Air Quality Assessment

University of California Irvine
2007 Long Range Development Plan

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1.0 INTRODUCTION

An air quality impact analysis has been prepared to estimate and evaluate potential air quality impacts associated with the proposed University of California, Irvine (UCI) 2007 Long Range Development Plan (2007 LRDP). The UCI campus is located in the southern portion of the City of Irvine, Orange County, California. UCI is adjacent to the City of Newport Beach, and the City of Costa Mesa is located approximately 0.5 mile to the west of the campus. The Cities of Santa Ana and Lake Forest are situated approximately 2.5 miles to the north and 5 miles to the east, respectively. The UCI campus is bounded generally by Campus Drive and Jamboree Road on the north, Culver Drive on the east, Bonita Canyon Drive on the south, and State Route 73 (SR-73) and MacArthur Boulevard on the west. Regional access is provided to UCI via Interstate 405 (I-405), State Route 55 (SR-55), and SR-73. Newport Coast Drive provides access to and from the beach communities to the south. The toll road extension of SR-73 provides access from areas in southern Orange County.

A Long Range Development Plan (LRDP) is defined by statute as "a physical development and land use plan to meet the academic and institutional objectives for a particular campus or medical center of public higher education" (Public Resources Code Section 21080.09). UCI prepared an LRDP and a related program-level Environmental Impact Report (EIR) that were adopted by The Regents of the University of California in September 1989. The 1989 LRDP identifies the physical development and land use plan for UCI through the horizon year 2005-06. Since its adoption, the 1989 LRDP has been amended eight times, most notably the LRDP Circulation and Open Space Amendment in 1995. The proposed project involves updating the UCI LRDP to reflect student enrollment projections through the horizon year 2025-26.

The UCI campus is currently comprised of approximately 1,475 acres. Approximately 770 acres (52 percent) of the campus is currently developed, with most development focused in the central academic core. The primary areas of undeveloped property remain in the outer campus areas. The LRDP land use plan includes ten land use categories:

academic and support, campus support services, student housing, faculty/staff housing, housing reserve, mixed use, income-producing Inclusion Area, parking and roadways, open space – athletics and recreation, and open space - general.

This air quality analysis was prepared as part of the UCI 2007 LRDP EIR, pursuant to the California Environmental Quality Act (CEQA). The federal and state ambient air quality standards were used to evaluate impact levels associated with the 2007 LRDP. The analysis addresses criteria air pollutant impacts. Toxic air pollutant emissions and health risk impacts are evaluated in the *Air Toxics Health Risk Assessment - University of California Irvine 2007 Long Range Development Plan* (SRA 2006).

The principal elements of this air quality impact analysis, which are discussed in separate sections of this report, are as follows:

- Description of the environmental setting and regulatory framework (Section 2)
- Description of applicable significance criteria (Section 3)
- Evaluation of construction impacts (Section 4)
- Evaluation of operational impacts (Section 5)
- Evaluation of “hot spots” (Section 6)
- Analysis of odor impacts (Section 7)
- Estimation of cumulative impacts (Section 8)
- Mitigation measures (Section 9)
- References (Section 10)

Supporting information and data on emission calculations and modeling analyses are provided in Appendix A.

2.0 ENVIRONMENTAL SETTING

2.1 Climate and Meteorology

UCI is located in the South Coast Air Basin (SCAB). The SCAB includes Los Angeles and Orange Counties, as well as the western portions of San Bernardino and Riverside Counties. The climate of Orange County is dominated by a semi-permanent high pressure cell located over the Pacific Ocean. This cell influences the direction of prevailing winds (westerly to southwesterly) and maintains clear skies for much of the year. The high pressure cell also creates two types of temperature inversions that may act to degrade local air quality.

Subsidence inversions occur during the warmer months as descending air associated with the Pacific high pressure cell comes into contact with cool marine air. The boundary between the two layers of air creates a temperature inversion that traps pollutants. The other type of inversion, a radiation inversion, develops on winter nights when air near the ground cools by heat radiation and air aloft remains warm. The shallow inversion layer formed between these two air masses also can trap pollutants. As the pollutants become more concentrated in the atmosphere, photochemical reactions occur that produce ozone, commonly known as smog.

According to climatic data for the Irvine area (Western Regional Climatic Center 2006), the average annual temperature in the region is 62.7 ºF, with an average maximum temperature of 75.6 ºF and an average minimum temperature of 49.6 ºF. The mean annual precipitation is 12.82 inches per year, with 56 percent of precipitation occurring in the winter season and 27 percent occurring in the spring season. Figure 2-1 provides a graphic representation of the prevailing winds in the project vicinity, as measured at the Anaheim meteorological monitoring station (the closest meteorological monitoring station to the site).

