06	1.99E-05	4.78E-05	0.001477	1.53E-07	3.26E-06			0.017218								
6077	2270002066	250		1974		2.43883E-06	6.72E-06	1.62E-05	0.000492	5.11E-08	1.11E-06			0.005739								
			total			0.000691986	0.002051	0.004925	0.203843	2.12E-05	0.000321			2.376035	0.55	249	1	0.004253165	0.012607541	0.030272545	0.000130035	0.001973156
6077	2270003020	50		1984		2.33315E-05	4.41E-05	1.83E-05	0.001008	1.2E-07	4.04E-06			0.137552								
6077	2270003020	50		1983		1.27548E-05	2.41E-05	9.77E-06	0.000531	6.33E-08	2.2E-06			0.072396								
6077	2270003020	50		1982		4.40994E-06	8.31E-06	3.31E-06	0.000177	2.11E-08	7.59E-07			0.024132								
			total			4.04962E-05	7.65E-05	3.13E-05	0.001716	2.05E-07	7.01E-06			0.234079	0.3	39	1	0.029573012	0.055841045	0.022883225	0.000149402	0.005115957
6077	2270003020	120		2000		0.000299224	0.000759	0.001386	0.097947	1.06E-05	0.000168			6.279312	0.3	83	1	0.003827493	0.009708647	0.017731408	0.000135568	0.002151044
6077	2270003040	120		1990		0.000235746	0.000541	0.001203	0.055649	6.02E-06	0.000132			1.795694	0.51	97	1	0.00530763	0.01218864	0.027087867	0.000135568	0.002974242

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2005	1	2.194628	8.004401	3.28275E-05	0.000425416	0.000658338	0.08808409	9.1421E-06	2.13262E-05	0	2.96197E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2004	1	2.046133	7.470732	4.68235E-05	0.000409549	0.000665958	0.08212405	8.52352E-06	2.55809E-05	0	4.22481E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2003	1	1.88094	6.878171	6.66804E-05	0.00038836	0.00070041	0.07549386	7.83538E-06	3.20173E-05	0	6.01646E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2002	0	1.657318	6.083153	0.000115166	0.000352651	0.000843433	0.06651846	6.90384E-06	4.81975E-05	0	1.03912E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2001	0	1.587829	5.83152	0.000115656	0.00034789	0.000829365	0.06372947	6.61438E-06	4.9362E-05	0	1.04355E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	2000	1	1.796177	6.600576	0.00013685	0.000404879	0.000962281	0.07209177	7.48229E-06	5.94423E-05	0	1.23477E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1999	1	1.853527	6.815318	0.000147429	0.000429508	0.001017865	0.07439356	7.72119E-06	6.50585E-05	0	1.33023E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1998	1	1.776576	6.536201	0.00014726	0.000422893	0.000999434	0.07130504	7.40063E-06	6.59215E-05	0	1.3287E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1997	0	1.60354	5.90304	0.000138289	0.000391827	0.000923598	0.06436004	6.67982E-06	6.27176E-05	0	1.24776E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1996	0	0.684461	2.521149	6.13208E-05	0.00017157	0.000468353	0.02747166	2.85124E-06	2.56785E-05	0	5.53288E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1995	0	0.456092	1.680955	4.23892E-05	0.000117206	0.000319176	0.01830579	1.89993E-06	1.79457E-05	0	3.82471E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1994	0	0.337554	1.244805	3.25032E-05	8.88751E-05	0.000241469	0.01354815	1.40614E-06	1.38995E-05	0	2.93271E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1993	0	0.189058	0.6975989	1.88378E-05	5.09709E-05	0.000138181	0.007588059	7.87552E-07	8.13089E-06	0	1.6997E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1992	0	0.149834	0.5531911	1.54315E-05	4.13419E-05	0.000111841	0.006013766	6.24159E-07	6.71823E-06	0	1.39236E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1991	0	0.107055	0.3954802	1.13843E-05	3.02143E-05	8.15732E-05	0.004296776	4.45955E-07	4.99605E-06	0	1.02719E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1990	0	0.094447	0.3491062	1.03599E-05	2.72521E-05	7.34338E-05	0.003790725	3.93433E-07	4.58052E-06	0	9.34758E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1989	0	0.056687	0.2096554	6.40791E-06	1.67145E-05	4.49559E-05	0.00227519	2.36138E-07	2.85298E-06	0	5.78176E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	175	Construction and Mining Equipment	U	P	NHH	P	San Joaquin	SJV	SJU	1988	0	0.018896	0.06992591	2.19928E-06	5.69081E-06	1.5279E-05	0.000758397	7.87128E-08	9.85579E-07	0	1.98437E-07
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2005	1	4.255011	21.54913	6.81295E-05	0.000392326	0.001757642	0.2384044	2.47436E-05	3.91815E-05	0	6.14722E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2004	1	3.967103	20.10126	8.61804E-05	0.000377679	0.001748523	0.2222732	2.30694E-05	3.90058E-05	0	7.77592E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2003	1	3.646825	18.49172	0.000110456	0.000358126	0.001800783	0.2043282	2.12069E-05	4.14874E-05	0	9.96624E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2002	1	3.213255	16.31318	0.000146644	0.000325187	0.002067845	0.1800358	1.86856E-05	4.81443E-05	0	1.32315E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2001	1	3.078529	15.63305	0.00014726	0.000320786	0.002033379	0.1724872	1.79022E-05	4.86121E-05	0	1.3287E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	2000	1	3.482484	17.68872	0.000174235	0.000373324	0.002359279	0.1951202	2.02512E-05	5.78034E-05	0	1.57209E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1999	1	3.593673	18.258	0.000187694	0.000396023	0.002495584	0.2013502	2.08978E-05	6.25514E-05	0	1.69354E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1998	1	3.44448	17.50433	0.000187471	0.000389914	0.002450423	0.1929911	2.00302E-05	6.27365E-05	0	1.69152E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1997	1	3.108992	15.80331	0.000176043	0.000361262	0.002264506	0.1741939	1.80793E-05	5.9137E-05	0	1.58841E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1996	0	1.327053	6.747201	7.80586E-05	0.000158183	0.000989106	0.07435355	7.71703E-06	2.63141E-05	0	7.0431E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1995	0	0.884284	4.549594	0.000114729	0.000317223	0.000863868	0.0495456	5.14226E-06	4.85711E-05	0	1.03518E-05
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1994	0	0.65446	3.369134	8.79716E-05	0.000240545	0.00065355	0.03666881	3.8058E-06	3.76198E-05	0	7.93754E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1993	0	0.36655	1.888088	5.09854E-05	0.000137955	0.000373993	0.02053748	2.13155E-06	2.20067E-05	0	4.60033E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1992	0	0.290502	1.497241	4.17661E-05	0.000111894	0.000302704	0.01627658	1.68932E-06	1.81832E-05	0	3.76849E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1991	0	0.207561	1.07039	3.08122E-05	8.17766E-05	0.000220782	0.01162947	1.207E-06	1.35221E-05	0	2.78013E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1990	0	0.183116	0.9448746	2.80396E-05	7.37591E-05	0.000198753	0.0102598	1.06485E-06	1.23974E-05	0	2.52997E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1989	0	0.109906	0.5674436	1.73434E-05	4.52388E-05	0.000121676	0.006157924	6.39121E-07	7.72174E-06	0	1.56486E-06
2005	Annual	Mon-Sun	2270002045	Cranes	D	250	Construction and Mining Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1988	0	0.036635	0.1892581	5.95245E-06	1.54025E-05	4.13534E-05	0.002052642	2.1304E-07	2.66752E-06	0	5.3708E-07
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2005	21	52.83642	124.3461	0.000847881	0.007635774	0.01197677	1.365334	0.000147736	0.000591943	0	7.65029E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2004	21	52.63005	124.1481	0.001456189	0.008011786	0.01311738	1.360002	0.000147159	0.000844465	0	0.00013139
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2003	21	51.94328	123.2769	0.003111349	0.008743813	0.0162726	1.342255	0.000145239	0.001563528	0	0.000280732
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2002	20	51.20804	121.6043	0.003185188	0.008817556	0.01636684	1.323256	0.000143183	0.001629696	0	0.000287394
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2001	20	50.31062	119.5442	0.003245178	0.00885707	0.01639888	1.300066	0.000140674	0.001687887	0	0.000292807
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2000	24	61.50771	146.2368	0.004109012	0.01106553	0.02043847	1.589408	0.000171982	0.002169602	0	0.00037075
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1999	24	60.23257	143.2902	0.004162481	0.01106844	0.02039653	1.556458	0.000168416	0.002228484	0	0.000375574
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1998	23	58.78019	139.918	0.004197417	0.01102826	0.02027726	1.518926	0.000164355	0.002276103	0	0.000378726
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1997	23	57.50322	136.9596	0.004238601	0.01101046	0.02511401	1.485928	0.000160785	0.00212209	0	0.000382442
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1996	23	56.77089	135.2955	0.004315304	0.0110892	0.02523983	1.467004	0.000158737	0.002184381	0	0.000389363
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1995	18	44.84735	106.9429	0.003512201	0.008933119	0.02029079	1.15889	0.000125398	0.001796155	0	0.0003169
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1994	12	30.95396	73.85647	0.002495401	0.006285092	0.01424784	0.7998745	8.65504E-05	0.001288419	0	0.000225156
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1993	8	21.19232	50.59505	0.001757236	0.004384765	0.00992101	0.5476264	5.92559E-05	0.000915445	0	0.000158553
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1992	8	21.16679	50.56401	0.001803845	0.004461125	0.01007523	0.5469669	5.91845E-05	0.000947644	0	0.000162758
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1991	8	19.90047	47.56706	0.001741737	0.004270986	0.009628681	0.5142437	5.56437E-05	0.000922259	0	0.000157154
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1990	12	30.7187	73.46871	0.002759288	0.006711248	0.01510414	0.7937954	8.58926E-05	0.001471944	0	0.000248966
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1989	7	18.16577	43.47201	0.001673545	0.004038819	0.009074569	0.4694177	5.07933E-05	0.000899027	0	0.000151001
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1988	5	12.33014	29.52433	0.001164313	0.002788932	0.006256216	0.3186203	3.44763E-05	0.000629619	0	0.000105054
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1987	4	10.63592	25.7886	0.001496278	0.003365593	0.008148599	0.2748404	2.97391E-05	0.000681464	0	0.000135007
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1986	4	9.506438	23.06911	0.001369203	0.003058636	0.007394464	0.2456538	2.6581E-05	0.0006273	0	0.000123541
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1985	3	8.659329	21.03087	0.001276181	0.00283204	0.006836845	0.2237639	2.42124E-05	0.000587984	0	0.000115148
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1984	3	7.341607	17.84528	0.001106554	0.002440038	0.005882333	0.1897128	2.05279E-05	0.000512566	0	9.98426E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1983	3	6.494499	15.79928	0.001000615	0.002192962	0.005279572	0.1678229	1.81593E-05	0.00046586	0	9.02839E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1982	2	5.74151	13.97902	0.00090382	0.001969174	0.004734607	0.1483651	1.60538E-05	0.000422842	0	8.15502E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1981	2	4.894406	11.92639	0.000786853	0.001704616	0.004093314	0.1264753	1.36852E-05	0.000369828	0	7.09965E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1980	2	3.953171	9.640799	0.000648768	0.001397784	0.003352378	0.102153	1.10535E-05	0.000306277	0	5.85373E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1979	1	3.200188	7.810897	0.000535906	0.001148523	0.002751265	0.08269535	8.94804E-06	0.000254067	0	4.83539E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1978	1	2.353078	5.748039	0.000401925	0.00085699	0.002050514	0.0608054	6.57944E-06	0.00019132	0	3.6265E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1977	1	1.882463	4.602217	0.000327841	0.000695582	0.001662431	0.04864432	5.26355E-06	0.00015666	0	2.95806E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1976	1	1.317723	3.224203	0.0002339	0.000493901	0.001179116	0.03405103	3.68449E-06	0.000112186	0	2.11044E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1975	0	0.705924	1.728671	0.000127666	0.000268336	0.000639927	0.01824162	1.97383E-06	6.14512E-05	0	1.15191E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	120	Construction and Mining Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1974	0	0.235308	0.5766972	4.33432E-05	9.06941E-05	0.000216062	0.006080542	6.57944E-07	2.09343E-05	0	3.91078E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2005	1	1.288692	9.992829	3.06597E-05	0.000181152	0.000813153	0.1105588	1.14747E-05	1.8016E-05	0	2.76637E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2004	1	1.283659	9.957986	0.000040021	0.000184772	0.000859685	0.110127	1.14299E-05	1.8846E-05	0	3.61103E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2003	1	1.266909	9.834395	5.47531E-05	0.000186632	0.000944245	0.10869	1.12808E-05	2.12167E-05	0	4.94028E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2002	0	1.248976	9.706854	8.3366E-05	0.000188201	0.001200508	0.1071515	1.11211E-05	2.72161E-05	0	7.52198E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2001	0	1.227088	9.538467	8.49354E-05	0.000189039	0.00120287	0.1052737	1.09262E-05	2.7853E-05	0	7.66358E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2000	1	1.500188	11.66345	0.000107543	0.000236169	0.001499189	0.1287033	1.33579E-05	3.54137E-05	0	9.70347E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1999	1	1.469088	11.42372	0.000108942	0.000236226	0.001496125	0.1260351	1.3081E-05	3.60131E-05	0	9.82967E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1998	1	1.433663	11.15027	0.000109856	0.000235363	0.001487388	0.1229959	1.27656E-05	3.64461E-05	0	9.9121E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1997	1	1.402518	10.91002	0.000110933	0.000234978	0.001481823	0.120324	1.24882E-05	3.69275E-05	0	1.00093E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1996	1	1.384655	10.77301	0.00011294	0.000236653	0.001489356	0.1187915	1.23292E-05	3.77141E-05	0	1.01904E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1995	0	1.093836	8.603083	0.000195426	0.000559612	0.001534724	0.09384177	9.73968E-06	8.00445E-05	0	1.7633E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1994	0	0.754976	5.940477	0.000138853	0.000393728	0.00107769	0.06477043	6.72242E-06	5.74156E-05	0	1.25285E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1993	0	0.516886	4.068829	9.77814E-05	0.000274681	0.000750433	0.04434435	4.60243E-06	4.07933E-05	0	8.82266E-06

