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4.3 AIR QUALITY

This section of the EIR analyzes air quality impacts associated with implementation of the LRDP. Impacts evaluated include (1) dust emissions related to construction activities, (2) emissions of ozone (O_3) precursors related to construction activities, (3) emissions of carbon monoxide (CO), reactive organic gases (ROG), nitrogen oxides (NO_x), sulfur oxides (SO_x), and particulate matter less than 10 microns in diameter (PM_{10}) from vehicles, residential, academic, and administrative sources, (4) odor emissions, (5) toxic air contaminant emissions, and (6) cumulative regional criteria pollutant and toxic air contaminant emissions.

Public comments in response to the Notice of Preparation of this EIR requested that the following issues be addressed in the EIR: quantification of air quality impacts from stationary, area, mobile, and construction sources; mitigation strategies to alleviate increases in emissions; and the effect of the LRDP on concentrations of criteria pollutants in the air. All of these topics are addressed in this section.

4.3.1 Environmental Setting

4.3.1.1 Regulatory Background

The project area is subject to major air quality planning programs by both the federal Clean Air Act (CAA) and the California Clean Air Act (CCAA). Both the federal and state statutes provide for ambient air quality standards to protect public health, timetables for progressing toward achieving and maintaining ambient standards, and the development of plans to guide the air quality improvement efforts of state and local agencies. Within the project vicinity, air quality is monitored, evaluated, and controlled by the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and the Yolo-Solano Air Quality Management District (YSAQMD).

Air quality evaluations are based on ambient air quality standards developed by federal and state agencies. The CAA of 1970 required the EPA to establish national ambient air quality standards (NAAQS) with states retaining the option to adopt more stringent standards or to include other specific pollutants. California had standards in existence before federal standards were established, and its standards are more stringent than the federal standards, as shown in Table 4.3-1.

The ambient air quality standards identify the level of air quality considered safe to protect the public health and welfare, especially for those most susceptible to respiratory distress such as asthmatics, the very young, the elderly, people weak from other illness or diseases, or persons who engage in heavy work or exercise. Healthy adults can tolerate periodic exposure to air pollution levels somewhat above these standards before adverse health effects are observed. Emissions limitations are typically imposed upon individual sources of air pollutants by local agencies or upon certain large or unique facilities by the EPA. Mobile sources of air pollutants such as automobiles, aircraft, and trains are controlled primarily through state and federal agencies.

Table 4.3-1
State and Federal Ambient Air Quality Standards

Pollutant	Averaging Time	California Standards[a]	National Standards[b]		Sacramento Valley State Status/ Classification	Sacramento Valley National Status/ Classification
		Concentrations [c]	Primary[c, d]	Secondary[c, e]		
Ozone[f]	8-hour	--	0.08 ppm	Same as Primary	Nonattainment/ Serious	Nonattainment/ Severe
	1-hour[g]	0.09 ppm	0.12 ppm			
Carbon Monoxide	8-hour	9.0 ppm	9 ppm		Attainment/ None	Attainment/ None
	1-hour	20.0 ppm	35 ppm			
Nitrogen Dioxide	Annual Mean	--	0.053 ppm	Same as Primary	Attainment/ None	Attainment/ None
	1-hour	0.25 ppm	--			
Sulfur Dioxide	Annual Mean	--	0.03 ppm	--	Attainment/ None	Attainment/ None
	24-hour	0.04 ppm	0.14 ppm	--		
	3-hour	--	--	0.5 ppm		
	1-hour	0.25 ppm	--	--		
Fine Particulate Matter (PM_{10})	Annual Mean	--	50 μg/m^3	Same as Primary	Nonattainment/ Serious	Unclassified/ None
	Annual Geometric Mean	30 μg/m^3	--	--		
	24-hour	50 μg/m^3	150 μg/m^3	Same as Primary		
Fine Particulate Matter ($PM_{2.5}$)	Annual Mean	12 μg/m^3	15 μg/m^3	Same as Primary	Not Designated/ None	Not Designated/ None
	24-hour	--	65 μg/m^3			

ppm = parts per million, μg/m^3 = micrograms per cubic meter

[a] California standards, other than CO, SO_2 (1-hour), and fine particulate matter, are values that are not to be equaled or exceeded. The CO, SO_2 (1-hour), and fine particulate matter standards are not to be exceeded.

[b] National standards, other than O_3, the 24-hour $PM_{2.5}$, the PM_{10}, and those standards based on annual averages, are not to be exceeded more than once a year. The 1-hour O_3 standard is attained when the expected number of days per calendar year with maximum hourly average concentrations above the standard is equal to or less than one. The 8-hour O_3 standard is attained when the 3-year average of the annual fourth highest daily maximum concentration is less than 0.08 ppm. The 24-hour PM_{10} standard is attained when the 99th percentile of 24-hour PM_{10} concentrations in a year, averaged over 3 years, at the population-oriented monitoring site with the highest measured values in the area, is below 150 μg/m^3. The 24-hour $PM_{2.5}$ standard is attained when the 98th percentile of 24-hour $PM_{2.5}$ concentrations in a year, averaged over 3 years, at the population-oriented monitoring site with the highest measured values in the area, is below 65 μg/m^3. The annual average $PM_{2.5}$ standard is attained when the 3-year average of the annual arithmetic mean $PM_{2.5}$ concentrations, from single or multiple community-oriented monitors, is less than or equal to 15 μg/m^3.

[c] All measurements of air quality are to be corrected to a reference temperature of 25° C and a reference pressure of 760 mm of mercury (Hg) (1,013.2 millibar); ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas.

[d] National Primary Standards: The levels of air quality deemed necessary by the federal government, with an adequate margin of safety, to protect the public health.

[e] National Secondary Standards: The levels of air quality deemed necessary by the federal government, to protect the public welfare from any known or anticipated adverse effects of a pollutant.

[f] Also referred to as photochemical oxidants, measured as O_3.

[g] The 1-hour O_3 standard will be replaced by the 8-hour standard on an area-by-area basis when the area has achieved 3 consecutive years of air quality data meeting the 1-hour standard.

Historically, air quality laws and regulations have divided air pollutants into two broad categories: “criteria pollutants” and “toxic air contaminants.” Federal and state air quality standards have been established for six ambient air pollutants, which are “criteria pollutants,” so named because EPA periodically publishes criteria documents to help establish these standards. The criteria air pollutants for which federal and state ambient standards have been established include O_3, CO, nitrogen dioxide (NO_2), sulfur dioxide (SO_2), PM_{10}, and lead (Pb). Recently, particulate matter less than 2.5 microns in diameter ($PM_{2.5}$) has been added to the list of criteria pollutants. In this analysis, O_3 is evaluated by assessing emissions of O_3 precursors: ROG and NO_2. These criteria pollutants have been regulated for more than 3 decades.

“Toxic air contaminants” are airborne pollutants that have no air quality standards but are known to have adverse human health effects. They have been regulated under federal and state statutes for more than two decades, primarily by control technology requirements on stationary sources, mobile source control requirements, and mitigation established by human health risk assessment.

Federal. The 1990 Clean Air Act Amendments (CAAA) require emission controls on factories, businesses, and automobiles to reduce criteria pollutant emissions. The CAAA regulate automobiles by lowering the limits on ROG and NO_x emissions, requiring the phasing in of alternative fuel cars, requiring on-board canisters to capture vapors during refueling, and extending emission-control warranties. Toxic air pollutants are reduced by requiring factories to install “maximum achievable control technology” and establishing urban pollution control programs.

The CAAA require that each state have an air pollution control plan called the State Implementation Plan (SIP). The SIP includes strategies and control measures to attain the NAAQS by deadlines established by the CAA. The CAAA dictate that states containing areas violating the NAAQS revise their SIPs to include extra control measures to reduce air pollution. The EPA reviews the SIPs to determine whether the plans would conform to the 1990 CAAA and achieve the air quality goals. The EPA may prepare a Federal Implementation Plan for a nonattainment area if the EPA determines a SIP to be inadequate.

In general, attainment plans contain a discussion of ambient air quality data and trends; a baseline emissions inventory; future year projections of emissions, which account for growth projections and already adopted control measures; a comprehensive control strategy of additional measures needed to reach attainment; an attainment demonstration, which generally involves complex atmospheric modeling; and contingency measures. Plans may also include interim milestones for progress toward attainment.

The EPA has classified Air Basins (or portions thereof) as being in “attainment,” “nonattainment,” or “unclassified” for each criteria air pollutant, based on whether or not the NAAQS have been achieved. If an area is designated unclassified, it is because inadequate air quality data were available as a basis for a nonattainment or attainment designation. The EPA classifies the Sacramento Valley Air Basin (SVAB) as nonattainment for O_3 and attainment for NO_2, PM_{10}, and CO with respect to federal air quality standards.

Under the EPA’s general conformity rule (40 CFR Parts 53 and 91), a detailed analysis of conformity with SIPs is required if emissions from a federally controlled aspect of a project exceed the established *de minimis* level of emissions. The de minimis concept refers to a major source threshold below which projects are not subject to these requirements. In addition, the conformity rule requires that the proposed project must be consistent with emission growth factors (land use and population forecasts that were used to generate emission forecasts) contained in the local air district's clean air plan. The *de minimis* level for O_3 is 50 tons per year, as it is a federal nonattainment pollutant. The *de minimis* levels for NO_x, PM_{10}, and CO, as attainment pollutants, are each 100 tons per year.

State of California. The CARB regulates mobile emissions sources, oversees the activities of county and regional Air Pollution Control Districts (APCDs) and Air Quality Management Districts (AQMDs), and implements the CCAA of 1988. The CARB regulates local air quality indirectly by establishing state ambient air quality standards and vehicle emission standards, by conducting research activities, and through its planning and coordinating activities.

California has adopted ambient standards that are more stringent than the federal standards for the criteria air pollutants. Under the CCAA, patterned after the federal CAA, areas have been designated as attainment, nonattainment or unclassified with respect to the state ambient air quality standards. The CCAA requires that districts design a plan to achieve an annual reduction in districtwide emissions of 5 percent or more for each nonattainment criteria pollutant or its precursor(s). These plans include the following: emission control standards that require local districts to stringently control emissions through varying degrees of stationary and mobile source control programs; application of additional control measures if a regional air quality management district or unified APCD contributes to downwind nonattainment areas; cost-effectiveness estimates for all proposed emission control measures; and development and implementation of transportation controls for cities and counties to enforce.

The SVAB is in nonattainment for the state O_3 and PM_{10} standards. The SVAB is designated an attainment area for the state NO_x, SO_x, CO, and Pb standards. Sulfates, hydrogen sulfide, and visibility-reducing particles are unclassified in the SVAB.

Yolo–Solano Air Quality Management District. The YSAQMD has jurisdiction over air quality in the Davis area, including all of Yolo County and the northeastern portion of Solano County. The YSAQMD is one of five air districts located in the SVAB. The YSAQMD regulates most air pollutant sources (stationary sources), with the exception of motor vehicles, aircraft, and agricultural equipment, which are regulated by the CARB or EPA. State and local government projects, as well as projects proposed by the private sector, are subject to requirements of the local air district and the state CCAA if the sources are regulated by the YSAQMD. In addition, the air districts located in the SVAB, along with the CARB, maintain ambient air quality monitoring stations at numerous locations throughout the SVAB. These stations are used to measure and monitor criteria and toxic air pollutant levels in the ambient air.