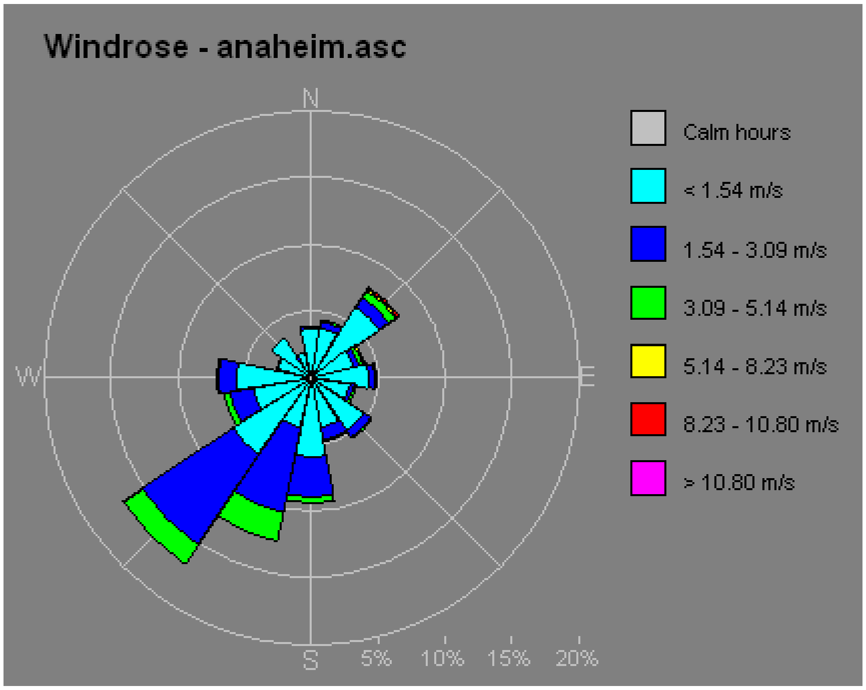

Figure 2-1. Wind Rose – Anaheim Monitoring Station

2.2 Regulatory Requirements

Air quality is defined by ambient air concentrations of specific pollutants identified by the United States Environmental Protection Agency (USEPA) to be of concern with respect to health and welfare of the general public. The USEPA is responsible for enforcing the Federal Clean Air Act (CAA) of 1970 and its 1977 and 1990 Amendments. The CAA required the USEPA to establish National Ambient Air Quality Standards (NAAQS), which identify concentrations of pollutants in the ambient air below which no adverse effects on the public health and welfare are anticipated. In response, the USEPA established both primary and secondary standards for several pollutants (called "criteria" pollutants). Primary standards are designed to protect human health with an adequate margin of safety. Secondary standards are designed to protect property and the public welfare from air pollutants in the atmosphere.

In September 1997, the EPA promulgated 8-hour O_3 and 24-hour and annual $PM_{2.5}$ national standards (particulate matter less than 2.5 microns in diameter). The EPA has issued attainment designations for these pollutants and, as of July 15, 2005, rescinded the 1-hour O_3 NAAQS.

States that are designated nonattainment for the NAAQS are required to develop a State Implementation Plan (SIP), which outlines federally-enforceable rules, regulations, and programs designed to reduce emissions and bring the area into attainment of the NAAQS. In California, the California Air Resources Board (ARB) is the agency responsible for developing the SIP. The responsibility for developing plans and programs for each air basin has been delegated to the local agency responsible for attaining and maintaining air quality standards in that air basin.

The CAA allows states to adopt ambient air quality standards and other regulations provided they are at least as stringent as federal standards. The ARB has established the more stringent California Ambient Air Quality Standards (CAAQS) for the six criteria pollutants through the California Clean Air Act of 1988, and also has established CAAQS for additional pollutants, including sulfates, hydrogen sulfide, vinyl chloride and visibility-reducing particles. Areas that do not meet the NAAQS or the CAAQS for a particular pollutant are considered to be "nonattainment areas" for that pollutant.

The ARB is the state regulatory agency with authority to enforce regulations to both achieve and maintain the NAAQS and CAAQS. The ARB is responsible for the development, adoption, and enforcement of the state's motor vehicle emissions program, as well as the adoption of the CAAQS. The ARB also reviews operations and programs of the local air districts, and requires each air district with jurisdiction over a nonattainment area to develop its own strategy for achieving the NAAQS and CAAQS. The local air district has the primary responsibility for the development and implementation of rules and regulations designed to attain the NAAQS and CAAQS, as well as the permitting of new or modified sources, development of air quality management plans, and adoption and enforcement of air pollution regulations.

It is the responsibility of the SCAQMD to ensure that state and federal ambient air quality standards are achieved and maintained in the SCAB. Health-based air quality standards have been established by California and the federal government for the following criteria air pollutants: ozone (O_3), CO, NO_2, particulate matter with a diameter of 10 microns or less (PM_{10}), particulate matter with a diameter of 2.5 microns or less ($PM_{2.5}$), sulfur dioxide (SO_2), and lead (Pb). These standards were established to protect sensitive receptors from adverse health impacts due to exposure to air pollution. The CAAQS are more stringent than the federal standards. California has also established standards for sulfates, visibility, hydrogen sulfide, and vinyl chloride. Hydrogen sulfide and vinyl chloride are currently not monitored in the Basin because these contaminants are not seen as a significant air quality problem. CAAQS and NAAQS for each of these pollutants are shown in Table 2-1. The SCAB is currently considered a nonattainment area for the CAAQS and NAAQS for O_3, PM_{10}, $PM_{2.5}$, and CO. A brief description of the criteria pollutants follows.

<u>Ozone.</u> Ozone is considered a photochemical oxidant, which is a chemical that is formed when reactive organic compounds (ROC) and nitrogen oxides, both byproducts of combustion, react in the presence of ultraviolet light. Ozone is present in relatively high concentrations in the Basin. Ozone is considered a respiratory irritant and prolonged exposure can reduce lung function, aggravate asthma, and increase susceptibility to respiratory infections. Children and those with existing respiratory diseases are at greatest risk from exposure to ozone.

<u>Carbon monoxide.</u> Carbon monoxide is a product of combustion, and the main source of carbon monoxide in the Basin is from motor vehicle exhaust. CO is an odorless, colorless gas. CO affects red blood cells in the body by binding to hemoglobin and reducing the amount of oxygen that can be carried to the body's organs and tissues. CO can cause health effects to those with cardiovascular disease, and can also affect mental alertness and vision.

Nitrogen dioxide. NO_2 is also a by-product of fuel combustion, and is formed both directly as a product of combustion and in the atmosphere through the reaction of NO with oxygen. NO_2 is a respiratory irritant and may affect those with existing respiratory illness, including asthma. NO_2 can also increase the risk of respiratory illness.

Fine particulate matter. Fine particulate matter, or PM_{10}, refers to particulate matter with an aerodynamic diameter of 10 microns or less. Particulate matter in this size range has been determined to have the potential to lodge in the lungs and contribute to respiratory problems. PM_{10} arises from a variety of sources, including road dust, diesel exhaust, combustion, tire and break wear, construction operations, and windblown dust. PM_{10} can increase susceptibility to respiratory infections and can aggravate existing respiratory diseases such as asthma and chronic bronchitis. In 1997, the U.S. EPA proposed a new standard for $PM_{2.5}$, which is particulate matter with an aerodynamic diameter of 2.5 microns or less. These finer particulates are considered to have the potential to lodge deeper in the lungs.