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1992	0	0.516264	4.065677	0.000100377	0.000279464	0.000762119	0.04429097	4.59689E-06	4.22268E-05	0	9.05688E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1991	0	0.485377	3.824084	9.69234E-05	0.000267553	0.00072836	0.04164121	4.32187E-06	4.10944E-05	0	8.74524E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1990	0	0.749236	5.90545	0.000153551	0.000420421	0.001142579	0.06427805	6.67131E-06	6.55857E-05	0	1.38546E-05
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1989	0	0.443067	3.493737	9.31325E-05	0.000253008	0.000686478	0.03801138	3.94514E-06	4.00571E-05	0	8.40319E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.300735	2.372413	6.4795E-05	0.00017471	0.000473285	0.02580047	2.67779E-06	2.80526E-05	0	5.84635E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.259413	2.065674	7.40434E-05	0.000238381	0.000557896	0.02225537	2.30985E-06	3.61281E-05	0	6.68082E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.231864	1.847409	6.77551E-05	0.000216637	0.000506249	0.01989197	2.06456E-06	3.32565E-05	0	6.11344E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.211203	1.683789	6.31519E-05	0.000200585	0.000468059	0.01811942	1.88058E-06	3.11721E-05	0	5.6981E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.179064	1.43043	5.85075E-05	0.000177125	0.000402701	0.01536212	1.59441E-06	2.71738E-05	0	5.27904E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.158402	1.266167	5.29064E-05	0.000159192	0.000361426	0.01358956	1.41044E-06	2.46976E-05	0	4.77366E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.140037	1.120062	4.77889E-05	0.00014295	0.000324111	0.01201397	1.24691E-06	2.24169E-05	0	4.31191E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1981	0	0.119376	0.9553999	4.16045E-05	0.000123747	0.000280204	0.01024141	1.06294E-06	1.96064E-05	0	3.75391E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1980	0	0.096419	0.772148	3.43035E-05	0.000101474	0.000229478	0.008271906	8.58528E-07	1.62372E-05	0	3.09515E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1979	0	0.078053	0.6263924	3.01529E-05	8.51326E-05	0.000205689	0.006696306	6.94999E-07	1.34693E-05	0	2.72064E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1978	0	0.057392	0.4608803	2.26146E-05	6.35211E-05	0.000153301	0.004923755	5.11028E-07	1.01427E-05	0	2.04048E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1977	0	0.045914	0.3689424	1.84464E-05	5.15558E-05	0.000124287	0.003939004	4.08823E-07	8.30528E-06	0	1.66439E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1976	0	0.03214	0.2584263	1.31608E-05	3.66063E-05	8.81539E-05	0.002757302	2.86176E-07	5.94746E-06	0	1.18748E-06
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1975	0	0.017218	0.138532	7.18346E-06	1.98876E-05	4.78429E-05	0.001477126	1.53309E-07	3.2578E-06	0	6.48152E-07
2005	Annual	Mon-Sun	2270002066	Tractors/Loaders/Backhoes	D	250	Construction and Mining Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1974	0	0.005739	0.04620709	2.43883E-06	6.72156E-06	1.61535E-05	0.000492376	5.11029E-08	1.10982E-06	0	2.20051E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2005	1	5.150716	7.318703	5.20808E-05	0.000454515	0.000709732	0.0803431	8.69352E-06	3.59181E-05	0	4.69916E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2004	1	5.029932	7.167117	9.13156E-05	0.000477802	0.000774562	0.07845908	8.48966E-06	5.29917E-05	0	8.23926E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2003	1	5.095717	7.310581	0.000201217	0.000546221	0.00101035	0.07948521	8.60069E-06	0.0001053	0	1.81555E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2002	1	5.718499	8.213609	0.000241372	0.000639056	0.001176686	0.08919966	9.65184E-06	0.000129828	0	2.17786E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2001	1	5.631436	8.097967	0.000253024	0.000655007	0.001200973	0.08784165	9.5049E-06	0.000139332	0	2.283E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2000	1	6.279312	9.04009	0.000299224	0.000758997	0.001386196	0.09794746	1.05984E-05	0.000168163	0	2.69985E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1999	1	6.088161	8.775064	0.000306685	0.000763655	0.001389622	0.09496579	1.02758E-05	0.000175456	0	2.76717E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1998	1	5.947677	8.582513	0.000315795	0.000773156	0.001402127	0.09277447	1.00387E-05	0.000183533	0	2.84937E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1997	1	5.684893	8.212811	0.000317315	0.00076492	0.001718235	0.08867546	9.59512E-06	0.000170633	0	2.86308E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1996	1	5.569162	8.054917	0.000326012	0.000774744	0.001734945	0.08687024	9.39979E-06	0.000177518	0	2.94156E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1995	1	4.839629	7.007844	0.000296478	0.000695326	0.001552593	0.07549065	8.16846E-06	0.000163267	0	2.67507E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1994	1	3.911213	5.670019	0.000250248	0.000579773	0.001291051	0.06100882	6.60145E-06	0.000139222	0	2.25794E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1993	0	1.077971	1.564517	7.19047E-05	0.000164707	0.000365832	0.01681468	1.81943E-06	4.03761E-05	0	6.48785E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1992	0	0.764966	1.111513	5.3108E-05	0.00012037	0.000266707	0.01193228	1.29113E-06	3.00752E-05	0	4.79185E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1991	0	0.667375	0.9708257	4.81491E-05	0.000108057	0.000238876	0.01041001	1.12641E-06	2.74797E-05	0	4.34441E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1990	0	1.035729	1.508398	7.75436E-05	0.000172422	0.000380336	0.01615576	1.74813E-06	4.45736E-05	0	6.99664E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1989	0	0.818524	1.193435	6.35095E-05	0.000139996	0.000308171	0.0127677	1.38153E-06	3.67485E-05	0	5.73036E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.716208	1.045452	5.752E-05	0.000125762	0.000276297	0.01117173	1.20884E-06	3.34872E-05	0	5.18994E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.579788	0.8610737	7.00129E-05	0.000143687	0.00034074	0.009043789	9.78582E-07	3.43096E-05	0	6.31715E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.420631	0.6257008	5.24584E-05	0.000106883	0.000253021	0.00656118	7.09952E-07	2.58436E-05	0	4.73324E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.312631	0.4657914	4.02266E-05	8.14015E-05	0.00019238	0.004876553	5.27667E-07	1.99159E-05	0	3.62958E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.215999	0.3223329	2.86478E-05	5.75963E-05	0.000135904	0.003369253	3.6457E-07	1.42491E-05	0	2.58484E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.113684	0.1699193	1.55277E-05	3.10271E-05	7.31008E-05	0.001773291	1.91879E-07	7.7569E-06	0	1.40104E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	120	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.037895	0.05672988	5.32587E-06	1.05802E-05	2.4891E-05	0.000591097	6.39596E-08	2.67143E-06	0	4.80545E-07
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2005	1	3.280057	2.192719	2.19859E-05	0.000138521	0.000202001	0.02404081	2.86678E-06	1.41307E-05	0	1.98375E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2004	1	3.20314	2.155385	4.4948E-05	0.000172341	0.000209596	0.02347706	2.79955E-06	1.76824E-05	0	4.05558E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2003	1	3.245034	2.220459	0.000114897	0.000250689	0.000238586	0.02378411	2.83617E-06	2.78397E-05	0	1.0367E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2002	1	3.641633	2.503944	0.00014775	0.000316835	0.000276	0.02669093	3.18279E-06	3.44735E-05	0	1.33313E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2001	1	3.586192	2.477747	0.000164026	0.000346977	0.000279927	0.02628459	3.13434E-06	3.71308E-05	0	1.47998E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	2000	1	3.998765	2.776094	0.000203552	0.000425884	0.000321196	0.0293085	3.49493E-06	4.49508E-05	0	1.83662E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1999	1	3.877036	2.704475	0.000217383	0.000450721	0.000320207	0.02841631	3.38854E-06	4.70226E-05	0	1.96141E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1998	1	3.787572	2.690743	0.000288189	0.000582543	0.000377243	0.02776059	3.31035E-06	5.6975E-05	0	2.60029E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1997	1	3.620229	2.586714	0.000298706	0.000599918	0.000368704	0.02653406	3.16409E-06	5.81703E-05	0	2.69517E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1996	1	3.546533	2.548609	0.000315401	0.000629942	0.000369162	0.02599391	3.09968E-06	6.06232E-05	0	2.84582E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1995	1	3.081953	2.227399	0.000293878	0.000584126	0.000327723	0.02258882	2.69363E-06	5.58424E-05	0	2.65161E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1994	1	2.490721	1.810322	0.000253497	0.000501731	0.000270446	0.01825546	2.17689E-06	4.7684E-05	0	2.28726E-05
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1993	0	0.68647	0.5017614	7.42751E-05	0.000146458	7.60793E-05	0.005031405	5.99976E-07	1.38462E-05	0	6.70173E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1992	0	0.487143	0.358066	5.58367E-05	0.000109733	5.50823E-05	0.003570457	4.25764E-07	1.03253E-05	0	5.03805E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1991	0	0.424996	0.3141299	5.14427E-05	0.000100795	4.90095E-05	0.003114959	3.71447E-07	9.44391E-06	0	4.64159E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1990	0	0.659569	0.490218	8.4072E-05	0.000164283	7.75408E-05	0.004834238	5.76465E-07	1.53328E-05	0	7.58568E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1989	0	0.521249	0.389552	6.97886E-05	0.000136039	6.24499E-05	0.003820438	4.55573E-07	1.26519E-05	0	6.29691E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.456093	0.3427294	6.39941E-05	0.000124466	5.56677E-05	0.003342882	3.98626E-07	1.15381E-05	0	5.77408E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.369218	0.279408	5.53586E-05	0.000105155	4.64837E-05	0.002706144	3.22697E-07	9.71901E-06	0	4.99492E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.267864	0.2038209	4.19198E-05	7.94788E-05	3.43307E-05	0.001963279	2.34114E-07	7.32574E-06	0	3.78235E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.199088	0.1523158	3.24629E-05	6.1443E-05	2.59674E-05	0.001459194	1.74003E-07	5.64897E-06	0	2.92908E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.137552	0.105808	2.33315E-05	4.40897E-05	1.82529E-05	0.001008171	1.20221E-07	4.04399E-06	0	2.10517E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.072396	0.05598931	1.27548E-05	2.40673E-05	9.7709E-06	0.000530616	6.3274E-08	2.20266E-06	0	1.15084E-06
2005	Annual	Mon-Sun	2270003020	Forklifts	D	50	Industrial Equipment	U	P	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.024132	0.0187634	4.40994E-06	8.30981E-06	3.31167E-06	0.000176872	2.10913E-08	7.58967E-07	0	3.97902E-07
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2005	1	3.036863	8.572254	5.99162E-05	0.000529826	0.000828898	0.09411284	1.01835E-05	4.15329E-05	0	5.40614E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2004	1	3.03056	8.576696	0.000105584	0.000563994	0.000918094	0.09391753	1.01623E-05	6.12547E-05	0	9.52666E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2003	1	2.994957	8.531324	0.000226524	0.000623686	0.001156553	0.09281416	1.0043E-05	0.00011664	0	2.04389E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2002	1	2.954822	8.42476	0.000236137	0.000636521	0.001175882	0.09157038	9.90836E-06	0.000124552	0	2.13063E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2001	1	2.906122	8.293538	0.000244686	0.000646874	0.001190754	0.09006114	9.74506E-06	0.000131817	0	2.20776E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	2000	1	3.372694	9.633912	0.000298407	0.000774918	0.001421681	0.1045203	1.13096E-05	0.000163795	0	2.69248E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1999	1	3.306452	9.453377	0.0003067	0.000783413	0.001432729	0.1024674	1.10875E-05	0.00017118	0	2.7673E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1998	1	3.228275	9.238346	0.000313268	0.000788045	0.001436905	0.1000447	1.08253E-05	0.000177485	0	2.82656E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1997	1	3.162095	9.057262	0.000320382	0.000794569	0.001795539	0.09799379	1.06034E-05	0.00016787	0	2.89075E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1996	1	3.137023	8.99369	0.00033127	0.000810769	0.001827097	0.09721684	1.05193E-05	0.000175717	0	2.989E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1995	1	2.734734	7.847529	0.000300495	0.000726411	0.001632713	0.08474981	9.17034E-06	0.000161184	0	2.71132E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1994	0	1.757671	5.048391	0.000200658	0.000479487	0.001075038	0.05447051	5.89398E-06	0.000108739	0	1.81051E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1993	0	1.071558	3.080547	0.000126918	0.000300003	0.000671036	0.03320774	3.59324E-06	6.94272E-05	0	1.14516E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1992	0	1.076445	3.097425	0.000132104	0.000309092	0.00068981	0.0333592	3.60963E-06	7.28932E-05	0	1.19196E-05