Before the passage of the CCAA, the YSAQMD's primary role was stationary source control of industrial processes and equipment. After passage of the CCAA and the CAAA, air districts were directed to implement transportation control measures and were encouraged to employ indirect source control programs to reduce mobile source emissions.

In 1994, the YSAQMD and the four other air districts in the SVAB prepared the *Sacramento Regional Clean Air Plan* (Clean Air Plan), which set the strategy for compliance with the federal O_3 standard. The strategy includes numerous measures that require YSAQMD rulemaking and program development for their implementation. The Clean Air Plan is being updated by the five air districts in the SVAB. The update is not projected to be completed until the end of 2003 or beginning of 2004. In 2000, an Air Quality Attainment Plan (AQAP) was prepared by the

YSAQMD and the four other air districts in the SVAB to provide the strategy for compliance with the California hourly O_3 standard.

The YSAQMD provides guidance for analysis of the impacts on air quality of land development projects. This guidance is the YSAQMD Air Quality Handbook (1996). This handbook contains thresholds of significance for criteria pollutant emissions. The thresholds are 82 pounds a day for NO_x and ROG, 550 pounds a day for CO, and 150 pounds a day[1] for PM_{10}.

New Air Quality Standards. In July 1997, the EPA adopted a number of changes to NAAQS for O_3 and particulate matter (EPA 1997a,b). The new O_3 (8-hour) and $PM_{2.5}$ (24-hour and annual) standards are shown in Table 4.3-1. These new standards are discussed separately, because from a regulatory standpoint they have a different status than previously adopted standards. None of the new standards are fully effective at this time because several years will be required to collect the data and information needed to develop control programs. The EPA has not yet designated any areas of the country as being in attainment or nonattainment for the new O_3 and $PM_{2.5}$ standards. Planning requirements and control programs will be phased in with a full set of supporting regulations scheduled to be completed by 2008.

For O_3, the new 8-hour standard will eventually replace the existing 1-hour standard. The new O_3 standard was adopted after the EPA found that the previous national 1-hour standard of 0.12 part per million (ppm) did not adequately protect the public from adverse health effects. Of particular concern is evidence that exposure to O_3 levels below 0.12 ppm is associated with increased hospital admissions for people with respiratory ailments, including asthma, and with reductions in lung function in children and adults who are active outdoors. Evidence also exists that long-term exposure can cause repeated inflammation of the lungs, impairment of lung defense mechanisms, and irreversible damage in lung structure, leading to premature aging of the lungs and chronic respiratory illnesses (EPA 1997a).

For particulate matter, the EPA adopted a 24-hour standard and an annual average standard for the fine fraction of respirable particulate matter, $PM_{2.5}$. The EPA retained the existing PM_{10} standards, but slightly changed the form of the 24-hour PM_{10} standard. The EPA's review of its particulate matter standard showed that "coarse" respirable particles (2.5 to 10 micrometers in size) can be inhaled and aggravate health problems such as asthma. Therefore, the EPA chose to retain PM_{10} standards. The EPA also reviewed studies providing epidemiological evidence that exposure to particulate matter at levels below the existing PM_{10} standards were associated with increased hospital admissions and premature mortality. The EPA found that finer particles (less than 2.5 micrometers in diameter) can penetrate more deeply into lungs, and are more likely than coarser particles to contribute to more severe health effects (EPA 1997b). Therefore, the EPA established new standards for $PM_{2.5}$.

Soon after the promulgation of the new air quality standards, the EPA's authority to establish these new standards was challenged legally. On May 14, 1999, the federal D.C. Circuit Court of Appeals remanded both the new O_3 and $PM_{2.5}$ standards back to the EPA for failing to articulate adequately its authority to set the standards (*American Trucking Associations v. U.S. EPA*, 175 F.3d 1027, D.C. Cir. 1999). The EPA filed a petition for a rehearing on June 28, 1999, with the D.C. Circuit Court of Appeals. The petition was granted in part and denied in part (*American Trucking Associations v. U.S. EPA*, 195 F.3d 4, D.C. Cir. 1999). On January 27, 2000, the EPA

[1] The published threshold for PM_{10} is 82 pounds a day, which is in error (O'Brien 2003).

petitioned the U.S. Supreme Court (*Browner v. American Trucking Associations*, No. 99-1257, Sup. Ct. 2000). On February 27, 2001, the U.S. Supreme Court held that the EPA had authority to issue the new standards and upheld in part and reversed in part the other judgments of the D.C. Circuit Court of Appeals (*Whitman v. American Trucking Associations*, No. 99-1257 and No. 99-1426, Sup. Ct. 2001). The Supreme Court remanded the case back to the D.C. Circuit and the EPA for proceedings consistent with their opinion. On March 26, 2002, the D.C. Circuit, on remand from the Supreme Court, rejected all remaining challenges (*American Trucking Associations, Inc., et al. v. USEPA*, No. 97-1441, D.C. Circuit 2001). The CARB is now in the process of monitoring these pollutants to evaluate the attainment status of the state's air basins with respect to the federal standards. The EPA, on remand from the Supreme Court, is developing a new 8-hour O_3 standard implementation policy that is projected to be finalized in 2003.

4.3.1.2 Climate, Meteorology, and Topography

Air quality in the SVAB is a function of the criteria pollutants that are emitted locally, the existing regional ambient air quality, and meteorological and topographical features that influence the migration of pollutants from areas outside the immediate vicinity.

Geography plays a significant role in weather patterns throughout California's Central Valley. Sacramento Valley is that portion of the Central Valley that lies north of 38^{o} latitude and extends into the south central region of Shasta County. Sacramento Valley is bounded by the Coast and Diablo ranges on the west and the Sierra Nevada Range on the east. Carquinez Strait is a sea-level gap at about 38º north latitude between the Coast Ranges and the Diablo Range. Carquinez Strait exposes Sacramento Valley to the Pacific coast marine influence, which helps moderate climatic extremes.

Temperature and Precipitation. Davis experiences hot, dry summers, and cool winters. Temperatures range from a summer normal high of 93°F to a winter low normal of 36°F (Table 4.3-2).

The average annual precipitation in Davis is 18.13 inches. January is the wettest month, with an average of 3.94 inches of precipitation, and July is the driest, with an average of only 0.03 inch of precipitation. More than 80 percent of the area's rainfall occurs between November and March. Table 4.3-2 summarizes monthly average temperatures and precipitation.

Table 4.3-2
Average Monthly Temperature and Precipitation Data, Davis Station

Month	Normal Temperatures		Precipitation (inches)
	Maximum (°F)	Minimum (°F)	
January	52.8	36.3	3.94
February	59.9	39.5	2.86
March	64.3	41.6	2.65
April	71.3	44.2	1.1
May	80.0	49.2	0.28
June	87.9	54.2	0.15
July	92.7	55.3	0.03
August	91.4	54.8	0.06
September	87.0	52.8	0.29
October	78.1	47.7	1.08
November	63.3	41.2	2.83
December	53.0	36.6	2.86
Annual Average	73.5	46.1	18.13

Source: Monthly Station Normals of Temperature, Precipitation, and Heating and Cooling Degree Days 1961-1990, NCDC, January 1992.

Winds. Regional winds in Davis have two predominant wind flows. Wind flows from the south originate from marine air through Carquinez Strait into the Central Valley, then turn northward into Sacramento Valley. These winds appear slightly more predominant in the summer months when the marine air influence is highest. There are also periods of predominant wind flow from the north, a diurnal wind flow pattern from the evening drainage winds from the slopes of Sacramento Valley, which appear slightly more predominant in the cooler spring and fall months than in the summer. Winter also exhibits a strong diurnal southerly and northerly wind flow pattern; however, winter wind flows exhibit slightly more variability than the other months due to passing storm fronts. The average annual wind speed is about 3.4 miles per hour. Table 4.3-3 summarizes wind speeds and wind directions.

Dispersion Conditions. Dispersion of air pollutants in the SVAB is limited by inversions and low surface wind speeds. Temperature inversions, which limit vertical mixing in the atmosphere and result in increased ambient pollutant concentrations, can occur throughout the year. Between late spring and early fall, a layer of warm air overlays a layer of cool air from Carquinez Strait, resulting in frequent temperature inversions. In the winter, inversions are usually formed when the sun heats the upper air, trapping the lower air layers that are cooled by contact with the earth's surface during the night. During these conditions, radiation or "tule" fog often persists in the Central Valley.

Table 4.3-3
Surface Wind Summary for Davis January 1979–August 1982

Wind Direction	Winter		Spring		Summer		Fall		Annual	
	% of the Time	Mean Speed (mph)	% of the Time	Mean Speed (mph)	% of the Time	Mean Speed (mph)	% of the Time	Mean Speed (mph)	% of the Time	Mean Speed (mph)
N	14.8	5.1	16.7	4.5	9.7	4.4	14.8	3.1	14.6	4.8
NNE	12.1	3.8	10.9	3.6	9.1	3.5	17.0	3.1	12.2	3.7
NE	2.7	1.7	1.9	1.5	3.6	2.1	4.1	2.0	2.8	1.8
ENE	1.3	1.5	1.3	1.6	2.7	1.8	2.0	1.8	1.5	1.6
E	1.3	1.6	0.9	1.3	2.3	2.1	1.8	1.8	1.4	1.6
ESE	2.0	1.9	1.3	1.6	2.2	2.2	2.9	1.9	2.0	1.9
SE	4.6	2.9	3.2	2.0	3.0	2.5	4.4	2.3	4.4	2.8
SSE	10.0	4.0	5.3	3.2	5.5	2.3	5.5	3.0	8.8	3.9
S	13.0	3.4	7.6	2.9	2.6	2.3	2.6	2.1	10.8	3.4
SSW	14.9	3.9	16.3	3.7	19.4	4.0	9.7	2.9	15.0	3.9
SW	6.2	3.4	11.6	3.7	16.7	3.8	9.4	3.3	7.8	3.5
WSW	3.0	2.5	4.7	3.2	6.2	2.6	5.1	2.5	3.6	2.6
W	2.5	2.2	4.6	2.8	4.1	2.6	4.5	2.1	3.0	2.3
WNW	2.7	2.1	3.3	2.3	4.5	2.1	3.9	1.9	3.0	2.1
NW	3.3	2.0	4.1	2.3	4.1	2.2	5.4	1.9	3.6	2.1
NNW	5.4	2.6	6.3	2.7	4.3	2.3	6.8	2.0	5.5	2.5
CALM	0.0	----	0.0	----	0.0	----	0.0	----	0.0	----
ALL		3.5		3.3		3.2		2.6		3.4

Source: California Surface Wind Climatology, California Air Resources Board Aerometric Data Division, June 1984, reprinted January 1992.

4.3.1.3 Air Quality

Criteria Pollutants. The major criteria pollutants of concern are described below. Table 4.3-4 presents the major health effects from air pollutants of regulatory concern.