Sulfur dioxide. SO_2 is a colorless, reactive gas that is produced from the burning of sulfur-containing fuels such as coal and oil, and by other industrial processes. Generally, the highest concentrations of SO_2 are found near large industrial sources. SO_2 is a respiratory irritant that can cause narrowing of the airways leading to wheezing and shortness of breath. Long-term exposure to SO_2 can cause respiratory illness and aggravate existing cardiovascular disease.

Lead. Lead in the atmosphere occurs as particulate matter. Lead has historically been emitted from vehicles combusting leaded gasoline, as well as from industrial sources. With the phase-out of leaded gasoline, large manufacturing facilities are the sources of the largest amounts of lead emissions. Lead has the potential to cause gastrointestinal, central nervous system, kidney, and blood diseases upon prolonged exposure. Lead is also classified as a probable human carcinogen.

The attainment status of the SCAB is presented below in Table 2-2.

Table 2-1 AMBIENT AIR QUALITY STANDARDS						
POLLUTANT	AVERAGE TIME	CALIFORNIA STANDARDS		NATIONAL STANDARDS		
		Concentration	Measurement Method	Primary	Secondary	Measurement Method
Ozone (O_3)	1 hour	0.09 ppm (180 $\mu g/m^3$)	Ultraviolet Photometry	--	--	Ethylene Chemiluminescence
	8 hour	0.070 ppm (137 $\mu g/m^3$)		0.08 ppm (157 $\mu g/m^3$)	0.08 ppm (157 $\mu g/m^3$)	
Carbon Monoxide (CO)	8 hours	9.0 ppm (10 mg/m^3)	Non-Dispersive Infrared Spectroscopy (NDIR)	9 ppm (10 mg/m^3)	None	Non-Dispersive Infrared Spectroscopy (NDIR)
	1 hour	20 ppm (23 mg/m^3)		35 ppm (40 mg/m^3)		
Nitrogen Dioxide (NO_2)[1]	Annual Average	--	Gas Phase Chemiluminescence	0.053 ppm (100 $\mu g/m^3$)	0.053 ppm (100 $\mu g/m^3$)	Gas Phase Chemiluminescence
	1 hour	0.25 ppm (470 $\mu g/m^3$)		--	--	
Sulfur Dioxide (SO_2)	Annual Average	--	Ultraviolet Fluorescence	0.03 ppm (80 $\mu g/m^3$)	--	Pararosaniline
	24 hours	0.04 ppm (105 $\mu g/m^3$)		0.14 ppm (365 $\mu g/m^3$)	--	
	3 hours	--		--	0.5 ppm (1300 $\mu g/m^3$)	
	1 hour	0.25 ppm (655 $\mu g/m^3$)		--	--	
Respirable Particulate Matter (PM_{10})	24 hours	50 $\mu g/m^3$	Gravimetric or Beta Attenuation	--	--	Inertial Separation and Gravimetric Analysis
	Annual Arithmetic Mean	20 $\mu g/m^3$		50 $\mu g/m^3$	50 $\mu g/m^3$	
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 $\mu g/m^3$	Gravimetric or Beta Attenuation	15 $\mu g/m^3$	--	Inertial Separation and Gravimetric Analysis
	24 hours	--		35 $\mu g/m^3$	--	
Sulfates	24 hours	25 $\mu g/m^3$	Ion Chromatography	--	--	--
Lead (Pb)	30-day Average	1.5 $\mu g/m^3$	Atomic Absorption	--	--	Atomic Absorption
	Calendar Quarter	--		1.5 $\mu g/m^3$	1.5 $\mu g/m^3$	
Hydrogen Sulfide (H_2S)	1 hour	0.03 ppm (42 $\mu g/m^3$)	Ultraviolet Fluorescence	--	--	--
Vinyl Chloride	24 hours	0.010 ppm (26 $\mu g/m^3$)	Gas Chromatography	--	--	--

ppm= parts per million
$\mu g/m^3$ = micrograms per cubic meter
mg/m^3= milligrams per cubic meter
[1]On February 22, 2007, the ARB approved lower NO_2 standards. The 1-hour CAAQS for NO_2 will be 0.18 ppm and the annual CAAQS for NO_2 will be 0.030 ppm. The standards are in the process of implementation.
Source: California Air Resources Board, www.arb.ca.gov.

Table 2-2
South Coast Air Basin
Attainment Classification for Criteria Pollutants

Pollutant	CAAQS Attainment Classification	NAAQS Attainment Classification
1-hr Ozone	Nonattainment	Rescinded
8-hr Ozone	Nonattainment	Severe-17 Nonattainment
CO	Attainment	Serious Nonattainment
NO_2	Attainment	Attainment
SO_2	Attainment	Attainment
PM_{10}	Nonattainment	Serious Nonattainment
$PM_{2.5}$	Nonattainment	Nonattainment
Lead	Attainment	Attainment
Sulfates	Attainment	N/A
Hydrogen Sulfide	Unclassified	N/A
Vinyl Chloride	Unclassified	N/A

2.3 Existing Air Quality

The closest ambient air quality monitoring station to the project is the Pampas Lane monitoring station in Costa Mesa, which measures O_3, CO, NO_2, and SO_2. The nearest monitoring station to the project site that measures PM_{10} and $PM_{2.5}$ is the site at the Costa Mesa – Mesa Verde Drive station. Ambient concentrations of criteria pollutants measured at these monitoring stations during the period 2004-2006 are presented in Table 2-3. Ambient air concentrations were compared with the CAAQS and NAAQS. The data indicate that the area is in compliance with both CAAQS and NAAQS for CO, NO_2, and SO_2. The state 8-hour CO standard was not exceeded during this three-year period. The maximum measured concentrations of NO_2 each year were less than the 0.25-ppm one-hour state standard and the national annual standard. The SO_2 concentrations were below state and national standards during this period.