CY	Season	AvgDays	Code	Equipment	Fuel	MaxHP	Class	C/R	Pre	Hand	Port	County	Air Basin	Air Dist.	MY	Population	Activity	Consumption	ROG Exhaust	CO Exhaust	NOX Exhaust	CO2 Exhaust	SO2 Exhaust	PM Exhaust	N2O Exhaust	CH4 Exhaust
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1991	0	1.010994	2.911749	0.0001284	0.000297549	0.000662627	0.03133087	3.39015E-06	7.14189E-05	0	1.15853E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1990	0	1.795694	5.176466	0.000235746	0.000541377	0.001203148	0.05564883	6.02148E-06	0.000132105	0	2.1271E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1989	0	1.061901	3.063945	0.000143957	0.000327765	0.000726996	0.03290849	3.56086E-06	8.12287E-05	0	1.2989E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1988	0	0.720772	2.081565	0.000100797	0.000227642	0.000503975	0.02233685	2.41696E-06	5.72432E-05	0	9.09474E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1987	0	0.621735	1.823184	0.00013032	0.000276251	0.0006601	0.01926767	2.08486E-06	6.23177E-05	0	1.17586E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1986	0	0.55571	1.631651	0.00011994	0.000252399	0.000602089	0.01722154	1.86346E-06	5.76788E-05	0	1.0822E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1985	0	0.506192	1.488149	0.000112403	0.000234904	0.000559448	0.01568695	1.69741E-06	5.43416E-05	0	1.0142E-05
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1984	0	0.429163	1.263297	9.79697E-05	0.000203393	0.000483651	0.01329981	1.4391E-06	4.76004E-05	0	8.83965E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1983	0	0.379643	1.118951	8.90286E-05	0.000183671	0.000436102	0.0117652	1.27305E-06	4.34599E-05	0	8.03291E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1982	0	0.335627	0.9904735	8.07957E-05	0.000165688	0.000392841	0.01040113	1.12545E-06	3.96163E-05	0	7.29007E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1981	0	0.286108	0.8454075	7.06559E-05	0.000144066	0.000341104	0.00886653	9.59402E-07	3.479E-05	0	6.37517E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1980	0	0.231087	0.6836933	5.85067E-05	0.000118641	0.000280534	0.007161426	7.74901E-07	2.89225E-05	0	5.27897E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1979	0	0.187071	0.5541662	4.85271E-05	9.78892E-05	0.000231168	0.00579735	6.27302E-07	2.40796E-05	0	4.37852E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1978	0	0.137552	0.4079896	3.65379E-05	7.33348E-05	0.000172969	0.004262757	4.61251E-07	1.81954E-05	0	3.29676E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1977	0	0.110042	0.3268033	2.99153E-05	5.97538E-05	0.000140769	0.003410206	3.69001E-07	1.49482E-05	0	2.69921E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1976	0	0.077029	0.2290504	2.14202E-05	4.25879E-05	0.000100214	0.002387144	2.58301E-07	1.0738E-05	0	1.93271E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1975	0	0.041266	0.1228599	1.1732E-05	2.32222E-05	5.45835E-05	0.001278827	1.38375E-07	5.89946E-06	0	1.05856E-06
2005	Annual	Mon-Sun	2270003040	Other General Industrial Equipmen	D	120	Industrial Equipment	U	N	NHH	NP	San Joaquin	SJV	SJU	1974	0	0.013755	0.04100475	3.99628E-06	7.87647E-06	1.84937E-05	0.000426276	4.61251E-08	2.01547E-06	0	3.60578E-07
2005	Annual	Mon-Sun	2270006005	Generator Sets	D	750	Light Commercial Equipment	U	N	NHH	P	San Joaquin	SJV	SJU	1998	0	2.86E-01	7.04E+00	5.73E-05	1.32E-04	8.45E-04	7.78E-02	7.21E-06	1.91E-05	0.00E+00	5.17E-06