Table 4.3-4
Health Effects Summary of Air Pollutants of Regulatory Concern

Air Pollutant	**Adverse Effects**
Ozone (O_3)	Eye irritation
	Respiratory function impairment
Carbon Monoxide (CO)	Impairment of oxygen transport in the bloodstream, increase of carboxyhemoglobin
	Aggravation of cardiovascular disease
	Impairment of central nervous system function
	Fatigue, headache, confusion, and dizziness
	Can be fatal in the case of very high concentrations in enclosed places
Particulate Matter Less Than Ten Microns (PM_{10})	Increased risk of chronic respiratory disease with long exposure
	Altered lung function in children
	With SO_2, may produce acute illness
	May lodge in and/or irritate the lungs.

Source: Bay Area Air Quality Management District 1996.

Ozone. O_3 is a secondary pollutant that forms as a result of the interaction between ultraviolet light, ROG, and NO_x. ROG and NO_x are primary pollutants that are emitted directly into the environment, primarily generated by motor vehicle operation and emitted as exhaust, but also generated by stationary and area sources. Secondary or indirect pollutants are formed in the atmosphere, usually as the result of a chemical reaction involving primary pollutants. The major effects of O_3 and the other components of photochemical smog include reductions in plant growth and crop yield, chemical deterioration of various materials, and the irritation of the respiratory system and eyes.

A highly reactive molecule, O_3 readily combines with many different components of the atmosphere. Consequently, high levels of O_3 tend to exist only while high ROG and NO_x levels are present to sustain the O_3 formation process. Once the precursors have been depleted, O_3 levels rapidly decline. Motor vehicles are primary sources of ROG and NO_x in the SVAB. Because of the direct link between vehicular emissions and O_3 formation, SVAB air quality programs focus on reduction of mobile source emissions. Significant reductions in O_3 have been achieved through the state-mandated motor vehicle inspection program.

Particulate Matter Less Than 10 Microns in Diameter. Particulate matter consists of particles in the atmosphere resulting from many sources, including fume-producing industrial and agricultural operations, motor vehicle tires and exhaust, combustion, atmospheric photochemical reactions, burned agriculture waste, and construction activities. Natural activities also introduce particulates into the atmosphere. Wind-raised dust is one such source.

Because of health impacts from breathing the particulate matter, the former total suspended particulate standard was revised in 1987 to regulate particles that are small enough to be considered "inhalable," i.e., 10 microns or less in size. Current standards define acceptable concentrations of particles that are smaller than 10 microns in diameter, referred to as PM_{10}. Particulate matter can be responsible for a wide range of pollution effects, including visibility reduction, respiratory irritation, corrosion of structures and materials, and economic effects related to soiling.

In July 1997, EPA revised the PM_{10} NAAQS and issued a new NAAQS for 2.5 micron particulate matter ($PM_{2.5}$). The CARB is currently in the process of evaluating the attainment status of the state's air basins with respect to the federal $PM_{2.5}$ standard.

Carbon Monoxide. CO is an odorless, invisible gas usually formed as the result of incomplete combustion of organic substances. High levels of CO can impair the transport of oxygen in the bloodstream, thereby aggravating cardiovascular disease and causing fatigue, headaches and dizziness. Motor vehicles are a primary source of CO. CO tends to dissipate rapidly into the atmosphere; consequently, violations of the CO standard are generally limited to major intersections during peak hour traffic conditions.

Other Criteria Pollutants. The air basin is in attainment of ambient standards, or unclassified, for the remaining pollutants. Health effects associated with ROG are mostly associated with the formation of O_3. Additionally, portions of ROG emissions are toxic compounds. The primary sources of ROG are petroleum transfer and storage, mobile sources, and organic solvents. ROG can also result from stationary source combustion.

There are no state or federal ambient air quality standards for ROG. However, ROG is an important component of O_3 formation and is addressed in the regional air quality planning efforts.

Oxides of nitrogen (NO_x) are created during the combustion of fossil fuels under high temperature and pressure. Health effects associated with NO_x are an increase in the incidence of chronic bronchitis and lung irritation. Chronic exposure to NO_x may lead to eye and mucus membrane aggravation, along with pulmonary dysfunction. Airborne NO_x can also impair visibility. In addition, NO_x is a precursor to O_3 formation.

Sulfur oxides (SO_x) can damage and irritate lung tissue, accelerate the corrosion of materials exposed to them, and harm vegetation. Sulfur dioxide (SO_2) is a colorless gas created by the combustion of sulfur-containing fossil fuels. At concentrations above 0.3 part per million (ppm) in air, most people can detect SO_2 by taste. In concentrations above 3 ppm, it has a pungent, irritating odor.

Lead (Pb) is a metal that was used to increase the octane rating in automobile fuel. Adverse health impacts of lead toxicity include loss of appetite, weakness, apathy, and miscarriage. Lead can also cause lesions of the neuromuscular system, circulatory system, brain, and gastrointestinal tract. Regional exposures to airborne lead are no longer an issue in California with the suspension of leaded gasoline.

State-Regulated Pollutants. In addition to the six criteria pollutants that are regulated by both the state and federal governments, four pollutants are regulated by the state only: sulfates, hydrogen sulfide, vinyl chloride, and visibility-reducing particles. The status for sulfates, hydrogen sulfide, and visibility-reducing particles is unclassified in the SVAB because of the limited amount of monitoring data. Vinyl chloride is not required by state law to have a designation.

Sulfates are not evaluated in this EIR, because they are not associated with construction or routine operation of a campus. Sulfates are created by the photochemical reaction of by-products from the burning of fuels containing sulfur. Sulfates are also produced in mining soils that contain sulfates. Vinyl chloride is typically produced by plastic industrial processes, but is evaluated in this EIR as a potential landfill gas component from the Campus Landfill. The hydrogen sulfide standard was primarily created to reduce odors. Hydrogen sulfide, which typically creates smells similar to rotten eggs, is produced in petroleum processing, geothermal plants, and the decomposition of vegetable and animal material without oxygen. Thus, it is also a decomposition by-product in landfill gas and is evaluated in the health risk assessment for this EIR.

The visibility standard was created to increase visibility distance. Visibility is affected by light-scattering particles the size of visible spectrum wavelength and by the absorption of light by dark particles or soot. Sources of visibility-reducing particles include motor vehicles, industrial processes, power plants, and naturally occurring particles.

4.3.1.4 Existing Air Quality in the Project Area

Air quality on any given day is influenced by both meteorological conditions and pollutant emissions. In general, meteorological conditions vary more than pollutant emissions from day to day, and therefore, tend to have a greater influence on changes in measured ambient pollutant concentrations. The influence of emissions is greatest for CO and PM_{10}, two pollutants for which ambient concentrations are particularly influenced by local emission sources. A 5-year summary of the measured ambient concentrations of criteria air pollutants in the project area is provided in Table 4.3-5. These measurements were taken from six air quality sampling stations located in and around the Davis area and run by the CARB. The UC Davis monitoring station is located in the agricultural field west of the campus, just south of Russell Boulevard.

The EPA has classified the entire SVAB, which includes the project area, as a severe nonattainment area for O_3. The CARB has also designated the area as being in nonattainment under the state ambient air quality standards for O_3 and PM_{10}. The designation of an area as attainment and nonattainment is based on monitored data throughout the SVAB.

4.3.1.5 Toxic Air Contaminants

Toxic air contaminants are a category of air pollutants that have been shown to have an impact on human health but are not classified as criteria pollutants. Examples include certain aromatic and chlorinated hydrocarbons, certain metals, and asbestos. Adverse health effects of toxic air contaminants can be carcinogenic (cancer-causing), short-term (acute) noncarcinogenic, and long-term (chronic) noncarcinogenic. Several hundred such pollutants are currently regulated by various federal, state, and local programs, as described below.

Regulatory Background

Federal. Air toxics have been regulated at the federal level since the CAA of 1977. Following the passage of this law, regulations for seven hazardous air pollutants (HAPs) were promulgated as National Emission Standards for Hazardous Air Pollutants (NESHAPS) over a 13-year period. The federal Clean Air Act Amendments of 1990 revamped the NESHAPS program to offer a technology-based approach for reducing the emissions of a greater number of toxic air compounds. Under the 1990 CAAA, 189 substances were identified as HAPs and slated for regulation. The program requires certain facilities to control air toxic emissions by the installation of Maximum Achievable Control Technology (MACT), which is implemented and enforced in the YSAQMD through Rule 3.8, *Federal Operating Permits*, which administers the federal operating permits program established by the 1990 CAAA.

State. California’s air toxics control program began in 1983 with the passage of the Toxic Air Contaminant Identification and Control Act, better known as Assembly Bill 1807 (AB 1807) or the Tanner Bill. The Tanner Bill established a regulatory process for the scientific and public review of individual toxic compounds. When a compound becomes listed as a “toxic air contaminant” (TAC) under the Tanner process, the CARB normally establishes minimum statewide emission control measures to be adopted by local APCDs. By 1992, 18 of the 189 federal HAPs had been listed by the CARB as state TACs. Later legislative amendments (AB 2728, Tanner 1992) required the CARB to incorporate all 189 federal HAPs into the state list of TACs. In April 1993, the CARB added 171 substances to the state program to make the state TAC list equivalent to the federal HAP list.

Table 4.3-5
Summary of Criteria Air Pollutant Monitoring

Monitoring Station	Pollutant	1996	1997	1998	1999	2000	2001
Ozone							
UC Davis	Peak 1-hour concentration (ppm)	0.122	0.104	0.115	0.117	0.103	0.1
	Days above federal standard	0	0	0	0	0	0
	Days above state standard	12	1	9	9	4	5
	Year Coverage	99	98	99	100	97	99
UC Davis	Peak 8-hour concentration (ppm)	0.104	0.086	0.095	0.094	0.089	0.093
	Days above federal standard	4	1	4	5	1	2
	Days above state standard	N/A	N/A	N/A	N/A	N/A	N/A
	Year Coverage	99	98	99	100	97	99
Carbon Monoxide							
UC Davis	Peak 8-hour concentration (ppm)	1.76	1.77	1.14	1.37	1.28	3.35
	Days above federal standard	0	0	0	0	0	0
	Days above state standard	0	0	0	0	0	0
	Year Coverage	57	100	98	90	96	63
PM_{10}							
Woodland-Sutter Street	Peak 24-hour concentration ($\mu g/m^3$)	77	126	130	56	N/A	N/A
	Measured days above federal standard	0	0	0	0	N/A	N/A
	Measured days above state standard	7	2	10	1	N/A	N/A
	Annual geometric mean ($\mu g/m^3$)	23	24	22	17	N/A	N/A
	Exceedance of state standard	42	8	55	6	N/A	N/A
	Annual arithmetic mean ($\mu g/m^3$)	--	--	--	--	N/A	N/A
	Exceedance of federal standard	0	0	0	0	N/A	N/A
West Sacramento-15th Street	Peak 24-hour concentration ($\mu g/m^3$)	76	109	63	126	79	95
	Measured days above federal standard	0	0	0	0	0	0
	Measured days above state standard	2	2	2	8	5	5
	Annual geometric mean ($\mu g/m^3$)	21	21	19	25	22	23
	Exceedance of state standard	12	8	7	48	30	30
	Annual arithmetic mean ($\mu g/m^3$)	N/A	N/A	N/A	N/A	N/A	N/A
	Exceedance of federal standard	0	0	0	0	0	0
Woodland-Gibson Road	Peak 24-hour concentration ($\mu g/m^3$)	N/A	N/A	69	179	63	67
	Measured days above federal standard	N/A	N/A	0	1	0	0
	Measured days above state standard	N/A	N/A	2	10	2	3
	Annual geometric mean ($\mu g/m^3$)	N/A	N/A	21	23	20	19
	Exceedance of state standard	N/A	N/A	7	60	12	18
	Annual arithmetic mean ($\mu g/m^3$)	N/A	N/A	N/A	N/A	N/A	N/A
	Exceedance of federal standard	N/A	N/A	N/A	6.6	0.0	0.0
$PM_{2.5}$							
Vallejo-Tuolumne Street	Peak 24-hour concentration ($\mu g/m^3$)	N/A	N/A	N/A	90.5	60.1	90.1
	Measured days above federal standard	N/A	N/A	N/A	1	0	2
Woodland-Gibson Road	Peak 24-hour concentration ($\mu g/m^3$)	N/A	N/A	N/A	70	46	57
	Measured days above federal standard	N/A	N/A	N/A	1	0	0
Nitrogen Dioxide							
UC Davis	Peak 1-hour concentration ($\mu g/m^3$)	0.06	0.057	0.06	0.073	0.053	0.172
	Days above state standard	0	0	0	0	0	0
	Annual arithmetic mean ($\mu g/m^3$)	N/A	0.01	0.011	0.012	0.011	0.01
	Year Coverage	75	99	98	99	95	97

Sources: CARB 1997, 1998, 1999, 2000 and 2001 Internet Air Quality Data Summaries.