Exceedances of the ozone standards and PM_{10} and $PM_{2.5}$ standards have been recorded at the Costa Mesa and Mission Viejo monitoring stations. Data for 2004 through 2006 indicate that exceedances of the particulate standards were observed in Mission Viejo.

Table 2-3
Background Air Quality Data
(2004 – 2006)
ppm (unless otherwise indicated)

Pollutant	Averaging Time	2004	2005	2006	NAAQS	CAAQS	Monitoring Station
Ozone	8 hour	0.087	0.072	0.062	0.09	0.070	Costa Mesa
	1 hour	0.104	0.085	0.074	-	0.08	Costa Mesa
PM_{10}[2]	Annual Arithmetic Mean	23.7 $\mu g/m^3$	17.6 $\mu g/m^3$	21.1 $\mu g/m^3$	50 $\mu g/m^3$	20 $\mu g/m^3$	Mission Viejo
	24 hour	47 $\mu g/m^3$	41 $\mu g/m^3$	57 $\mu g/m^3$	150 $\mu g/m^3$	50 $\mu g/m^3$	Mission Viejo
$PM_{2.5}$	Annual Arithmetic Mean	12.0 $\mu g/m^3$	10.6 $\mu g/m^3$	11.0 $\mu g/m^3$	15 $\mu g/m^3$	12 $\mu g/m^3$	Mission Viejo
	24 hour	49.4 $\mu g/m^3$	35.3 $\mu g/m^3$	46.9 $\mu g/m^3$	35 $\mu g/m^3$	-	Mission Viejo
NO_2	Annual	0.016	0.014	0.015	0.053	-	Costa Mesa
	1 hour	0.097	0.085	0.101	-	0.25	Costa Mesa
CO	8 hour	4.07	3.16	3.01	9	9.0	Costa Mesa
	1 hour	4.9	4.7	3.5	35	20	Costa Mesa
SO_2	Annual	0.002	0.002	0.001	0.03	-	Costa Mesa
	24 hour	0.008	0.008	0.005	0.14	0.04	Costa Mesa
	3 hour	0.020	0.010	0.009	0.05[1]	-	Costa Mesa
	1 hour	0.031	0.012	0.012	-	0.25	Costa Mesa

[1]Secondary NAAQS
[2]California averages reported for PM_{10}
N/A = not available from current website data
Source: www.arb.ca.gov (all pollutants except 1-hour CO and 1-hour and 3-hour SO_2 and annual data for 2004)
www.epa.gov/air/data/monvals.html (1-hour CO and 1-hour and 3-hour SO_2 and annual data for 2004)

2.4 Toxic Air Contaminants

Cancer Risk. One of the primary health risks of concern due to exposure to toxic air contaminants (TACs) is the risk of contracting cancer. The carcinogenic potential of TACs is a particular public health concern because it is currently believed by many scientists that there is no "safe" level of exposure to carcinogens, that is, any exposure to a carcinogen poses some risk of causing cancer. Health statistics show that one in four people will contract cancer over their lifetime, or 250,000 in a million, from all causes, including diet, genetic factors, and lifestyle choices. Approximately two percent of cancer deaths in the United States may be attributable to environmental pollution (Doll and Peto 1981).

Noncancer Health Risks. Unlike carcinogens, for most noncarcinogens it is believed that there is a threshold level of exposure to the compound below which it will not pose a health risk. The California Environmental Protection Agency (CalEPA) and California Office of Environmental Health Hazard Assessment (OEHHA) have developed reference exposure levels (RELs) for noncarcinogenic TACs that are health-conservative estimates of the levels of exposure at or below which health effects are not expected. The noncancer health risk due to exposure to a TAC is assessed by comparing the estimated level of exposure to the REL. The comparison is expressed as the ratio of the estimated exposure level to the REL, called the hazard index (HI).

2.5 Existing Campus Air Quality Control Programs

This section presents an evaluation of existing campus air quality programs designed to reduce emissions from stationary and mobile sources.

Stationary Source Controls. All stationary sources of emissions recently constructed and operated within the UCI campus have incorporated Best Available Control Technology in accordance with the requirements of the SCAQMD for permitting new sources. Under SCAQMD Rules, BACT is defined as the most stringent emissions control which, for a given class of air pollutant source, has been achieved in practice, is identified in a State Implementation Plan, or has been found by the SCAQMD to be technologically achievable and cost-effective. The primary stationary source of emissions at the UCI campus is the combustion of fuel in the Central Plant boilers. The Central Plant will be upgraded to include a state-of-the-art natural gas turbine equipped with BACT to control emissions of criteria pollutant emissions.

Energy Conservation. UCI has implemented an energy saving program that is designed to exceed Title 24 standards. Campus Facilities' Management has exceeded Title 24 energy conservation standards by 20 percent. UCI has participated in Southern California Edison's Standard Performance Contract Program to conserve energy, which in turn reduces emissions. UCI energy conservation projects included replacing outmoded lighting with T5, T8, and compact fluorescent lighting, upgrading traffic signals with energy-efficient LED lamps, stalling occupancy sensors to turn off lights when classrooms are not in use, installing window film to reduce radiant heat gain in buildings, and optimizing air conditions and heating systems by installing variable speed drives on pump motors. UCI is also planning to procure 20 percent of its electricity needs from renewable sources by 2017 and to use energy efficiency retrofit programs to reduce system-wide growth by 10 percent by 2014.

Alternative Transportation. The UCI campus is served by several modes of alternative transportation, including public bus services, campus bus services, vanpool services, carpool priority parking, and bicycle facilities. The following is a summary of the specific transportation options at UCI.

1. UCI operates twenty-one comfortable, air conditioned vanpools that transport employees, graduate students and undergraduate students to the UC Irvine campus each day. UC Irvine vanpools provide transportation to the campus Monday through Friday.

2. UCI maintains an employee and graduate student carpool program that provides for preferential parking for carpool participants. The student carpool program was suspended for lack of funding. UCI also maintains a Carpool Matching website that connects potential carpoolers.