APPENDIX F

DETAILED EMISSION CALCULATIONS

Summary of Diesel Particulate Matter Emissions
Stockton Rail Yard, Stockton, CA

Source	DPM Emissions (tpy)
Locomotives	6.472
On-Road Diesel Fuel Trucks	0.007
HHD Diesel-Fueled Trucks	0.174
Heavy Equipment	0.099
Aux. Generator Set	0.068
Total	**6.819**

Emissions from Locomotives
Stockton Rail Yard, Stockton, CA

Activity	DPM Emissions (tpy)
Through trains	0.381
Freight trains	1.276
ACE trains	0.418
Power moves	0.005
Yard operations	3.578
Service and Shop Idling	0.782
Load tests	0.032
Total	**6.472**

Emissions from Heavy-Heavy Duty Diesel-Fueled Trucks
Stockton Rail Yard, Stockton, CA

Running Exhaust Emissions

Number of Truck Trips	VMT per Trip	VMT per Year	Emission Factors (g/mi)					Emissions (tpy)				
			ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
2,920	0.5	1,460	3.17	7.53	23.66	1.19	0.30	0.005	0.012	0.038	0.002	0.000

Idling Exhaust Emissions

Number of Truck Trips	Idling		Emission Factors (g/hr)					Emissions (tpy)				
	(mins/trip)	(hr/yr)	ROG	CO	NOx	DPM	SOx	ROG	CO	NOx	DPM	SOx
2,920	5	243.33	9.58	47.04	117.70	1.41	0.58	1.165	5.724	14.321	0.172	0.071

Notes:
1. Number of vehicle trips is equal to 8 vehicles at 1 round trip (in and out of yard) per day.
2. VMT per trip and idling per day estimated based on personal observation and discussions with UPRR staff.
3. Running exhaust emission factors calculated from EMFAC-WD 2006 with the BURDEN output option.
4. Idling exhaust emissions factors calculated using the EMFAC-WD 2006 model with the EMFAC output option.
5. Traveling exhaust emission factor calculations assumed an average speed of 15 mph.