The second major component of California's air toxics program, supplementing the Tanner process, was provided by the passage of AB 2588, the Air Toxics "Hot Spots" Information and Assessment Act of 1987. AB 2588 currently regulates over 600 air compounds, including all of the Tanner-designated TACs. Under AB 2588, specified facilities must quantify emissions of regulated air toxics and report them to the local APCD. If the APCD determines that a potentially significant public health risk is posed by a given facility, the facility is required to perform a health risk assessment and notify the public in the affected area if the calculated risks exceed specified criteria. The YSAQMD's implementation of AB 2588 is discussed below.

In addition to the above, Proposition 65 was passed by California voters in 1986, which required that a list of carcinogenic and reproductive toxicants found in the environment be compiled, the discharge of these toxicants into drinking water be prohibited, and warnings of public exposure by air, land, or water be posted if a potential public health risk is posed. The handling of any of these substances by a facility would require a public warning unless health risks could be demonstrated to be insignificant. For carcinogens, Proposition 65 defines the "no significant risk level" as the level of exposure that would result in an increased cancer risk of greater than 10 in one million over a 70-year lifetime. This program is currently administered by the Office of Environmental Health Hazard Assessment.

On August 27, 1998, the CARB formally identified particulate matter emitted by diesel-fueled engines as a TAC. Diesel engines emit TACs in both gaseous and particulate forms. The particles emitted by diesel engines are coated with chemicals, many of which have been identified by the EPA as HAPs and by the CARB as TACs. Since by weight, the vast majority of diesel exhaust particles are very small (94 percent of their combined mass consists of particles less than 2.5 microns in diameter), both the particles and their coating of TACs are inhaled into the lung. While the gaseous portion of diesel exhaust also contains TACs, the CARB's August 1998 action was specific to diesel particulate emissions, which, according to supporting CARB studies, represent 50 to 90 percent of the mutagenicity of diesel exhaust (CARB 1998).

The CARB action was taken at the end of a lengthy process that considered dozens of health studies, extensive analysis of health effects and exposure data, and public input collected over the previous 9 years. CARB's Scientific Advisory Committee has recommended a unit risk factor of 300 in one million for diesel particulate. The CARB action will lead to additional control of diesel engine emissions in coming years by the CARB. The EPA has also begun an evaluation of both the cancer and noncancer health effects of diesel exhaust.

The CARB's 1998 ruling prompted the CARB to begin searching for means to reduce diesel particulate matter emissions. In September 2000, the CARB approved the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* (Diesel Risk Reduction Plan). The Diesel Risk Reduction Plan outlines a comprehensive and ambitious program that includes the development of numerous new control measures over the next several years aimed at substantially reducing emissions from new and existing on-road vehicles (e.g., heavy-duty trucks and buses), off-road equipment (e.g., graders, tractors, forklifts, sweepers, and boats), portable equipment (e.g., pumps), and stationary engines (e.g., stand-by power generators).

Many laboratory fume hoods are operated on the UC Davis campus. Title 8 of the California Code of Regulations contains California Occupational Safety and Health Administration requirements for these emission sources. The regulations are concerned with worker health and safety, requiring a minimum flow of speed, face velocity, and certain design features to protect laboratory personnel in their work. In addition, the code establishes specific requirements for the use and storage of carcinogens, including a requirement to scrub or filter air emissions from areas where carcinogens are used. Other than the requirement that the top of the fume hood stack must be located at least 7 feet above the roof, the regulations do not address emissions once the exhausted air mixes with outdoor air.

Local. In compliance with federal law, YSAQMD Rule 3.8, as described above, implements federal NESHAPS and MACT requirements through the federal operating permit program. The YSAQMD has also developed various rules for specific source categories pursuant to the Tanner process under YSAQMD Regulation IX, *State Designated Toxics Sources*. Among these rules, Rule 9.9, *Asbestos*, applies to UC Davis. This rule governs the airborne emissions of asbestos, including from demolition and renovation activities. Prior to any demolition and renovation, except for single-family residential dwellings and activities involving defined small amounts of regulated asbestos-containing material (RACM), the rule requires surveys for the presence of RACM. Then, during demolition, the rule requires wetting, physical barriers to outside air, signage, collection of RACM, proper waste handling and disposal of RACM, and record-keeping. Other dust from construction and demolition activities is addressed by YSAQMD Rule 2.5, *Nuisance*, which states that sources cannot emit air contaminants that cause nuisances to "any considerable number of persons or the public."

The YSAQMD's permitting program also includes a "Best Available Control Technology for Toxics" (T-BACT) review under YSAQMD Rule 3.13, *Toxics New Source Review*. This rule covers proposed new or reconstructed major sources of federal HAPs. It implements Section 112(g) of the federal 1990 CAAA, which addresses new or reconstructed major sources of federal HAPs included in the specific source categories for which EPA promulgates MACT standards (as described above). If a source falls under this rule, a case-by-case T-BACT determination must be made, unless the source is specifically exempt (research and development activities as defined in 40 CFR 63.41). A major HAP source is one that emits 10 tons per year or more of a single federal HAP, or 25 tons per year or more of any combination of federal HAPs.

In compliance with state law, the YSAQMD also administers the AB 2588 Air Toxics "Hot Spots" Program. Facilities must report their TAC emissions and if the YSAQMD determines the facility poses a potential public health risk, the facility must perform a health risk assessment (HRA). An HRA includes an analysis of TAC emissions and characterizes human health risks as a result of the estimated TAC exposures. If the estimated health risks exceed threshold levels, the public in the affected area must be notified and steps taken to reduce emissions. For carcinogens, the YSAQMD uses a 70-year cancer risk level of 10 in one million as the AB 2588 public notification level, which matches the "no significant risk level" used by Proposition 65. For noncarcinogens, public health risk is assessed by the "hazard index" for both long-term (chronic) and short-term (acute) exposures. A "hazard index" is the sum of the ratios of each chemical's actual exposures to acceptable exposures. Hazard index values less than 1.0 indicate an acceptable non-cancer health risk. The YSAQMD uses a hazard index threshold of 1.0 as the AB 2588 public notification level for non-cancer toxicants.

Existing Air Toxics

Air Toxics Emissions Sources. Air toxics are generated by a number of sources, including stationary sources, such as dry cleaners, gas stations, combustion sources, and laboratories;

mobile sources, such as automobiles; and area sources, such as farms, landfills, construction sites, and residential areas. The CARB has prepared a stationary source air toxics emissions inventory. The inventory identifies air toxics emissions from sources in each California air district and quantifies these emissions where feasible from information reported through the AB 2588 Program.

Existing Ambient Concentrations. Air toxics monitoring stations are located throughout California. These stations, maintained either by the CARB or the local APCD, monitor and record existing levels of various organic gases and metals in air.

The YSAQMD does not operate any TAC air monitors. The TAC monitoring station located closest to Davis is a CARB-operated station in Roseville. The Roseville station is located in a more urbanized area than Davis and is much closer to Sacramento. Because of the location and urban land use in the area of the TAC monitor in Roseville, the data from this monitor are not considered representative of the TAC concentrations near Davis. Nevertheless, to provide an approximate level of existing air toxics levels in the Yolo-Solano region, Chapter 5 of *The 2002 California Almanac of Emissions and Air Quality* (CARB 2002) presents annual average concentrations and health risks for the Sacramento Valley Air Basin. CARB's background estimates of TAC concentrations and 70-year cancer risks in the Sacramento Valley Air Basin for the ten TACs posing the greatest health risk, based on monitored values from the Roseville station and from a monitor in Chico, are presented in Table 4.3-6 for the year 2000, the latest year for which data are available. These data provide an estimate of 160 in one million from ambient air toxics without considering diesel particulate matter and 520 in one million considering diesel particulate matter. In the case of diesel particulate matter, there is no routine method for monitoring ambient concentrations, thus CARB made preliminary estimates using their PM_{10} emissions database and PM_{10} ambient monitoring data, the results of several studies with chemical speciation of ambient data, and receptor modeling techniques. Since 1990, annual average concentrations of TACs in the Sacramento Valley Air Basin have declined due to the implementation of air toxics control programs. Considering diesel particulate matter, the estimated Sacramento Valley Air Basin TAC cancer risk was 1,135 in one million in 1990 and 705 in one million in 1995 (CARB 2002).

The calculated average cancer risk values from monitored TACs can be compared against the lifetime probability of being diagnosed with cancer in the United States from all causes, which is about 40%, or 400,000 in a million (National Cancer Institute (NCI) 2000). Medical advances have improved cancer cure rates such that the lifetime probability of dying from cancer in the United States today is about 220,000 in a million (NCI 2000), or about 55% of the lifetime probability of a cancer diagnosis. It is generally believed that a large portion of these cancer cases come from smoking habits, genetic susceptibilities, diet, natural radiation including radon, and other lifestyle factors. According to one source, smoking may account for about 30.5% of the cancer deaths in the United States (Shopland et al. 1991). Environmental and occupational exposures are generally thought to be responsible for a small portion of this background risk. But, because these exposures are often involuntary and in principle can be reduced by regulatory initiatives, environmental and occupational carcinogens are a principal focus of regulatory policy.