3. UCI operates a shuttle service that includes five main shuttle services. These shuttles serve the Main Campus, the East Campus, Vista del Campo Housing, Vista del Campo Norte, and the Parkwest area.

4. UCI offers incentives to both employees and students who use the train to commute. Employees and students who commute by train (to the campus) and do not purchase long term parking permits (one month or longer) may register to receive a monthly subsidy of 20% off of their monthly pass or their 10-trip ticket. The OCTA operates a bus service from the Tustin train station to the UCI campus.

5. UCI offers a free University Pass that provides unlimited free access to the Orange County Transportation Authority's (OCTA) bus system.

3.0 SIGNIFICANCE CRITERIA

Guidelines to address the significance of air quality impacts are based on Appendix G of the State CEQA Guidelines, which provides guidance that a project would have a significant environmental impact if it would:

1. Conflict or obstruct the implementation of the SCAQMD's Air Quality Management Plan (AQMP) or applicable portions of the State Implementation Plan (SIP);
2. Result in emissions that would violate any air quality standard or contribute substantially to an existing or projected air quality violation;
3. Result in a cumulatively considerable net increase of PM_{10} or exceed quantitative thresholds for O_3 precursors, oxides of nitrogen (NO_X) and volatile organic compounds (VOCs);
4. Expose sensitive receptors (including, but not limited to, schools, hospitals, resident care facilities, or day-care centers) to substantial pollutant concentrations; or
5. Create objectionable odors affecting a substantial number of people.

Projects that are anticipated in growth forecasts included in the AQMP, and projects that are consistent with the SIP rules (i.e., the federally-approved rules and regulations adopted by the SCAQMD) are consistent with the SIP. Projects would be required to conform with measures adopted in the AQMP and would also be required to comply with all applicable rules and regulations adopted by the SCAQMD.

To determine whether a project would (a) result in emissions that would violate any air quality standard or contribute substantially to an existing or projected air quality violation; or (b) result in a cumulatively considerable net increase of nonattainment pollutants or exceed quantitative thresholds for O_3 precursors (NO_X and VOCs), project emissions may be evaluated based on the quantitative emission thresholds established by the SCAQMD in their CEQA Air Quality Handbook (SCAQMD 1999). In addition, the

SCAQMD has recently adopted significance thresholds for $PM_{2.5}$ (SCAQMD 2006). These quantitative thresholds are listed in Table 3-1. For CEQA purposes, these screening criteria can be used as numeric methods to demonstrate that a project's total emissions would not result in a significant impact to air quality.

Table 3-1
Air Quality Significance Thresholds

Pollutant	Construction	Operation
Criteria Pollutants Mass Daily Thresholds		
NO_x	100 lbs/day	100 lbs/day
ROC	75 lbs/day	55 lbs/day
PM_{10}	150 lbs/day	150 lbs/day
$PM_{2.5}$	55 lbs/day	55 lbs/day
SO_x	150 lbs/day	150 lbs/day
CO	550 lbs/day	550 lbs/day
Lead	3 lbs/day	3 lbs/day
TAC, AHM, and Odor Thresholds		
Toxic Air Contaminants (TACs)	Maximum Incremental Cancer Risk ≥ 10 in 1 million Hazard Index ≥ 1.0 (project increment) Hazard Index ≥ 3.0 (facility-wide)	
Odor	Project creates an odor nuisance pursuant to SCAQMD Rule 402	
Ambient Air Quality for Criteria Pollutants		
PM_{10} 24-hour PM_{10} annual geometric mean	2.5 $\mu g/m^3$ 1.0 $\mu g/m^3$	
Sulfate 24-hour average	1 $\mu g/m^3$	
CO 1-hour average CO 8-hour average	1.1 mg/m^3 0.50 mg/m^3	

$\mu g/m^3$ = microgram per cubic meter; pphm = parts per hundred million; mg/m^3 = milligram per cubic meter; ppm = parts per million; TAC = toxic air contaminant; AHM = Acutely Hazardous Material

To further evaluate the potential for significant impacts associated with the construction phase, the SCAQMD's *Final Localized Significance Threshold Methodology* was used (SCAQMD 2003). The Localized Significance Threshold (LST) Methodology provides a look-up table for construction and operational emissions based on the emission rate, location, and distance from receptors, and provides a methodology for air dispersion modeling to evaluate whether a construction or operation could cause an exceedance of an ambient air quality standard. The LST lookup tables are applicable only to sources that are five acres or less in size. A screening air dispersion modeling approach was therefore used to assess the significance of localized construction impacts on receptors in the project vicinity. The LST Methodology only applies to impacts to NO_2, CO, and PM_{10} concentrations.

According to the LST Methodology, Irvine is located in Source Receptor Area Zone 20, the Central Orange County Coastal Zone. LSTs for UCI are shown in Table 3-2, based on the size of the site and the distance to the nearest receptor.

Table 3-2
Localized Significance Thresholds, lbs/day

	Pollutant					
Distance to Nearest Receptor, meters	**NOx**	**CO**	**PM_{10} - Construction**	**PM_{10} - Operation**	**$PM_{2.5}$ - Construction**	**$PM_{2.5}$ - Operation**
1 acre						
25	158	333	4	1	3	1
50	164	500	13	3	5	2
100	189	929	77	19	9	3
200	244	1785	142	34	22	6
500	382	5870	206	50	76	19
2 acres						
25	226	481	7	2	5	2
50	226	692	21	5	7	2
100	244	1247	86	21	12	3
200	288	2216	150	36	26	7
500	408	6405	215	52	83	20
5 acres						
25	335	950	14	3	9	2
50	335	1124	43	10	11	3
100	354	1894	109	26	18	5
200	390	3269	174	42	35	9
500	484	7890	239	57	101	25

In the event that emissions exceed these thresholds, the project would result in a significant air quality impact. For ozone, with ozone precursors NO_x and VOCs, if emissions exceed the thresholds shown in Table 3-1, the project could have the potential to result in a cumulatively considerable net increase in these pollutants and thus could have a significant impact on the ambient air quality.