Emissions from On-Road Diesel-Fueled Trucks
Stockton Rail Yard, Stockton, CA

Running Exhaust Emissions

Equipment Type	Make	Model	Model Year	Vehicle Class	Annual VMT	Emission Factors (g/mi) ROG	CO	NOx	DPM	SOx	Emissions (tpy) ROG	CO	NOx	DPM	SOx
Dump Truck	Ford	Unk.	1985	HHD	600	9.07	29.94	28.12	4.54	0.00	0.0060	0.0198	0.0186	0.0030	0.0000
Sweeper Truck	Unk.	Unk.	1990	HHD	250	8.72	29.31	28.61	4.19	0.35	0.0024	0.0081	0.0079	0.0012	0.0001
Pickup Truck	Ford	F800	1992	MHD	1,200	0.00	9.07	18.14	1.81	0.00	0.0000	0.0025	0.0050	0.0005	0.0000
Boom Truck	Ford	F800	1993	MHD	1,040	1.51	7.56	18.14	1.51	0.00	0.0004	0.0021	0.0050	0.0004	0.0000
Boom Truck	GMC	C7500	1998	MHD	1,600	0.70	4.88	12.56	0.70	0.00	0.0002	0.0013	0.0035	0.0002	0.0000
Boom Truck	International	Unk.	1998	MHD	1,825	0.70	4.88	12.56	0.70	0.00	0.0002	0.0013	0.0035	0.0002	0.0000
Pickup Truck	Ford	F550	2005	LHD	1,100	0.30	1.51	5.44	0.00	0.00	0.0001	0.0004	0.0015	0.0000	0.0000
Pickup Truck	Ford	F550	2005	LHD	1,200	0.30	1.51	5.44	0.00	0.00	0.0001	0.0004	0.0015	0.0000	0.0000
Boom Truck	Sterling	Unk.	2005	HHD	400	0.81	1.30	14.74	0.49	0.32	0.0002	0.0004	0.0041	0.0001	0.0001
Pickup Truck	GMC	550	2005	LHD	1,800	0.30	1.51	5.44	0.00	0.00	0.0001	0.0004	0.0015	0.0000	0.0000
Total											**0.0097**	**0.0368**	**0.0520**	**0.0056**	**0.0002**

Idling Exhaust Emissions

Equipment Type	Make	Model	Model Year	Vehicle Class	Idling (min/day)	Idling (hr/yr)	Emission Factors (g/hr) ROG	CO	NOx	DPM	SOx	Emissions (tpy) ROG	CO	NOx	DPM	SOx
Dump Truck	Ford	Unk.	1985	HHD	15	91	33.61	74.81	58.65	7.10	0.58	0.0034	0.0075	0.0059	0.0007	0.00006
Sweeper Truck	Unk.	Unk.	1990	HHD	15	91	19.68	61.68	84.93	3.54	0.58	0.0020	0.0062	0.0085	0.0004	0.00006
Pickup Truck	Ford	F800	1992	MHD	15	91	3.17	26.30	75.05	1.40	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Boom Truck	Ford	F800	1993	MHD	15	91	3.17	26.30	75.05	1.40	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Boom Truck	GMC	C7500	1998	MHD	15	91	3.17	26.30	75.05	0.75	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Boom Truck	International	Unk.	1998	MHD	15	91	3.17	26.30	75.05	0.75	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Pickup Truck	Ford	F550	2005	LHD1	15	91	3.17	26.30	75.05	0.75	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Pickup Truck	Ford	F550	2005	LHD1	15	91	3.17	26.30	75.05	0.75	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Boom Truck	Sterling	Unk.	2005	HHD	15	91	7.74	43.69	122.65	1.07	0.58	0.0008	0.0044	0.0123	0.0001	0.00006
Pickup Truck	GMC	550	2005	LHD1	15	91	3.17	26.30	75.05	0.75	0.37	0.0003	0.0026	0.0075	0.0001	0.00004
Total												**0.0084**	**0.0366**	**0.0796**	**0.0018**	**0.00043**

Notes:
1. Annual VMT estimated by UPRR personnel based on total vehicle mileage and the amount of time spent in the Yard.
2. Idling time (min/day) estimated by UPRR personnel.
3. Running exhaust emissions calculated using the EMFAC-WD 2006 model with the BURDEN output option.
4. Idling exhaust emissions factors calculated using the EMFAC-WD 2006 model with the EMFAC output option.
5. Traveling exhaust emission factor calculations assumed an average speed of 15 mph.

Summary of Emissions from Heavy Equipment
Stockton Rail Yard, Stockton, CA

Equipment Type	Make	Model	Year	Rating (hp)	Annual Hours of Operation	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr)					VOC Evaporative Emissions		Emissions (tpy)				
							VOC	CO	NOX	DPM	SOx	Part 1 (g/hr)	Part 2 (g/yr)	VOC	CO	NOX	DPM	SOx
Backhoe	John Deere	610C	1992	95	300	0.55	1.87	4.64	10.47	0.98	0.06	-	-	0.032	0.080	0.181	0.017	0.001
Backhoe	Case	480C	pre-1990	177	30	0.55	1.93	5.72	13.73	0.90	0.06	-	-	0.006	0.018	0.044	0.003	0.000
Trackmobile	Trackmobile	TM4000	1990	115	730	0.51	2.41	5.53	12.29	1.35	0.06	-	-	0.114	0.261	0.580	0.064	0.003
Fork Lift	Clark	Unknown	pre-1985	47.5	10	0.30	13.41	25.33	10.38	2.32	0.07	-	-	0.002	0.004	0.002	0.000	0.000
Crane	Pettibone	25RS	1970	122	120	0.43	1.65	4.26	11.45	0.74	0.06	-	-	0.011	0.030	0.079	0.005	0.000
Crane	Century	6CT8-3-C	1980	215	15	0.43	1.65	4.26	11.45	0.74	0.06	-	-	0.003	0.007	0.018	0.001	0.000
Fork Lift	JCB930	YPKXL04.2ARI	2000	75	365	0.30	1.74	4.40	8.04	0.98	0.06	-	-	0.016	0.040	0.073	0.009	0.001
Total														**0.184**	**0.439**	**0.976**	**0.099**	**0.005**

Notes:
1. Hours of operation estimated by UP personnel.
2. Emission factors and load factors from CARB s OFFROAD2006 model.
3. Assumes a Diesel fuel sulfur content of 130 ppm.
4. VOC evaporative emissions are negligible.

Particulate Matter Emissions from the Sand Tower
Stockton Rail Yard, Stockton, CA

Pollutant	2005 Sand Throughput (ton/yr)	Pneumatic Transfer Emission Factor (lb/ton)	Gravity Transfer Emission Factor (lb/ton)	Process Emissions (tpy)		
				Pneumatic Transfer	Gravity Transfer	Total
PM10	312.00	0.00034	0.00099	0.0001	0.0002	0.0002

Notes:

1. Sand throughput is based on the SJVAPCD Permit throughput limit of 26 tons per month.
2. Pneumatic transfer emission factor from AP-42, Table 11.12-2, 6/06. Factor for controlled pneumatic cement unloading to elevated storage silo was used. The unit is equipped with a fabric filter.
3. Gravity transfer emission factor from AP-42, Table 11.12-2, 6/06. Factor for sand transfer was used.
4. There are no TAC emissions from this source.

Emissions from Primary Clarifier and Oil/Water Separator
Stockton Rail Yard, Stockton, CA

Pollutant	Emission Rate (grams/sec)	Emissions (tpy)
Benzene	2.26E-07	1.11E-05
Bis(2-ethylhexyl) Phthalate	2.28E-07	1.12E-05
Bromomethane	4.40E-07	2.15E-05
Chloroform	2.74E-07	1.34E-05
Ethylbenzene	1.14E-06	5.58E-05
Methylene Chloride	5.15E-06	2.52E-04
Toluene	1.39E-06	6.81E-05
Xylene	2.67E-21	1.31E-19
Total	**8.85E-06**	**4.33E-04**

1. Emission rates are from the Air Emissions Inventory and Regulatory Analysis Report for Stockton Yard, Trinity Consultants, July 2003.
2. Emission rates from USEPA s Water8 Program and are based on the 2000 wastewater flow rate of 2,200,000 gallons per year.
3. Emissions (lb/yr) were calculated multiplying the emission rate by the ratio of the 2000 wastewater flow rate and the 2005 wastewater flow rate.

   lb/yr = Emissions (g/sec) x (3600 sec/hr) x (8760 hr/yr) x (1 lb/ 453.59 g) x (2,200,000 gal/yr / 1,562,030 gal/yr)

4. The 2005 wastewater flow rate was provided by Mr. Jim Diel of Union Pacific.

Emissions from Auxiliary Generator Sets
Stockton Rail Yard, Stockton, CA

Equipment Type	Model Year	Fuel Type	Rating (hp)	No.of Units	Operating Schedule (hr/day)	(hr/yr)	Load Factor	Exhaust & Crankcase Emissions (g/hp-hr) ROG	CO	NOx	DPM	SOx	VOC Evaporative Emissions Part 1 (g/hr)	Part 2 (g/yr)	Emissions (tpy) ROG	CO	NOx	DPM	SOx
Aux. Gen Set	1998	Diesel	750	3	9	780	0.25	0.42	0.97	6.17	0.14	0.05	-	-	0.20	0.47	2.99	0.07	0.03

Notes:
1. The units are located on the ACE passenger trains and are used to provide comfort cooling.
2. There are a total of 3 units, but only 1 unit is operated overnight to provide cooling for cleaning and maintenance crews. The other 2 trains are connected to landside power, so the gensets are not operated.
3. The unit is operated from 8:00 p.m. - 5:00 a.m. from Sunday through Friday.
4. Load factor was estimated at 25% due to the nature of the operations.
5. VOC evaporative emissions are negligible.