Table 4.3-6
Average Ambient Concentrations of Toxic Air Contaminants in the Sacramento Valley Air Basin in 2000

Compound	Concentration		Unit Risk	Cancer Risk (Chances In One Million)
	(ppb)	(µg/m³)	(µg/m³)⁻¹	
Gaseous TACs				
Acetaldehyde	0.83	1.49	2.70E-06	4
1,3-Butadiene	0.12	0.27	1.70E-04	45
Benzene	0.45	1.44	2.90E-05	42
Carbon Tetrachloride	0.09	0.59	4.20E-05	25
Para-Dichlorobenzene	0.11	0.63	1.10E-05	7
Formaldehyde	2.51	3.07	6.00E-06	18
Methylene Chloride	0.57	1.96	1.00E-06	2
Perchloroethylene	0.06	0.37	5.90E-06	2
Compound	**Concentration**		**Unit Risk**	**Cancer Risk (Chances in one million)**
	(ng/m³)	**(µg/m³)**	**(µg/m³)⁻¹**	
Particulate TACs				
Chromium (Hexavalent)	0.10	0.0001	1.50E-01	15
Diesel Exhaust Particulate Matter	1200	1.2	3.00E-04	360
Total Risk for All TACs				**520**

Source: CARB 2002

4.3.1.6 Odors

Four major elements are involved in evaluating odor emissions: deductibility, recognition, intensity, and hedonic tone. Deductibility is the lowest concentration of an odorant that will elicit a sensory response; at this concentration there is an awareness of the presence of an added substance but not necessarily an odor sensation. Recognition, however, is the minimum concentration that is recognized as having a characteristic odor quality by a segment of the population. Odor intensity refers to the perceived strength of the odor sensation, and odorant character is what the substance smells like (e.g., fishy, rancid, hay, sewer, turpentine, ammonia, etc.). Hedonic tone is a judgment of the relative pleasantness or unpleasantness of the odor, and is influenced by factors such as subjective experience and frequency of occurrence. The apparent presence of an odor in ambient air depends on the properties of the substance emitted, its concentration in facility emissions, and the dilution of emissions between the emissions point and the receptor (person). YSAQMD Rule 2-5 covers emissions that would be a general nuisance, and this rule covers odorous emissions.

4.3.1.7 Sensitive Receptors

Some receptors are considered more sensitive to air pollution than the general population. Sensitive receptors include children, the elderly, and people with health problems who are more often susceptible to respiratory infections and other air-quality-related health problems. Schools, daycare centers, hospitals, and nursing homes are all considered sensitive receptors. Sensitive receptors within a 5-mile radius of UC Davis were identified. Included in the identified sensitive receptors were 20 daycare centers, two nursing homes, 26 schools (not including UC Davis), and one hospital (not including the UC Davis on-campus Cowell Student Health Center).

4.3.2 Impacts and Mitigation Measures

4.3.2.1 Standards of Significance

The following standards of significance are based on Appendix G of the CEQA Guidelines.

Criteria Pollutants

For the purposes of this EIR, an impact is considered significant if the implementation of the LRDP or a specific project under the 2003 LRDP would:

- Conflict with or obstruct implementation of the applicable air quality plan
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation

  According to the YSAQMD, emissions of NO_x and ROG in excess of 82 pounds a day, CO emissions in excess of 550 pounds a day, and 150 pounds a day[2] for PM_{10} would be considered significant (discussed in Section 4.3.1.1).

- Result in a cumulatively considerable net increase of any criteria pollutant for which the project region is non-attainment under an applicable federal or state ambient air quality standard (including releasing emissions which exceed quantitative thresholds for ozone precursors)
- Expose sensitive receptors to substantial pollutant concentrations
- Create objectionable odors affecting a substantial number of people

Toxic Air Contaminants

An impact would be considered significant if the implementation of the 2003 LRDP or a specific project under the 2003 LRDP would:

- Contribute to the probability of contracting cancer for the Maximally Exposed Individual (MEI) exceeding the AB 2588 and Proposition 65 threshold of 10 in one million
- Result in a noncarcinogenic (chronic and acute) health hazard index greater than the AB 2588 threshold of 1.0

4.3.2.2 Analytical Method

Vehicular Emissions

Emissions from vehicle trips associated with the 2003 LRDP were estimated with the EMFAC2002 model. This is the latest in a series of models by the CARB for calculation of emissions from all classes of on-road vehicles. Traffic data for No Project Alternative and LRDP conditions were obtained from the traffic analysis (Fehr and Peers Associates 2003). Average daily vehicle miles traveled under both "2015 No Project" and "2015 With 2003

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[2] According to the YSAQMD Air Quality Handbook, this threshold is 82 pounds a day. However, the published threshold is in error. The correct threshold for PM_{10} is 150 pounds a day (O'Brien 2003).

LRDP" conditions were used with the EMFAC2002 factors to calculate daily emissions of ROG, CO, NO_x, SO_2, and PM_{10}. The No Project Alternative conditions represent traffic volumes that would affect study area streets and intersections in 2015 if the 2003 LRDP were not implemented (see Section 4.14 Transportation [Volume II] for a definition of No Project conditions).

Local Carbon Monoxide Emissions

Impacts from CO emissions from vehicles associated with the full development under the 2003 LRDP were evaluated at intersections in the project vicinity exhibiting the most congestion due to the proposed project and where the difference between project and no-project volumes was greater than 5 percent. The method of evaluation followed that described in the Transportation Project-Level Carbon Monoxide Protocol (UC Davis 1997) referred to as the "CO Protocol." The analysis approach in the CO Protocol involves a screening process where dispersion modeling (e.g., with CALINE4) is not required if the air basin is in attainment of the CO standard and there exists a similar intersection in the air basin that has equal or higher traffic volumes or congestion, or receptors that are as close or closer to the roadway as the intersection(s) under consideration for impacts from the proposed project. The results of this analysis are discussed below.

Construction Emissions

Construction emissions were estimated for the five individual projects that are currently proposed under the 2003 LRDP. The sum of the emissions from these projects is considered to be representative of the typical annual level of campus construction emissions under the 2003 LRDP. Those emission estimates are discussed in more detail in Volume III where the project-specific impacts from each of the projects are discussed.

Stationary Source Emissions

Stationary sources of air pollutant emissions that are expected to be added to the campus under the 2003 LRDP include the following:

- Additional cooling towers at the Chilled Water Plant
- New boilers associated with the campus steam plant and the I-80 Research Park
- Emergency generators associated with future laboratory buildings
- Expansion of the campus wastewater treatment plant

Four new cooling towers would be added to the campus Chilled Water Plant, as described in Section 6 (Volume III). Assuming that another similar expansion of chilled water facilities would be needed through the end of the LRDP period, emissions estimated for the four cooling towers were doubled to represent full development under the 2003 LRDP. The new cooling tower emissions were assumed to be the same as the permitted emissions from the existing cooling towers on campus.

Boiler emissions were estimated based on the size and fuel of the boiler (all at UC Davis are natural gas fueled). Emission factors were obtained from AP-42 (EPA 1995), an industry-specific emission factor inventory document, and are expressed in terms of pounds of pollutant per hourly fuel energy input to the boiler.

Emergency generators are provided in most of the laboratory buildings on campus for backup electricity. Emissions from the periodic testing of the additional emergency generators that would be added under the 2003 LRDP were calculated based on the power output of the generators and using factors from AP-42 of pounds of pollutant per horsepower-hour.

The wastewater treatment plant throughput would be increased with the implementation of the 2003 LRDP. Wastewater treatment plant emissions were obtained from the Wastewater Treatment Plant EIR (UC Davis 1996). This analysis increased those emissions by 50 percent to account for the growth under the 2003 LRDP.

Area Source Emissions

Area sources that would be added to the campus under the 2003 LRDP include housing, educational and research facilities, and limited retail space. Emissions associated with these land uses include:

- diesel-powered landscaping equipment,
- natural gas combustion emissions from space and water heating,
- wood-burning fireplace emissions, and
- ROG emissions from consumer product use, such as automotive products, household cleaners, and personal care products.

Note that there is no specific regulatory framework for these types of sources, since they are a result of various activities by individuals rather than pollutants emitted by businesses or industry. The URBEMIS 2001 model was used to estimate emissions from area sources, based on the number of students projected at full development under the 2003 LRDP, as well as the building space planned for campus development. URBEMIS is a computer program that estimates air pollutant emissions from many types of land use development projects, and also estimates construction emissions associated with these types of projects. The model was developed under the cooperation of several California air districts and the California Air Pollution Control Officers Association (CAPCOA). The URBEMIS model also provide estimates of vehicular emissions from land development projects. Rather than using URBEMIS to estimate vehicle emissions, this analysis used project-specific traffic data and the CARB vehicle emissions model EMFAC2002 to calculate vehicle emissions.

Toxic Air Contaminant Emissions

Since there are no ambient standards for toxic air contaminants, evaluation of impacts is based upon a health risk assessment (HRA). The *Air Toxics Health Risk Assessment for the University of California Davis 2003 Long Range Development Plan* (URS 2003) performed in support of this EIR assessed total campus health risks associated with full development under the 2003 LRDP. That is, the projected cancer risks and non-cancer hazard indices in the 2003 HRA were evaluated for existing campus operations and all potential development under the 2003 LRDP through the academic year 2015-16. In addition to campus stationary sources, the 2003 HRA included the impact of diesel-powered mobile sources on campus roads, and diesel-powered off-road equipment used for landfill operations and campus agricultural operations.

Hundreds of chemicals are used or produced by campus operations, but only a portion of these chemicals contribute substantially to human health risks. A total of 60 chemicals were selected for modeling in the 2003 HRA based on a detailed assessment of their use, production, volatility, and toxicity. These chemicals are listed in Table 4.3-7. A full description of the HRA analytical methodology can be found in the *Air Toxics Health Risk Assessment for the University of California Davis 2003 Long Range Development Plan* (URS 2003).

Table 4.3-7
Toxic Air Contaminants Included in the UC Davis 2003 LRDP Health Risk Assessment for Academic Year 2015-16

Laboratory Chemicals	Combustion Chemicals	Wastewater/Landfill Chemicals
Acetonitrile	Acetaldehyde	Acrylonitrile
Acrylamide	Acrolein	p-Dichlorobenzene
Benzene[1,2]	1,3-Butadiene	Ethylene dibromide
Bromine and compounds	Diesel particulate	Hydrogen sulfide
t-Butyl alcohol	Dioxins/furans	Methyl mercaptan
Carbon tetrachloride[2]	Ethylbenzene[2]	Styrene
Chloroform[2]	Naphthalene	1,1,2,2-Tetrachloroethane
Dimethylformamide	Polyaromatic hydrocarbons	
1,4-Dioxane	Propylene	
Ethanol[2]	Propylene oxide	
Ethyl acetate	Vinyl chloride[2]	
Ethylene dichloride[2]	Arsenic	
Ethyl ether	Beryllium	
Formaldehyde[1]	Cadmium	
Glutaraldehyde	Chromium (+6)	
n-Hexane[1,2]	Copper	
Hydrazine	Lead	
Hydrochloric acid[1]	Mercury[2]	
Hydrofluoric acid[1]	Nickel	
Hydrogen-3 (Tritium)	Selenium	
Iodine-125 (I-125)	Zinc	
Isopropanol[2]		
Methyl alcohol		
Methyl bromide		
Methylene chloride[2]		
Pyridine		
Tetrachloroethylene[2]		
Tetrahydrofuran		
Toluene[1,2]		
Trichloroethylene[2]		
Triethylamine		
Xylenes[1,2]		

[1] These chemicals are also from combustion (includes veterinary medicine incinerator and power/steam generation).
[2] These chemicals are also from wastewater treatment and/or landfill operations (as well as chloroform remediation).

4.3.2.3 LRDP Impacts and Mitigation Measures

LRDP Impact 4.3-1: Implementation of the 2003 LRDP would result in daily operational emissions above the YSAQMD thresholds that may contribute substantially to a violation of air quality standards or hinder attainment of the regional air quality plan.