With regard to evaluating whether a project would have a significant impact on sensitive receptors, air quality regulators typically define sensitive receptors as schools (Preschool-12th Grade), hospitals, resident care facilities, or day-care centers, or other facilities that may house individuals with health conditions that would be adversely impacted by changes in air quality. Any project which has the potential to directly impact a sensitive receptor located within 1 mile and results in a health risk greater than the risk significance thresholds discussed above would be deemed to have a potentially significant impact.

In addition to impacts from criteria pollutants, project impacts may include emissions of pollutants identified by the state and federal government as toxic air contaminants (TACs) or Hazardous Air Pollutants (HAPs). TAC impacts are addressed in the *Air Toxics Health Risk Assessment for the University of California Irvine 2007 Long Range Development Plan* (SRA 2006).

The impacts associated with construction and build-out conditions for the UCI 2007 LRDP were evaluated for significance based on these significance criteria.

4.0 CONSTRUCTION IMPACTS

The UCI 2007 LRDP is a land use plan that guides physical development of the UCI campus. A detailed construction schedule and description of each of the required construction activities has not been developed for the LRDP. Construction associated with implementation of the LRDP is therefore evaluated on a programmatic level. Accordingly, a worst likely case for a peak construction day was developed based on estimated project construction requirements. To develop the maximum daily construction scenario, it was assumed that construction of three large projects and two to three smaller projects could occur simultaneously. Construction activities for individual projects include site work (clearing, grubbing, and grading activities), foundation excavation, and building construction activities.

As discussed above, construction would occur in three general phases: Early Phase (mainly involving demolition, grading, and site preparation for the larger projects and all phases of construction for smaller projects); Middle Phase (involving utilities installation and building construction for the larger projects and all phases of construction for smaller projects); and the Later Phase (involving external/internal building work, paving and landscaping for the larger projects and all phases of construction for the smaller projects). A peak day construction scenario was defined for each of these general construction phases. It was assumed that all equipment would operate for 8 hours per day. $PM_{2.5}$ emissions were calculated based on draft methodologies recommended in the South Coast Air Quality Management District's *Final Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 CEQA Significance Thresholds* (SCAQMD 2006).

Tables 4-1 through 4-3 summarize the assumptions used to develop peak day construction emissions, providing estimates of heavy equipment, worker trips, truck trips, and site grading on a per-project basis.

Table 4-1
UCI LRDP
Major Construction Activity – Early Phase

Square Footage:	500,000		15,000	
Project Type	Large Project (per project)		Small Project (per project)	
Type of Work:	Demolition, Grading, Site Preparation Work		Demolition, Grading, External/Internal Building Work	
Typical Duration at Each Site:	8 months		8 months	
Equipment Type	**Quantity**	**Hours/Day**	**Quantity**	**Hours/Day**
Off-highway Truck	2	8	1	4
Tractor	4	8	2	4
Scraper	2	8	1	4
Roller	3	12	1	8
Crane	0	0	1	4
Bulldozer	2	8	1	4
Water Truck	1	4	1	1
Tracked Loader	1	4	1	1
Wheeled Loader	1	4	1	1
Motor Grader	1	4	1	1
Miscellaneous	2	8	2	8
Vehicle Type	**Quantity**	**Vehicle Trips/ Day**	**Quantity**	**Vehicle Trips/ Day**
Haul Trucks	1	20	0	0
Construction Employee Vehicles	237	2	50	2
Emission Source	**Acres/Day**		**Acres/Day**	
Site Grading	16		4	
Asphalt Work	0		0	
Demolition Work	1,600 cubic yards/project		400 cubic yards/project	

Table 4-2
UCI LRDP
Major Construction Activity – Middle Phase

Square Footage:	500,000		15,000	
Project Type	Large Project (per project)		Small Project (per project)	
Type of Work:	Utilities Installation, Building Construction		Demolition, Grading, External/Internal Building Work	
Typical Duration at Each Site:	8 months		8 months	
Equipment Type	**Quantity**	**Hours/Day**	**Quantity**	**Hours/Day**
Off-highway Truck	2	8	1	4
Tractor	4	8	2	4
Scraper	2	8	1	4
Roller	3	12	1	8
Crane	2	8	1	4
Bulldozer	0	0	1	4
Water Truck	1	4	1	1
Tracked Loader	0	0	1	1
Wheeled Loader	1	4	1	1
Motor Grader	1	4	1	1
Miscellaneous	5	12	2	8
Vehicle Type	**Quantity**	**Vehicle Trips/ Day**	**Quantity**	**Vehicle Trips/ Day**
Haul Trucks	1	2	0	0
Construction Employee Vehicles	237	2	50	2
Emission Source	**Acres/Day**		**Acres/Day**	
Site Grading	1		0	
Asphalt Work	0		0	

Table 4-3
UCI LRDP
Major Construction Activity – Later Phase

Square Footage:	500,000		15,000	
Project Type	Large Project (per project)		Small Project (per project)	
Type of Work:	External/Internal Building Work		Demolition, Grading, External/Internal Building Work	
Typical Duration at Each Site:	6 months		6 months	
Equipment Type	**Quantity**	**Hours/Day**	**Quantity**	**Hours/Day**
Off-highway Truck	0	0	1	4
Tractor	2	8	2	4
Scraper	2	8	1	4
Roller	3	12	1	8
Crane	2	8	1	4
Bulldozer	0	0	1	4
Water Truck	1	4	1	1
Tracked Loader	0	0	1	1
Wheeled Loader	1	4	1	1
Motor Grader	1	4	1	1
Miscellaneous	5	12	2	8
Vehicle Type	**Quantity**	**Vehicle Trips/ Day**	**Quantity**	**Vehicle Trips/ Day**
Haul Trucks	1	2	0	0
Construction Employee Vehicles	237	2	50	2
Emission Source	**Acres/Day**		**Acres/Day**	
Site Grading	1		0	
Asphalt Work	1		0	

Fugitive dust associated with demolition of existing buildings and/or pavement was estimated based on the SCAQMD's CEQA Air Quality Handbook emission factor of 0.00042 lbs PM_{10}/cubic foot of building demolished. Emissions associated with cut and fill were represented in the overall grading emission factor of 10 lbs/acre/day, assuming that watering active grading sites three times daily would control fugitive dust by 50 percent (based on the URBEMIS2002 control efficiency for watering three times daily).