Equipment Specifications and Emissions from Storage Tanks
Stockton Rail Yard, Stockton, CA

Tank No.	Tank Location	Material Stored	Tank Capacity	Tank Dimensions	Shell Color	Shell Condition	Annual Throughput (gal/yr)	VOC Emissions (lb/yr)	Permitted?	Citation
AST-1	Repair Track Area	Wastewater	2,000	10 x 6 (V)	White	Good	NA	NA	Exempt	Rule 2020 - 6.6.5
TNKG-0019	Repair Track Area	Diesel	250	8 x 3 x 2 (H)	White	Good	NA	NA	Exempt	Rule 2020 -6.6.4
TNKG-0019	Repair Track Area	Gasoline	250	8 x 3 x 2 (H)	White	Good	NA	NA	Exempt	Rule 2020 -6.6.4
TNKO-0294	WWTP	Sludge	7,000	16 x 8	White	Good	8,000	Neg.	NA	NA
TNKS-0056	WWTP	Industrial Stormwater	88,000	34 x 20 (V)	White	Good	1,562,030	Neg.	NA	NA
TNKD-9010	WWTP	Industrial Stormwater	357,300	32 x 42 (v)	White	Good	1,562,030	Neg.	NA	NA
TNKO-0295	WWTP	Recovered Oil	10,000	15 x 10.5 (V)	White	Good	NA	NA	Exempt	Rule 2020 - 6.6.5
TNKO-0296	Diesel Shop	Empty	20,000	33.5 x 10 (H)	White	Good	NA	NA	NA	NA
TNKO-0297	Diesel Shop	Empty	20,000	33.5 x 10 (H)	White	Good	NA	NA	NA	NA
ACE	Repair Track Area	Used Oil	200	Unknown	Unk.	Good	NA	NA	Exempt	Rule 2020 - 6.6.4

Notes:
1. TNKO-0294 stores sludge and other solids from WWTP operations; therefore, emissions from this tank are assumed to be negligible.
2. TNKS-0056 and TNKD-9010 store industrial stormwater and are located downstream of the primary clarifier at the WWTP. The primary clarifier has an organics removal efficiency of 99%; therefore, emissions from these tanks are assumed to be negligible.

Equipment Specifications for Heaters
Stockton Rail Yard, Stockton, CA

Location	Heater Type	Fuel Type	Rating (MMBtu/hr)	Permitted?	Citation
Yard Office	Space Heater	Natural Gas	0.065	Exempt	Rule 2020 - 6.1.1
Yard Office	Space Heater	Natural Gas	0.065	Exempt	Rule 2020 - 6.1.1
Yard Office	Space Heater	Natural Gas	0.065	Exempt	Rule 2020 - 6.1.1
Yard Office	Water Heater	Natural Gas	0.035	Exempt	Rule 2020 - 6.1.1
Signal Shop	Space Heater	Propane	0.125	Exempt	Rule 2020 - 6.1.1
Engineering Office	Space Heater	Natural Gas	0.05	Exempt	Rule 2020 - 6.1.1
Engineering Office	Space Heater	Natural Gas	0.05	Exempt	Rule 2020 - 6.1.1
Engineering Office	Space Heater	Natural Gas	0.05	Exempt	Rule 2020 - 6.1.1
Engineering Office	Space Heater	Natural Gas	0.05	Exempt	Rule 2020 - 6.1.1
Engineering Office	Space Heater	Natural Gas	0.05	Exempt	Rule 2020 - 6.1.1
Engineering Office	Space Heater	Natural Gas	0.05	Exempt	Rule 2020 - 6.1.1

Notes:
1. Heaters with a rating of 5.0 MMBtu or less and are fired exclusively with natural gas or propane are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.1.

Equipment Specifications for Welders
Stockton Rail Yard, Stockton, CA

Location	Make	Fuel Type	Rating (hp)	Permitted?	Citation
One Spot Car Dept	Bobcat 225G	Gasoline	16	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	15	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	15	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	12.5	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	12.5	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	12.5	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	12.5	Exempt	Rule 2020-6.1.2 and 6.10
One Spot Car Dept	Unknown	Gasoline	12.5	Exempt	Rule 2020-6.1.2 and 6.10
Boom Truck	Miller Bobcat 250D	Diesel	20	Exempt	Rule 2020-6.1.2 and 6.11
Boom Truck	Miller 3 Air Pak	Diesel	40	Exempt	Rule 2020-6.1.2 and 6.12
Boom Truck	Miller Big Blue 400D	Diesel	35	Exempt	Rule 2020-6.1.2 and 6.13
Locomotive Maint. Truck	Weldmark 225	Gasoline	20	Exempt	Rule 2020-6.1.2 and 6.14
Bridge Maintenance	Miller Bobcat 225	Gasoline	16	Exempt	Rule 2020-6.1.2 and 6.15
Bridge Maintenance	Miller Bobcat 225	Gasoline	16	Exempt	Rule 2020-6.1.2 and 6.16
Bridge Maintenance	Lincoln WP225 G7	Gasoline	20	Exempt	Rule 2020-6.1.2 and 6.17
WWTP - Repair Truck	Unknown	Gasoline	16	Exempt	Rule 2020-6.1.2 and 6.17

Notes:
1. Welding equipment and operations are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.10.
2. Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.2.

Equipment Specifications for Portable Steam Cleaners
Stockton Rail Yard, Stockton, CA

Location	Make	Emission Unit	Fuel Type	Rating (MMBtu/hr or hp)	2005 Hours of Operation (hr/yr)	Permitted?	Citation
Locomotive Maintenance	Unknown	Pump	Electric	11	48	Exempt	Electric motor.
		Heater	Diesel	*0.24*	48	Exempt	Rule 2020 - 3.6
ACE	Lambda	Pump	Gasoline	11	10	Exempt	Rule 2020 - 6.1.2.
		Heater	Diesel	0.245	10	Exempt	Rule 2020 - 3.6
Locomotive Maintenance (Contractor Owned)	North Star	Pump	Gasoline	13	20	Exempt	Rule 2020 - 6.1.2.
		Heater	Diesel	*0.24*	20	Exempt	Rule 2020 - 3.6

Notes:
1. Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.2.
2. Units are "low emitting units" per Rule 2020, Section 3.6.

Equipment Specifications for Miscellaneous Combustion Devices
Stockton Rail Yard, Stockton, CA

Location	Equipment Type	Make	Fuel Type	Rating (hp)	Permitted?	Citation
MoW Repair Compound	Hydraulic Power Pack	Unknown	Gasoline	18	Exempt	Rule 2020-6.1.2
MoW Repair Compound	Pressure Washer	Stanley	Gasoline	18	Exempt	Rule 2020-6.1.2
One Spot Car Department	Air Compressor	Unknown	Gasoline	5	Exempt	Rule 2020-6.1.2
Locomotive Repair	Pressure Washer	Power Ease	Diesel	10	Exempt	Rule 2020-6.1.2
Locomotive Repair	Pressure Washer	Power Ease	Diesel	10	Exempt	Rule 2020-6.1.2
Bridge Maintenance	Hydraulic Jack	Unknown	Gasoline	5.5	Exempt	Rule 2020-6.1.2
Maintenance Crew	Air Compressor	Unknown	Gasoline	5	Exempt	Rule 2020-6.1.2

Notes:
1. Internal combustion engines rated at 50 hp or less are exempt from SJVAPCD permitting requirements per Rule 2020, Section 6.1.2.