Significance: Significant

LRDP Mitigation 4.3-1(a): Vehicular Sources. The following measures will be implemented to reduce emissions from vehicles, as feasible.

- The campus shall continue to actively pursue Transportation Demand Management to reduce reliance on private automobiles for travel to and from the campus.
- Provide pedestrian-enhancing infrastructure to encourage pedestrian activity and discourage vehicle use.
- Provide bicycle facilities to encourage bicycle use instead of driving.
- Provide transit-enhancing infrastructure to promote the use of public transportation.
- Provide facilities to accommodate alternative-fuel vehicles such as electric cars and CNG vehicles.
- Improve traffic flows and congestion by timing of traffic signals to facilitate uninterrupted travel.
- When the campus purchases new vehicles, the campus will evaluate the practicality and feasibility of acquiring low-pollution vehicles that are appropriate for the task and will purchase these types of vehicles when practical and feasible. When replacing diesel engines in existing equipment, the campus will install up-to-date technology.

LRDP Mitigation 4.3-1(b): Area Sources. The following measures will be implemented to reduce emissions from area sources, as feasible.

- Use solar or low-emission water heaters in new or renovated buildings.
- Orient buildings to take advantage of solar heating and natural cooling and use passive solar designs.
- Increase wall and attic insulation in new or renovated buildings.
- For fireplaces or wood-burning appliances, require low-emitting EPA certified wood-burning appliances, or residential natural-gas fireplaces.

- Provide electric equipment for landscape maintenance.

LRDP Mitigation 4.3-1(c): The campus will work with the YSAQMD to ensure that emissions directly and indirectly associated with the campus are adequately accounted for and mitigated in applicable air quality planning efforts. The YSAQMD can and should adopt adequate measures consistent with applicable law to ensure that air quality standard violations are avoided.

Residual Significance: Significant and unavoidable

Implementation of the 2003 LRDP would increase the amount of building space, the number of people living on campus, as well as the number of persons traveling to and from the campus on a daily basis. Other activities or facilities that would generate additional air emissions including landscape maintenance, wastewater treatment plant operations, and the operation of steam and chilled water facilities. Other campus operations would also increase in response to the increased on-campus population. Estimated daily emissions from each major emission source are presented below.

Operational Vehicular Emissions

The increased number of vehicles from students, faculty, and staff using the campus would contribute to regional emissions of NO_x, ROG, CO, SO_2, and PM_{10}. These emissions were estimated for the campus using the EMFAC2002 on-road vehicle emissions model. Daily vehicle emissions associated with the 2003 LRDP at full development are summarized in Table 4.3-8 below.

Table 4.3-8
Daily Vehicular Emissions Associated with the 2003 LRDP
(in lbs/day)

Scenario	NO_x	ROG	PM_{10}	CO	SO_2
2015 No Project Vehicle Emissions	4,877.5	2,793.1	486.1	41,218.8	53.4
2015 with 2003 LRDP Vehicle Emissions	5,278.7	3,025.1	526.0	44,628.4	57.8
Increase due to 2003 LRDP	401.2	232.0	39.9	3,409.6	4.4
2015 with 2003 LRDP without the NMP Project Vehicle Emissions	5,439.7	3,044.8	544.1	45,363.4	59.7

Note: Vehicle emission estimates include total vehicle emissions from trips within the City of Davis and UC Davis area, as well as emissions form vehicle trips made by UC Davis faculty, staff and students that would live in surrounding communities. Details of vehicle trips and vehicle miles traveled are provided in Table 4.14-18 (Volume II) of this EIR.

Stationary Source Emissions

Emissions of NO_x, ROG, CO, SO_2, and PM_{10} from stationary sources associated with the 2003 LRDP are summarized in Table 4.3-9 below.

Table 4.3-9
Daily Stationary Source Emissions Associated with the 2003 LRDP
(in lbs/day)

	NO_x	ROG	PM_{10}	CO	SO_2
Boilers	65.5	27.1	65.3	289.3	13.6
Emergency Generators	49.3	4.0	3.5	10.6	3.3
Cooling Towers	0	0	6.8	0	0
WWTP Expansion	0	0.8	0	0	0
TOTAL	114.8	31.9	75.6	299.9	16.9

Boilers assumed to operate 8,760 hours per year, emergency generators assumed to operate 1/2 hour every week (26 hours per year); steam plant boiler emissions based on information provided in the Central Plant Master Plan, UC Davis. WWTP emissions assumed to increase over existing by 50%. Existing WWTP emissions from UC Davis 1996 WWTP Environmental Impact Report. Cooling tower emissions based on existing cooling tower permitted emission rates. All new generators assumed to be 410 hp, which is the average size of the existing engines on campus. Emergency generators assumed to be tested at 25% load.

For the addition of any new stationary source, the campus Title V permit would have to be revised. If the source exceeded the offset threshold for a particular pollutant, emission reduction credits would likely be required.

Area Source Emissions

Emissions of NO_x, ROG, CO, PM_{10}, and SO_2 from area sources (water and space heating, landscaping equipment, and consumer product use) are summarized in Table 4.3-10 below.

Table 4.3-10
LRDP Area Source Emissions
(in lbs/day)

NO_x	ROG	PM_{10}	CO	SO_2
112.9	183.3	16.9	183.9	1.6

Total Emissions

Total operational emissions of criteria pollutants are the sum of regional emissions from vehicular sources, stationary sources (boilers, cooling towers, emergency generators, and wastewater treatment plant), and area sources (housing and other building space) under the 2003 LRDP. Total emissions of NO_x, ROG, CO, PM_{10} and SO_2 from the full development under the 2003 LRDP are summarized in Table 4.3-11 below. With the exception of SO_2 and PM_{10}, the emissions of all criteria pollutants would exceed significance thresholds, resulting in a significant impact.

Table 4.3-11
Total Operational Emissions
(in lbs/day)

Source	NO_x	ROG	PM_{10}	CO	SO_2
Vehicles	401.1	232.0	39.9	3,409.6	4.4
Stationary	114.8	31.9	75.6	299.9	16.9
Area	112.9	183.3	16.9	183.9	1.6
TOTAL	628.8	447.2	132.4	3,893.4	22.9
YSAQMD Thresholds	82	82	150	550	82

LRDP Mitigation 4.3-1 (a-b) is identified to reduce daily emissions from campus operations. While some reduction would certainly be achieved, it is considered unlikely that these emissions could be lowered to levels that would be considered less than significant.

Given the likelihood of exceedance even with mitigation, it appears that the implementation of the 2003 LRDP could potentially hinder the attainment of the regional air quality plan. The campus is located in an area that is in nonattainment of ozone and PM_{10} standards. The Sacramento federal nonattainment area for ozone includes all of Sacramento and Yolo counties, and portions of El Dorado, Placer, Sutter, and Solano counties. This region is moving toward a 2005 deadline for meeting the federal ozone standard. The region has a clean air plan called the Sacramento Regional Clean Air Plan, that contains strategies for lowering the region's emissions such that it meets the ozone standard by the deadline. However, the transportation planning that is part of the Clean Air Plan may not meet the emissions budget that is part of the Clean Air Plan's strategy for reaching attainment. As such, the 1994 Clean Air Plan must be updated so that the transportation planning will conform to it. The region must update its Clean Air Plan or transportation funding could be withheld.

The current Clean Air Plan was prepared in 1994 and expires in 2005. In addition to transportation sources, this plan projected growth and emissions from major stationary sources in the region through the year 2005. Campus growth projected under the 1994 LRDP through 2005 was included in the 1994 Clean Air Plan. Campus growth under the 2003 LRDP is not addressed by the current Clean Air Plan.

The Yolo-Solano AQMD has commenced the process of updating the current Clean Air Plan to extend it beyond the year 2005. The projected growth under the 2003 LRDP would be provided to the air district for inclusion in the Clean Air Plan update. This planning would be coordinated with the Sacramento Area Council of Governments (SACOG), whereby growth in regional population and vehicle miles traveled associated with the 2003 LRDP would be incorporated into SACOG's growth projections and then provided to the air district for its analysis and inclusion in the Clean Air Plan. Regional air quality attainment plans include a baseline emissions inventory, future year projections of emissions that account for growth and already adopted control measures, a comprehensive control strategy of individual measures needed to reach attainment, and contingency measures.

With the implementation of the LRDP mitigation measures and coordinated planning efforts with the YSAQMD (LRDP Mitigation 4.3-1(c)), the impacts from operational emissions would be substantially reduced. However, because the YSAQMD region does not attain the state ozone standard, the growth of the campus could potentially hinder the YSAQMD's attainment efforts, and it is possible that the YSAQMD will not attain the air quality standards with the inclusion of this project in the plan. The impact (on a campus-wide basis) is therefore considered to be significant and unavoidable.

* * *

LRDP Impact 4.3-2: Implementation of the 2003 LRDP would not contribute substantially to a violation of CO standards or expose receptors to substantial CO concentrations associated with vehicular traffic.

Significance: Less than significant

LRDP Mitigation: Mitigation is not required.

Localized CO impacts were analyzed for the cumulative case (see discussion under LRDP Impact 4.3-7, below) and found to be less than significant. Therefore, project impacts would be less than significant, as well.

* * *

LRDP Impact 4.3-3: Emissions from construction activities associated with the 2003 LRDP would exceed YSAQMD thresholds.

Significance: Significant

LRDP Mitigation 4.3-3(a): The campus shall include in all construction contracts the measures specified below to reduce fugitive dust impacts, including but not limited to the following:

- All disturbed areas, including storage piles, which are not being actively utilized for construction purpose, shall be effectively stabilized of dust emissions using water, chemical stabilizer/suppressant, or vegetative ground cover.
- All on-site unpaved roads and off-site unpaved access roads shall be effectively stabilized of dust emissions using water or chemical stabilizer/suppressant.
- All land clearing, grubbing, scraping, excavation, land leveling, grading, cut and fill, and demolition activities shall be effectively controlled of fugitive dust emissions utilizing application of water or by presoaking.
- When demolishing buildings up to six stories in height, all exterior surfaces of the building shall be wetted during demolition.
- When materials are transported off-site, all material shall be covered, effectively wetted to limit visible dust emissions, or at least two feet of freeboard space from the top of the container shall be maintained.

- All operations shall limit or expeditiously remove the accumulation of mud or dirt from adjacent public streets at least once every 24 hours when operations are occurring. The use of dry rotary brushes is expressly prohibited except where preceded or accompanied by sufficient wetting to limit the visible dust emissions. Use of blower devices also is expressly forbidden.
- Following the addition of materials to, or the removal of materials from, the surface of outdoor storage piles, said piles shall be effectively stabilized of fugitive dust emissions by utilizing sufficient water or chemical stabilizer/ suppressant.

LRDP Mitigation 4.3-3(b): The campus shall include in construction contracts for large construction projects near receptors, the following control measures:

- Limit traffic speeds on unpaved roads to 15 mph.
- Install sandbags or other erosion control measures to prevent silt runoff to public roadways from sites with a slope greater than one percent.
- To the extent feasible, limit area subject to excavation, grading, and other construction activity at any one time.
- Limit the area subject to excavation, grading, and other construction activity at any one time.