For the purpose of estimating emissions from the application of architectural coatings, it was assumed that water-based coatings that meet the requirements of SCAQMD Rule 1113 for VOC content (using the campus specification of Green Label paints) would be used for both exterior and interior surfaces, and that coatings would be applied using electrostatic spray guns and/or brushes. It was assumed that the architectural coatings application would take place during the building construction phase. The methodology presented in Table A11-13-D of the SCAQMD CEQA Air Quality Handbook was used to estimate emissions from the use of water-based coatings. In accordance with the Handbook, for non-residential structures, the floor area can be multiplied by 2.0 to obtain the total area to be coated.

Tables 4-4 through 4-6 present estimates of air emissions associated with each phase of construction on a per project basis during the maximum construction year, which was assumed to be 2010 for the purpose of utilizing emission factors for off-road equipment and on-road sources.

Table 4-4
Summary of Estimated Air Pollutant Emissions
Early Phase (per project)

Emission Source	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Heavy Equipment Exhaust	49.48	12.83	99.44	0.19	5.26	4.68
Truck Exhaust	19.69	4.05	53.03	0.07	2.33	2.31
Site Grading Fugitive Dust	-	-	-	-	100.00	21.00
Demolition Fugitive Dust	-	-	-	-	22.68	4.76
Architectural Coatings Emissions	-	6.11	-	-	-	-
Employee Vehicle Exhaust	175.47	8.56	15.33	0.21	1.79	1.72
Total	**244.64**	**31.55**	**167.80**	**0.47**	**132.06**	**34.47**
Significance Threshold (lbs/day)	***550***	***75***	***100***	***150***	***150***	***55***
Above Threshold?	**No**	**No**	**Yes**	**No**	**No**	**No**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources, 89% for off-road sources, and 21% of PM_{10} for fugitive dust sources.

Table 4-5
Summary of Estimated Air Pollutant Emissions
Middle Phase (per project)

Emission Source	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Heavy Equipment Exhaust	58.60	14.85	115.36	0.20	5.41	4.81
Truck Exhaust	1.97	0.41	5.30	0.01	0.23	0.23
Site Grading Fugitive Dust	-	-	-	-	5.00	1.05
Architectural Coatings Emissions	-	6.11	-	-	-	-
Employee Vehicle Exhaust	175.47	8.56	15.33	0.21	1.79	1.72
Total	**236.04**	**29.93**	**135.99**	**0.42**	**12.43**	**7.81**
Significance Threshold (lbs/day)	***550***	***75***	***100***	***150***	***150***	***55***
Above Threshold?	**No**	**No**	**Yes**	**No**	**No**	**No**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources, 89% for off-road sources, and 21% of PM_{10} for fugitive dust sources.

Table 4-6
Summary of Estimated Air Pollutant Emissions
Later Phase (per project)

Emission Source	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Heavy Equipment Exhaust	56.45	13.39	103.35	0.16	3.98	3.54
Truck Exhaust	1.97	0.41	5.30	0.01	0.23	0.23
Site Grading Fugitive Dust	-	-	-	-	5.00	1.05
Architectural Coatings Emissions	-	74.30	-	-	-	-
Asphalt Paving Emissions	-	2.62	-	-	-	-
Employee Vehicle Exhaust	175.47	8.56	15.33	0.21	1.79	1.72
Total	**233.89**	**99.28**	**118.68**	**0.38**	**11.00**	**6.54**
Significance Threshold (lbs/day)	***550***	***75***	***100***	***150***	***150***	***55***
Above Threshold?	**No**	**Yes**	**Yes**	**No**	**No**	**No**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources, 89% for off-road sources, and 21% of PM_{10} for fugitive dust sources.

Based on the results of the calculations presented in Tables 4-4 through 4-6, the emissions of NOx would be above the significance thresholds for the maximum daily emissions scenario for all phases of construction, and emissions of VOCs would be above the significance threshold for the later phase of construction. Construction would therefore result in temporary adverse impacts to the ambient air quality. The impacts would be short-term and would be dependent on the construction schedule and level of activity on a maximum daily basis. Actual emissions may be lower than presented in Table 4-4 through 4-6. Mitigation measures for construction are discussed in Section 10.

To further evaluate the potential significance of emissions associated with construction, the SCAQMD LST Methodology was used. As discussed in Section 3.0, the LST Methodology provides a means of evaluating emissions associated with a project based on distance from receptors and size of the project. The LST Methodology lookup tables apply to projects that would be 5 acres in size or less. Tables 4-4 through 4-6 present overall emissions associated with the construction of 1 large project and 1 to 2 smaller projects simultaneously; this construction would be occurring at various sites throughout the UCI campus. It was assumed that individual construction sites would be less than 5 acres in size.

To evaluate the emissions associated with individual construction projects, it was assumed that the nearest receptor would be 25 meters or less, given that construction would occur on campus in the presence of students and workers. According to the LST Methodology lookup tables as shown in Table 3-2, for a 5-acre site, emissions of NOx that would exceed 335 lbs/day with the nearest receptor located at 25 meters would have the potential to cause a significant impact on the ambient air quality. Emissions of NOx would be less than the LST threshold for NOx. Emissions of PM_{10} and $PM_{2.5}$, while below the regional significance thresholds, would be above the LSTs for construction for during the early phase of construction when grading is occurring for both pollutants, because the LSTs for PM_{10} and $PM_{2.5}$ are 14 lbs/day and 9 lbs/day, respectively. Emissions associated with construction would therefore result in a significant, but temporary, impact on the ambient air quality.