APPENDIX G

DETAILED RISK SCREENING CALCULATIONS

Summary of Risk Index Values
Stockton Rail Yard, Stockton, CA

Source	Risk Index Value Cancer	% of Total Cancer Risk	Risk Index Value Chronic	% of Total Chronic Risk
Locomotives	1.94E-03	94.90	3.24E 01	94.24
Sand Tower[1]	0.00E 00	0.00	0.00E 00	0.00
WWTP	6.44E-10	0.00	2.38E-01	0.69
On-Road Diesel Fuel Trucks	2.23E-06	0.11	3.71E-02	0.11
HHD Diesel-Fueled Trucks	5.21E-05	2.55	8.69E-01	2.53
Heavy Equipment	2.97E-05	1.45	4.95E-01	1.44
Aux. Generator Set	2.03E-05	0.99	3.38E-01	0.99
Total	2.05E-03	100.00	3.43E 01	100.00
De Minimis Sources (% of Total)		5.10		5.76

Notes:
1. There are no TAC emissions from the sand tower.

Calculation of Risk Index Values for Diesel-Fueled Sources
Stockton Rail Yard, Stockton, CA

Source	DPM Emissions (tpy)	Unit Risk Factor Cancer	Cancer Risk Index Value	Unit Risk Factor Chronic	Chronic Risk Index Value
Locomotives	6.472	3.00E-04	1.94E-03	5.00E 00	3.24E 01
On-Road Diesel Fuel Trucks	0.007	3.00E-04	2.23E-06	5.00E 00	3.71E-02
HHD Diesel-Fueled Trucks	0.174	3.00E-04	5.21E-05	5.00E 00	8.69E-01
Heavy Equipment	0.099	3.00E-04	2.97E-05	5.00E 00	4.95E-01
Aux. Generator Set	0.068	3.00E-04	2.03E-05	5.00E 00	3.38E-01
Total	**6.819**		**2.05E-03**		**3.41E+01**

Notes:
1. Unit risk factor from Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values, April 25, 2005. Cancer inhalation risk used.

Calculation of Risk Index Values for the Wastewater Treatment Plant
Stockton Rail Yard, Stockton, CA

Chemical Name	Emissions (tpy)	Unit Risk Factor Cancer	Cancer Risk Index Value	Unit Risk Factor Chronic	Chronic Risk Index Value
Benzene	1.1E-05	2.90E-05	3.21E-10	6.00E 01	6.64E-04
Bis(2-ethylhexyl) Phthalate	1.1E-05		0.00E 00		0.00E 00
Bromomethane	2.2E-05		0.00E 00		0.00E 00
Chloroform	1.3E-05	5.30E-06	7.11E-11	3.00E 02	4.02E-03
Ethylbenzene	5.6E-05		0.00E 00	2.00E 03	1.12E-01
Methylene Chloride	2.5E-04	1.00E-06	2.52E-10	4.00E 02	1.01E-01
Toluene	6.8E-05		0.00E 00	3.00E 02	2.04E-02
Xylene	1.3E-19		0.00E 00	7.00E 02	9.15E-17
Total	**4.33E-04**		**6.44E-10**		**2.38E-01**

APPENDIX H

SOURCE TREATMENT AND ASSUMPTIONS FOR AIR DISPERSION MODELING FOR NON-LOCOMOTIVE SOURCES

Appendix H

Source Treatment and Assumptions for Air Dispersion Modeling for Non-Locomotive Sources

As shown in Figure 3 emissions were allocated spatially throughout the Yard in the areas where each source type operates or is most likely to operate. Emissions from heavy equipment were simulated as a series of volume sources along their corresponding travel routes and work areas. Emission sources are first allocated to the areas of the yard where their activity occurs, and are then allocated uniformly to a series of sources within the defined areas. Idling of elevated cargo handling equipment (Century crane) were simulated as a series of point sources within the areas where these events occur.

Assumptions used spatially to allocate emissions for each source group are shown in the Table below. See Figure 3 for the source locations. See Appendix A-4 for assumptions regarding the spatial allocation of locomotive emissions.

Source Treatment and Assumptions for Air Dispersion Modeling for Non-Locomotive Sources Stockton Rail Yard		
Source	Source Treatment	Assumptions for Spatial Allocation of Emissions
Heavy Equipment (idling and traveling)	Volume	Backhoes - Emissions from backhoe operations were distributed across the Yard. Trackmobile, Clark Forklift, Pettibone Crane - allocated all emissions to the areas in and around the RIP Track. Century Crane - allocated all emissions equally between the SP Yard and the East Yard. JBC Forklift - emissions from forklift operations were allocated to the area in and around the Signal Shop.

APPENDIX I

SEASONAL AND DIURNAL ACTIVITY PROFILES

Appendix I

Development of Temporal Activity Profiles for the UPRR StocktonYard

Locomotive activity can vary by time of day and season. For each yard, the number of trains arriving and departing from the yard in each month and each hour of the day was tabulated and used to develop temporal activity profiles for modeling. The number of locomotives released from service facilities in each month was also tabulated. The AERMOD EMISFACT SEASHR option was used to adjust emission rates by season and hour of the day, and the EMISFACT SEASON option was used where only seasonal adjustments were applied. Where hour of day adjustments (but not seasonal) were applied, the EMISFACT HROFDY option was used.

Time of day profiles for train idling activity were developed assuming that departure events involved locomotive idling during the hour of departure and the two preceding hours, and that arrival events involved locomotive idling during the hour of arrival and the two hours following. Thus, the hourly activity adjustment factor for hour *i* is given by

$$\frac{\frac{1}{3} \cdot \sum_{j=i}^{i+2} NA(j) + \frac{1}{3} \cdot \sum_{j=i-2}^{i} ND(j)}{\sum_{j=1}^{24} (NA(j) + ND(j))} ,$$

where *NA(j)* and *ND(j)* are respectively the number of arriving and departing trains in hour *j*. These factors were applied to both idling on arriving and departing trains and idling in the service area (if applicable).

Similarly, time of day profiles for road power movements in the yard (arrivals, departures, and power moves) were developed without including arrivals in preceding hours and departures in subsequent hours. In this case, the hourly activity adjustment factor for hour *i* is given by

$$\frac{NA(i) + ND(i)}{\sum_{j=1}^{24} (NA(j) + ND(j))} .$$

Seasonal adjustment factors are calculated as the sum of trains arriving and departing in each three month season, divided by the total number of arrivals and departures for the year. The hourly adjustment factors for each season are simply the product of the seasonal adjustment factor and the 24 hourly adjustment factors.

For yards with heavy duty truck and cargo handling activities related to rail traffic, seasonal train activity adjustments were applied, but not hour of day adjustments. Temporal profiles for yard switching operations were based on hourly (but not seasonal) factors developed from the operating shifts for the individual yard switching jobs. In some cases, locomotive load testing diurnal profiles were developed based on the specific times of day when load testing is conducted.

Table I-1 lists the hourly activity factors derived for train movements and train idling at the UPRR Stockton Yard. Table I-2 lists the hourly activity factors derived from operating shift information for yard switching operations. Separate temporal profiles are listed for day and night moving emissions as different volume source parameters are used for day and night. Table I-3 lists the seasonal activity factors for UPRR train and service activity.