LRDP Mitigation 4.3.3(c): The campus shall implement the following control measures to reduce emissions of ozone precursors from construction equipment exhaust:

- To the extent that equipment is available and cost effective, the campus shall encourage contractors to use alternate fuels and retrofit existing engines in construction equipment.
- Minimize idling time to a maximum of 5 minutes when construction equipment is not in use.
- To the extent practicable, manage operation of heavy-duty equipment to reduce emissions.
- To the extent practicable, employ construction management techniques such as timing construction to occur outside the ozone season of May through October, or scheduling equipment use to limit unnecessary concurrent operation.

Residual Significance: Significant and unavoidable

Construction-related activities would generate fugitive dust, which is measured in terms of PM_{10}, from earthmoving, excavation, grading, and travel over unpaved haul roads. The term “fugitive dust" refers to particulate matter emitted from an open area (i.e., not through a stack or an exhaust vent) due to human activities or by the forces of wind acting on exposed material such as dirt roads or soil storage piles. Particulate emissions from fugitive dust would vary with the level and type of activity, silt content, and moisture of the soil and prevailing weather. If no control measures are implemented, housing or other sensitive receptors located adjacent to construction areas could be affected by high concentrations of PM_{10}. The state 24-hour PM_{10} standards could be violated at times in the vicinity of several projects being constructed simultaneously. This would especially be the case if several ongoing grading or excavation activities occurred in proximity to each other on the campus. In addition, exhaust pollutants would be emitted from construction equipment use. These pollutant levels would vary with the level and type of activity.

The 2003 LRDP represents the campus' development plan through 2015-16. Although information is available at this time on five projects that are proposed for implementation soon after the approval of this EIR, specific information on the remainder of campus development is not available. As a result, construction emissions cannot be accurately characterized for all future development under the 2003 LRDP. However, as stated earlier, a quantitative analysis of fugitive dust and exhaust emissions was performed for each of the five projects. Results of that analysis are presented below in Table 4.3-12 to show the likely range of fugitive dust and exhaust emissions that could result at any time from the implementation of the 2003 LRDP. Note that PM_{10} emissions include mitigated fugitive dust emissions and exhaust emissions. Table 4.3-12 also reports the total daily emissions from the simultaneous construction of all the five projects which could potentially result during the first two years of construction when construction on all five projects would be underway.

Table 4.3-12
Estimated Construction Emissions from LRDP Projects

Pollutant	Range of Emissions	Total Emissions from Proposed Projects	YSAQMD Thresholds
NO_x (lb/day)	106 – 510	1,110	82
ROG (lb/day)	38 – 148	520	82
PM_{10} (lb/day)	11 – 20	120	150
CO (lb/day)	0.2 – 3	5	550
SO_2 (lb/day)	9 – 40	90	82

Note: Rounded numbers are reported above. For exact emissions from each project, see Volume III.

As the table above shows, the combined daily emissions of all criteria pollutants except CO from the simultaneous construction of five major projects on the campus would exceed YSAQMD thresholds. The emissions reported above are controlled (mitigated emissions) estimated assuming that each project will implement PM_{10} emission controls identified in LRDP Mitigation 4.3-3(a-b). With respect to combustion emissions from construction equipment and vehicles, although LRDP Mitigation 4.3-3(c) would be implemented, there is uncertainty with respect to the effectiveness of these control measures and the extent to which emissions would be reduced if these were implemented. As significance thresholds would be exceeded, the impact with respect to construction emissions is considered significant and unavoidable.

* * *

LRDP Impact 4.3-4: Implementation of the 2003 LRDP would not create objectionable odors that could affect a substantial number of persons.

Significance: Less than significant

LRDP Mitigation: Mitigation is not required.

The 2003 LRDP would involve changes to two existing sources of odors on the campus – the campus research dairy and the campus wastewater treatment plant (WWTP). Currently the campus research dairy is located east of La Rue Road on the central campus, adjacent to the Central Heating and Cooling Plant and Tercero Student housing. Under the 2003 LRDP, land has been designated on Russell Ranch to allow for the relocation of this dairy. This relocation would not result in odor impacts at the new location because, on Russell Ranch, the dairy site would be surrounded by other campus and non-campus agricultural land and few receptors (except for persons associated with agricultural activities) would be nearby to be affected by this change.

To serve the growth under the 2003 LRDP, the capacity of the campus WWTP would be expanded by about 50 percent. The WWTP, located on the south campus, is also surrounded by agricultural uses and there are no receptors located near this plant. To date, the wastewater treatment plant has not received any complaints due to odors. Therefore, there would not be any significant impacts associated with odors from the implementation of the 2003 LRDP.

* * *

LRDP Impact 4.3-5: Implementation of the 2003 LRDP would not expose campus occupants and other populations in the vicinity of the campus to substantial air toxics concentrations.

Significance: Less than significant

LRDP Mitigation: Mitigation is not required.

UC Davis conducted a health risk assessment (HRA) to identify potential health risks associated with development anticipated to occur under the 2003 LRDP (URS 2003). An HRA characterizes human health risks as a result of exposure to toxic substances. In order to assess potential health risks associated with the full development under the 2003 LRDP, total health risks for the academic year 2015-16 were evaluated for existing campus operations and future development combined. The HRA included toxic air contaminant (TAC) emissions associated with laboratory operations, hazardous materials bulking operations in the Environmental Services Facility (ESF), natural gas and diesel fired stationary combustion sources (including routine firing of back-up emergency generators and the veterinary medicine incinerator), campus chloroform groundwater/soil remediation operations, campus landfill operations, the campus wastewater treatment plant, diesel-fueled mobile sources on campus roadways, and diesel-fueled campus agricultural operations.

<u>**Components of the Health Risk Assessment**</u>

An HRA consists of four basic steps to assess potential public health risk. First, the TACs to be evaluated are identified and emissions quantified. This was accomplished by a review of activities and materials that are part of the existing campus operations and proposed new developments.

Laboratory emissions were assessed from a review of data from comparable University of California campuses and the specific laboratory chemical inventory at UC Davis. Other emission sources were evaluated using accepted U.S. EPA and California Air Resources Board (CARB) emission factors or specific UC Davis emissions reports. Second, ground-level impacts resulting from the transport and dilution of these emissions through the atmosphere were assessed by air dispersion modeling. The U.S. EPA-approved Industrial Source Complex Short Term 3 (ISCST3) dispersion model was used for this assessment. Third, potential public exposure to these compounds resulting from atmospheric transport were calculated. For this step, methods from current California Office of Environmental Health Hazard Assessment (OEHHA) guidance (OEHHA 2000) for exposure assessments from inhalation and non-inhalation exposure pathways were employed. Exposure pathways evaluated included direct inhalation, soil ingestion, dermal absorption, mother's milk, and consumption of locally grown produce. Finally, potential cancer and non-cancer health risks resulting from the calculated exposures were estimated using dose-response relationships developed from toxicological data. Toxicological data published by OEHHA were used when available for any modeled TAC (OEHHA 1999, 2002a, 2002b); otherwise, other data published by the California Air Pollution Control Officers Association (CAPCOA) (CAPCOA 1993), the U.S. EPA (EPA 2002a) or occupational exposure standards adjusted for application to the general public were used. The details of the above summarized steps can be found the *Air Toxics Health Risk Assessment for the University of California Davis 2003 Long Range Development Plan* (URS 2003).

Results of the Health Risk Assessment

Table 4.3-13 summarizes the results of the HRA at off-campus and on-campus maximally exposed individual (MEI) locations. The maximum lifetime cancer risk from total combined academic year 2015-16 operations (current operations plus LDRP projects) was calculated at the campus boundary near Russell Boulevard and College Parkway to be 7.78 in one million, which was taken to represent the maximum potential off-site residential exposure. As shown in Table 4.3-14, diesel-fueled mobile sources travelling along Howard Way coming to and from Russell Boulevard and College Parkway comprised about 37.0 percent of the total risk at this off-campus MEI location. Operation of the Central Plant comprised about 26.7 percent of the total risk at this location, and routine firing of existing and planned emergency generators comprised 22.2 percent of the total risk. Campus laboratory emissions were 8.0 percent of the risk, diesel-fired agricultural equipment comprised about 4.9 percent, and all other campus sources combined contributed the remaining 1.2 percent. These risks were calculated assuming that the MEI would remain at this location continuously for a 70-year period.

Table 4.3-13 shows that the highest cancer risk for the on-campus MEI was calculated to be 5.02 in one million in the proposed Neighborhood, with routine diesel generator operations contributing 56.0 percent, diesel-fired agricultural equipment contributing 25.5 percent, the Central Plant contributing 9.4 percent, campus laboratories contributing 4.2 percent, the ESF contributing 2.4 percent, and all other emissions combined contributing 2.5 percent, as shown in Table 4.3-14. As with the off-site residential MEI location, the on-site MEI in the proposed Neighborhood was assumed to be continuously exposed over a 70-year period, a highly unlikely exposure scenario but extremely conservative in accordance with approved protocols for assessing potential health risks.

Table 4.3-13
Results of UC Davis LRDP Academic Year 2015-16 Health Risk Assessment

Health Risk	Off-Campus MEI[1]	On-Campus MEI[2]	Significance Level
Cancer Risk	7.78 in one million	5.02 in one million	10 in one million
Chronic Hazard Index	0.05	0.07	1.0
Acute Hazard Index	0.14	0.16	1.0

[1] The maximum off-campus cancer risk and chronic hazard index were calculated at Russell Boulevard and College Parkway, where a 70-year exposure period was assumed. The maximum off-site acute hazard index was calculated near Russell Boulevard and Eisenhower Street.
[2] The maximum on-campus cancer risk was calculated in the proposed Master Plan Neighborhood assuming a 70-year exposure period. The maximum on-campus chronic hazard index was calculated near Hoagland Hall and the maximum on-campus acute hazard index was calculated in the proposed Master Plan Neighborhood..

Table 4.3-14
Source Breakdown of UC Davis LRDP Academic Year 2015-16 Cancer Risks
(Lifetime Cancer Risk; Chances in One Million)

Sources	Off-Campus MEI[1]		On-Campus MEI[2]	
	Risk	Percent	Risk	Percent
Diesel Mobile Sources	2.88	37.00%	0.07	1.39%
Emergency Generators	1.73	22.22%	2.81	55.97%
Agricultural Equipment	0.38	4.88%	1.28	25.49%
Campus Laboratories	0.62	7.96%	0.21	4.18%
ESF (Hazardous Materials)	0.03	0.39%	0.12	2.39%
Central Plant	2.08	26.72%	0.47	9.36%
All Other Combustion	0.05	0.64%	0.03	0.60%
Wastewater Treatment	0.01	0.13%	0.01	0.20%
Landfill Operations	0.004	0.05%	0.02	0.40%
Chloroform Remediation	0.001	0.01%	0.001	0.02%
Total Health Risk	7.78	100%	5.02	100%

[1] The maximum off-campus cancer risk and chronic hazard index were calculated at Russell Boulevard and College Parkway, where a 70-year exposure period was assumed. The maximum off-site acute hazard index was calculated near Russell Boulevard and Eisenhower Street.
[2] The maximum on-campus cancer risk was calculated in the proposed Master Plan Neighborhood assuming a 70-year exposure period. The maximum on-campus chronic hazard index was calculated near Hoagland Hall and the maximum on-campus acute hazard index was calculated in the proposed Master Plan Neighborhood.

The HRA modeling also included other specific on-campus locations with reduced exposure scenarios to assess potential health risks to University employees, students, and children at non-residential on-campus locations. For these locations, exposure durations included:

- University Staff: 8 hours/day, 245 days/year for 40 years
- Student: 24 hours/day, 365 days/year for 4 years
- Daycare/school child: 10 hours/day, 245 days/year for 12 years

Table 4.3-15 shows cancer risk results at representative locations employing the above exposure assumptions. With respect to potential daycare/school child exposures, cancer risk predictions were adjusted from the assumed adult parameters of 70 kilogram (kg) body weight and 20 cubic meters per day (m^3/day) breathing rate to assumed child parameters of 15 kg body weight and 10 m^3/day breathing rate. The 2003 HRA that supports this EIR discusses this in more detail (URS 2003). The estimated cancer risk for off-campus schools and daycare centers in the surrounding area were all lower than the on-campus daycare and school locations shown in Table 4.3-15.

Non-cancer health risk is assessed by the "hazard index," which is the sum of the ratios of each chemical's actual exposures to acceptable exposures. Hazard indices are calculated for both long-term (chronic) and short-term (acute) health effects. Hazard indices less than 1.0 indicate an acceptable non-cancer health risk. The highest calculated hazard indices for the offsite MEI was calculated to be 0.05 for chronic exposures (near Russell Boulevard and College parkway) and 0.14 for acute exposures (near Russell Boulevard and Eisenhower Street). The highest on-campus MEI locations were 0.07 for chronic exposures (at Hoagland Hall) and 0.16 for acute exposures (in the proposed Neighborhood). With respect to potential non-residential child exposures, the estimated non-cancer risk for all schools and daycare centers on campus and in the surrounding area had hazard index values lower than at the on-campus MEI locations summarized above.

Table 4.3-15
UC Davis LRDP Academic Year 2015-16 Cancer Risks at Representative On-Campus Locations

Location	Description	Exposure Assumption	Cancer Risk[1]
Storer Hall	Academic	University Staff	1.79 in one million
Schalm Hall	Academic	University Staff	1.16 in one million
Maddy Hall	Academic	University Staff	0.59 in one million
Memorial Union	Gathering Area	University Staff[2]	0.58 in one million
Tercero Housing	Student Housing	Student	0.40 in one million
Primero Grove	Student Housing	Student	0.32 in one million
La Rue Housing	Student Housing	Student	0.29 in one million
New Neighborhood School	Elementary School	Child	0.54 in one million
Russell Park Daycare Center	Child Daycare	Child	0.53 in one million
Proposed Childcare Center[3]	Child Daycare	Child	0.43 in one million
Child Care and Family Services	Child Daycare	Child	0.28 in one million

[1] Significance threshold is equal to or greater than 10 in one million.
[2] This is an area where students, faculty, and staff gather. University staff exposure assumptions yield the highest potential exposure for the HRA.
[3] Proposed campus childcare center at Orchard Park Housing Complex.

In summary, the total estimated cancer risk from UC Davis campus operations for academic year 2015-16 is predicted to be below 10 in one million for both the off-campus and on-campus MEI assuming a 70-year exposure period. This includes all current campus operations and future projects under the 2003 LRDP. Similarly, the total estimated non-cancer hazard indices for academic year 2015-16 are predicted to be below 1.0 at the MEI locations. The proposed and future LRDP projects, a subset of these total health risk estimates, would contribute a portion of these totals. Therefore, TAC emissions from the LRDP projects would not cause a significant impact since the estimated health risks for total campus emissions for academic year 2015-16 are less than significant.

* * *

4.3.2.4 Cumulative Impacts

LRDP Impact 4.3-6:	Implementation of the 2003 LRDP, in conjunction with other regional development, would result in a cumulatively considerable increase of non-attainment pollutants.
Significance:	Significant
LRDP Mitigation:	Implement LRDP Mitigation 4.3-1(a-c).
Residual Significance:	Significant and unavoidable

Development of the campus, together with regional growth throughout the air basin, would contribute to emissions of criteria pollutants for which the region is in non-attainment status and could hinder attainment efforts. The YSAQMD has accounted for a certain amount of growth in the existing Sacramento Regional Clean Air Plan. This plan is currently being updated to extend beyond the year 2005, and additional campus growth that is part of the LRDP will need to be incorporated in the plan update. Nevertheless, the YSAQMD remains a nonattainment area for ozone. This cumulative impact is considered significant and unavoidable.

* * *

LRDP Impact 4.3-7:	Implementation of the 2003 LRDP, in conjunction with cumulative development in the region, would not contribute to a cumulatively considerable increase in or expose receptors to substantial CO concentrations.
Significance:	Less than significant
LRDP Mitigation:	Mitigation is not required.

Development of the campus under the 2003 LRDP would result in increases in traffic that would produce additional CO emissions, compared to existing conditions. Because CO is heavier than air, CO emissions can raise ambient ground-level concentrations of CO if a large number of sources of CO are present in a given area, such as motor vehicles at congested intersections. Impacts from CO emissions from vehicles associated with the 2003 LRDP were evaluated at intersections in the project vicinity that would be most affected by the campus at full development under the 2003 LRDP where the change in traffic volumes between the "2015 With 2003 LRDP" and "2015 No Project" scenarios is greater than five percent. The method of evaluation followed that described in the UC Davis CO Protocol, as discussed under Analytical Method.

Vehicle volumes at the intersections most affected by the full development under the 2003 LRDP were compared to those at the intersection of Howe Avenue and University Avenue in Sacramento (the "worst case" intersection in the air basin based on traffic volume and congestion). The intersection found to exhibit the highest volumes due to LRDP development is the Anderson Road and La Rue Road intersection. Volumes at this intersection from the implementation of the 2003 LRDP plus the background traffic growth were compared to volumes at the "worst case" intersection of Howe Avenue and University Avenue. These comparisons are summarized in Table 4.3-16 below:

Table 4.3-16
Comparison of Project with Worse-Case Intersection

	Anderson Road and La Rue Road (Project condition)	Howe Avenue and University Avenue in Sacramento
Peak-Hour Traffic Volume	4,300	5,306

The volumes at Howe and University Avenues are higher than those at Anderson and La Rue Roads. In addition, the Howe and University intersection is located in the urbanized area of Sacramento with receptors (homes and businesses) nearby. The results of this analysis show that traffic under LRDP conditions at Anderson and La Rue Roads would not cause a violation of the CO standards because the emissions at the "worst case" intersection of Howe and University Avenues, with higher traffic volumes, do not cause a violation of the CO standard.

* * *

LRDP Impact 4.3-8: Regional growth could result in an increase in toxic air contaminants if compensating technological improvements are not implemented.

Significance: Potentially significant

LRDP Mitigation 4.3-8: EPA and CARB are expected to continue the development and implementation of programs to reduce air toxics, and UC Davis will continue its efforts in this area.

Residual Significance: Less than significant

As discussed under LRDP Impact 4.3-5, the total estimated cancer risk from UC Davis campus operations for academic year 2015-16 is predicted to be below 10 in one million for both the off-campus and on-campus MEI assuming a 70-year exposure period. This includes all current campus operations and future 2003 LRDP projects. Similarly, the total estimated non-cancer hazard indices for academic year 2015-16 are predicted to be below 1.0 at the MEI locations. The proposed and future 2003 LRDP projects, a subset of these total health risk estimates, would contribute a portion of these totals. But cumulatively with all other campus operations, the estimated health risks are still below levels that would require public notification and emissions reduction actions by the YSAQMD under the AB 2588 Air Toxics "Hot Spots" Law. For cancer risk, the YSAQMD's AB 2588 public notification level of 10 in one million matches the "no significant risk level" established under California's Proposition 65, a level below which public notification of potential health risks is not required.

As discussed in Section 4.3.1.5, there are no ambient TAC monitors operated in Yolo County. As an approximation of current TAC levels in the area, an average lifetime cancer risk from TACs for the year 2000 in the Sacramento Valley Air Basin of 520 in one million can be used, with 360 in one million of this background risk coming from diesel particulate matter (CARB 2002). Thus, diesel particulate matter emissions represent about 69 percent of the current background TAC cancer risk in the Sacramento Valley Air Basin. Since 1990, air toxics control programs have reduced the overall level of TACs in the Sacramento Valley Air Basin. In 1990, the TAC cancer risk was estimated at 1,135 in one million, with 750 in one million coming from diesel particulate matter. In 1995, the TAC cancer risk was 705 in one million, with 480 in one million coming from diesel particulate matter (CARB 2002). Diesel particulate matter emissions from mobile sources, emergency generator operation, and agricultural equipment estimated in the 2003 LRDP HRA from cumulative UC Davis operations for the academic year 2015-16 (current operations plus future LRDP projects) represent about 64 percent of the estimated off-campus MEI cancer risk, similar to the percentage of background ambient cancer risk attributable to background diesel particulate matter emissions.

Current UC Davis operations were assessed assuming no retrofit controls, and emissions from future equipment were based on current new equipment performance standards. Through CARB's implementation of its adopted *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles* ("Risk Reduction Plan") (CARB 2000), as well as future potential U.S. EPA emission standards, diesel emission sources at UC Davis will likely undergo further emission reductions not accounted for in the HRA. The CARB Risk Reduction Plan has retrofit standards for existing engines and more stringent emission standards for new engines. New emergency generators must already be CARB-certified cleaner burning engines. CARB estimates that full implementation of the Risk Reduction Plan for all covered emissions units will reduce diesel emissions in the year 2010 by 75 percent over year 2000 levels. In addition, the U.S. EPA has recently issued final rulemaking notices establishing more stringent federal emission standards for light-duty vehicles (EPA 2000a), heavy-duty vehicles (EPA 2000b), nonroad engines (EPA 2002b), and agricultural equipment (EPA 2003). These rulemakings will phase in requirements to use cleaner burning EPA-certified diesel engines between 2004 and 2008.

As described above, despite the growth of UC Davis operations between 1990 and 2000, the average TAC background cancer risk has declined due to control measures that have included UC Davis operations. In addition, UC Davis has reduced diesel emissions where feasible in switching to cleaner fuels in Unitrans buses and converting approximately 75 percent of the agricultural tractor fleet to "green tractors" with lower emissions than current emission standards. UC Davis will continue to implement diesel emission reduction efforts and will also be subject to required control measures in the future. UC Davis emission reductions in future years should continue to reflect the anticipated overall regional reductions in TAC levels.

In conclusion, TAC emissions from the 2003 LRDP in combination with existing campus operations are anticipated to decline due to implementation of new technologies to reduce air toxics, particularly from diesel engines. Furthermore, future operation of current campus activities, new campus projects and other air toxics sources in the region will be subject to future TAC emission control programs, and as such, regional TAC levels including future UC Davis operations are expected to continue to decline. Additionally, air toxics impacts generally are localized around emission sources, so impacts do not generally cumulate at a substantial distance. There are no reasonably foreseeable developments in the vicinity of the campus that would be significant sources of air toxics.

In light of the priority being given to air toxics regulation by CARB and EPA, the significant programs presently under development, and the availability of technologies to achieve substantial additional TAC reductions, CARB's projections of continuing regional TAC reductions are well supported, resulting in a less-than-significant cumulative impact.

* * *

4.3.3 References

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