Table I-1. Hourly Activity Factors for Train Activity at the UPRR Stockton Yard

Hour	UPRR Train and Service Idling	UPRR Train Movements (Daytime)	UPRR Train Movements (Nighttime)	ACE Train Idling	ACE Train Movements (Daytime)	ACE Train Movements (Nighttime)
1	0.948	0.000	0.965	2.400	0.000	0.000
2	1.074	0.000	0.973	2.400	0.000	0.000
3	1.200	0.000	1.111	2.400	0.000	0.000
4	1.224	0.000	1.197	2.400	0.000	0.000
5	1.077	0.000	1.100	2.400	0.000	4.000
6	0.879	0.000	1.017	0.000	0.000	4.000
7	0.731	0.766	0.000	0.000	4.000	0.000
8	0.731	0.678	0.000	0.000	0.000	0.000
9	0.903	0.601	0.000	0.000	0.000	0.000
10	0.971	0.720	0.000	0.000	0.000	0.000
11	0.963	1.241	0.000	0.000	0.000	0.000
12	1.014	0.979	0.000	0.000	0.000	0.000
13	1.276	1.227	0.000	0.000	0.000	0.000
14	1.366	1.447	0.000	0.000	0.000	0.000
15	1.318	1.274	0.000	0.000	0.000	0.000
16	1.034	0.962	0.000	0.000	0.000	0.000
17	0.954	1.326	0.000	0.000	0.000	0.000
18	0.819	0.940	0.000	0.000	4.000	0.000
19	0.926	0.000	1.095	0.000	0.000	4.000
20	0.925	0.000	0.874	2.400	0.000	4.000
21	0.969	0.000	0.951	2.400	0.000	0.000
22	0.891	0.000	0.728	2.400	0.000	0.000
23	0.910	0.000	0.866	2.400	0.000	0.000
24	0.899	0.000	0.962	2.400	0.000	0.000

Table I-2. Hourly Activity Factors for Yard Switching at the UPRR Stockton Yard

Hour	SP Yard Idling	East Yard South End Idling	SP Yard Daytime Yard Switching	SP Yard Nighttime Yard Switching	East Yard South End Daytime Yard Switching	East Yard South End Nighttime Yard Switching
1	2.000	0.600	0.000	2.000	0.000	0.600
2	2.000	0.600	0.000	2.000	0.000	0.600
3	2.000	0.600	0.000	2.000	0.000	0.600
4	2.000	0.600	0.000	2.000	0.000	0.600
5	0.000	0.600	0.000	0.000	0.000	0.600
6	0.000	0.600	0.000	0.000	0.000	0.600
7	0.000	0.600	0.000	0.000	0.600	0.000
8	0.000	1.200	0.000	0.000	1.200	0.000
9	0.000	1.200	0.000	0.000	1.200	0.000
10	0.000	1.200	0.000	0.000	1.200	0.000
11	0.000	1.200	0.000	0.000	1.200	0.000
12	0.000	1.200	0.000	0.000	1.200	0.000
13	0.000	1.200	0.000	0.000	1.200	0.000
14	0.000	1.200	0.000	0.000	1.200	0.000
15	0.000	1.200	0.000	0.000	1.200	0.000
16	0.000	1.200	0.000	0.000	1.200	0.000
17	2.000	1.200	2.000	0.000	1.200	0.000
18	2.000	1.200	2.000	0.000	1.200	0.000
19	2.000	1.200	0.000	2.000	0.000	1.200
20	2.000	1.200	0.000	2.000	0.000	1.200
21	2.000	1.200	0.000	2.000	0.000	1.200
22	2.000	1.200	0.000	2.000	0.000	1.200
23	2.000	1.200	0.000	2.000	0.000	1.200
24	2.000	0.600	0.000	2.000	0.000	0.600

Table I-3. Seasonal Activity Factors for the UPRR Stockton Yard

Activity Type	Winter	Spring	Summer	Fall
UPRR Trains	0.876	1.045	1.037	1.042
UPRR Service	0.689	1.073	1.131	1.107

APPENDIX J

SELECTION OF POPULATION FOR THE URBAN OPTION INPUT
IN AERMOD AIR DISPERSION MODELING ANALYSIS

Appendix J

Selection of Population for the Urban Option Input in AERMOD Air Dispersion Modeling Analysis

Urban heat islands and the thermal domes generated by them extend over an entire urbanized area[1]. Hot spots within the urban heat island are associated with roads and roofs, which surround each Union Pacific (UP) rail yard in high density. Following guidance cited by the ARB ("*For urban areas adjacent to or near other urban areas, or part of urban corridors, the user should attempt to identify that part of the urban area that will contribute to the urban heat island plume affecting the source.*"), it is the entire metropolitan area that contributes to the urban heat island plume affecting the rail yard. For metropolitan areas containing substantial amounts of open water, the area of water should not be included.

To simulate the effect of the urban heat island on turbulence in the boundary layer, especially at night, when the effect is substantial, AERMOD adjusts the height of the nighttime urban boundary layer for the heat flux emitted into the boundary layer by the urban surface, which is warmer than surrounding rural areas[2,3]. The difference between the urban and rural boundary layer temperatures is proportional to the maximum temperature difference of 12 Celsius degrees observed in a study of several Canadian cities, and directly related to the logarithm of the ratio of the urban population to a reference population of 2,000,000 (i.e., Montreal, the Canadian city with the maximum urban-rural temperature difference)[4].

The adjusted height of the nocturnal urban boundary layer is proportional to the one-fourth power of the ratio of the population of the city of interest to the reference population, based on the observation that the convective boundary layer depth is proportional to the square root of the city size, and city size is roughly proportional to the square root of its population, assuming constant population density[5]. Regardless of wind direction during any specific hour used by AERMOD, it is the entire metropolitan area, minus bodies of water, which moves additional heat flux into the atmosphere and affects its dispersive properties, not just the 400 km^2 area of the air dispersion modeling domain that surrounds the each rail yard, which was chosen purely for modeling convenience.

Continuing to follow the guidance cited by the ARB ("*If this approach results in the identification of clearly defined MSAs, then census data may be used as above to determine the appropriate population for input to AERMOD")*, the population of each Metropolitan Statistical Area is being used in the modeling run for each rail yard.

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[1] USEPA. *Thermally-Sensed Image of Houston,* http://www.epa.gov/heatisland/pilot/houston_thermal.htm, included in Heat Island Effect website, http://www.epa.gov/heatisland/about/index.html, accessed November 8, 2006.

[2] USEPA. *AERMOD: Description of Model Formulation,* Section 5.8 - Adjustments for the Urban Boundary Layer, pages 66-67, EPA-454/R-03-004, September 2004, accessed at http://www.epa.gov/scram001/7thconf/aermod/aermod_mfd.pdf on November 9,

[3] Oke, T.R. *City Size and the Urban Heat Island,* Atmospheric Environment, Volume 7, pp. 769-779, 1973.

[4] Ibid for References 3 and 4.

[5] Ibid.

APPENDIX K

DEMOGRAPHIC DATA

Appendix K

Population Shape Files for UPRR Rail Yards

The accompanying shape files include census boundaries as polygons and the corresponding residential populations from the 2000 U.S. Census. Separate shape files are included at the tract, block group, and block levels. The primary ID for each polygon begins with *ssccctttttt*, where *ss* is the FIPS state code (06 for California), *cc* is the county code, and *tttttt* is the tract code. The primary IDs for block groups have a single additional digit which is the block group number within each tract. Those for blocks have four additional digits identifying the block number. The population for each polygon are included as both the secondary ID and as attribute 1. Polygon coordinates are UTM zone 10 (Oakland and Stockton) or 11 (southern California yards), NAD83, in meters. The files contain entire tracts, block groups, or blocks that are completely contained within a specified area. For all yards except Stockton, the area included extends 10 kilometers beyond the 20 x 20 kilometer modeling domains. For Stockton, this area was extended to 20 kilometers beyond the modeling domain boundaries to avoid excluding some very large blocks.

In merging the population data[1] with the corresponding boundaries[2], it was noted that at all locations, there are defined census areas (primarily blocks, but in some cases block groups and tracts) for which there are no population records listed in the population files. Overlaying these boundaries on georeferenced aerial photos indicates that these are areas that likely have no residential populations (e.g., industrial areas and parks). The defined areas without population data have been excluded from these files. Areas with an identified population of zero have been included. It was also observed that some blocks, block groups and tracts with residential populations cover both residential areas and significant portions of the rail yards themselves. For this reason, any analysis of population exposures based on dispersion modeling should exclude receptors that are within the yard boundaries or within 20 meters of any modeled emission source locations.

To facilitate the exclusion of non-representative receptors, separate shape files have been generated that define the area within 20 meters of the yard boundaries for each yard. These files are also included with the accompanying population files. It should also be noted that the spatial extent of individual polygons can vary widely, even within the same type. For example, single blocks may be as small as 20 meters or as large as 10,000 meters or more in length. To estimate populations contained within specific areas, it may prove most useful to generate populations on a regular grid (e.g., 250 x 250 m cells) rather than attempting to process irregularly shaped polygons.

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[1] Population data were extracted from the *Census 2000 Summary File I* DVD, issued by the U.S. Department of Commerce, September 2001.
[2] Boundaries were extracted from ESRI shapefiles (*.shp) created from the U.S. Census TIGER Line Files downloaded from ESRI (*http://arcdata.esri.com/data/tiger2000/tiger_download.cfm*).