To provide perspective regarding the significance of UCI 2007 LRDP construction emissions, Table 4-7 provides a comparison of the estimated emissions with the data presented in the ARB's projected emissions for the year 2010. Emission forecasts on the ARB's website are listed in tons per day. As shown in Table 4-7, the emissions associated with construction for the UCI 2007 LRDP would be a small percentage of the total emissions projected for Orange County for the year 2010.

Table 4-7
Summary of Total Construction Air Pollutant Emissions

Construction Phase	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$**
Beginning of Construction	244.64	31.55	167.80	0.47	132.06	34.47
Mid-Construction	236.04	29.93	135.99	0.42	12.43	7.81
Latter-Construction	233.89	99.28	118.68	0.38	11.00	6.54
Maximum tons/day	**0.12**	**0.05**	**0.08**	**0.00024**	**0.066**	**0.017**
Projected 2010 County Emissions (tons/day)	**601.14**	**114.33**	**122.97**	**4.18**	**53.97**	**17.44**

5.0 OPERATIONAL IMPACTS

This section addresses potential operational impacts resulting from criteria air pollutant emissions for implementation of the UCI 2007 LRDP. Operational impacts associated with the LRDP would result from incremental increases in emissions of criteria air pollutants (CO, VOCs, NOx, SOx, PM_{10}, and $PM_{2.5}$) resulting from three main source categories: area sources, stationary sources, and mobile sources. The following subsections describe the source categories and emission estimation methodologies used to estimate emissions for each category.

5.1 Area Sources

Area sources of air pollutant emissions associated with implementation of the 2007 LRDP include:

- Fuel combustion emissions from energy use, including space and water heating
- Fuel combustion emissions from landscape maintenance equipment
- Consumer product VOC emissions

The URBEMIS2002 model, Version 8.7.0, was used to estimate incremental air pollutant emissions from the identified types of area sources. Land use data associated with the 2007 LRDP development scenarios for UCI were used in the model to estimate square footage based on land uses proposed under the 2007 LRDP. The analysis was based on a comparison of existing land uses with proposed land uses for 2025-26. The data used in the URBEMIS2002 model analysis are presented in Table 5-1.

Table 5-1
2007 LRDP Development by Function

Function	Units	Existing (2005-06)	Proposed (2025-26)	Incremental Increase
Academic/Support	GSF	4,755,100	9,557,000	4,801,900
Campus Support	GSF	206,200	218,800	12,600
Theatre/Cultural Facility	GSF	77,700	160,000	82,300
Events Center	GSF	100,000	100,000	0
Medical Clinic	GSF	58,900	184,000	125,100
R&D	GSF	1,244,640	2,399,640	1,155,000
Commercial Office	GSF	10,000	485,000	475,000
Neighborhood Retail	GSF	0	90,000	90,000
Pre-School/Day Care	GSF	35,000	50,000	15,000
Fitness Center	GSF	91,800	159,000	67,200
TOTAL		**6,579,340**	**13,528,440**	**6,949,100**
Faculty/Staff Housing	DU	1,108	1,250	142
Multi-Family Residential	DU	0	885	885
Lower Div UG Housing	BED	4,331	5,027	696
Upper Div UG/MG Housing	BED	6,491	12,610	6,119
Irrigated Open Space	AC	157.6	168.1	10.5
Non-Irrigated Open Space	AC	439.8	236.8	(203.0)

The modeling analysis for the area sources used model default emission factors contained within the URBEMIS model, assuming that buildings would include energy-efficient design measures that would exceed Title 24 standards by 20 percent. Consumer products emissions were also reduced by 50 percent because certain products would not be used in a dormitory setting (such as cleaners, degreasers, automotive products, charcoal lighters, etc.), and students and faculty may not be living in the on-campus housing for 365 days per year. Table 5-2 presents the estimated emissions for the area sources proposed for UCI. URBEMIS output files are provided in Appendix A of this report.

Table 5-2
Summary of Estimated Operational Area Source Emissions

Emission Source	Maximum Daily Emissions (mitigated) (lbs/day)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Fuel Combustion	43.17	4.40	59.52	0.00	0.11	0.11
Landscaping	6.87	0.98	0.10	0.00	0.01	0.01
Consumer Products Use	-	66.80	-	-	-	-
Total	**50.04**	**72.18**	**59.62**	**0.00**	**0.12**	**0.12**
Significance Threshold (lbs/day)	***550***	***55***	***100***	***150***	***150***	***55***
Above Threshold?	**No**	**Yes**	**No**	**No**	**No**	**No**
	Annual Emissions (mitigated) (tons/yr)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Fuel Combustion	7.88	0.80	10.86	0.00	0.02	0.02
Landscaping	0.62	0.09	0.01	0.00	0.00	0.00
Consumer Products Use	-	12.19	-	-	-	-
Total	**8.50**	**13.08**	**10.87**	**0.00**	**0.02**	**0.02**
Significance Threshold (lbs/day)	***100***	***10***	***10***	***100***	***70***	***10***
Above Threshold?	**No**	**Yes**	**Yes**	**No**	**No**	**No**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources.

5.2 Stationary Sources

Increases in air pollutant emissions associated with implementation of the UCI 2007 LRDP would be expected from the following stationary sources:

- Central utilities cogeneration turbines
- Central utilities boilers
- Academic laboratory uses
- Research laboratories
- Paint spray booth
- Painting operations
- Gasoline storage and dispensing
- Refrigerant use and recovery
- Diesel-fueled emergency engines

Criteria air pollutants generated from these sources include CO, VOCs, NOx, SOx, PM_{10}, and $PM_{2.5}$. Current air pollutant emissions were estimated based on the University of California Irvine's Annual Emission Report for the year 2004-2005 as calculated by the SCAQMD.

To estimate increases in stationary source emissions, it was assumed that emissions would be proportional to the developed square footage on campus. The total existing square footage was estimated at approximately 10,405,740 gross square feet based on current development (6,579,340 gross square feet) and housing estimates, assuming 1500 square feet per faculty/staff/multifamily housing, and 200 square feet per bed in undergraduate housing. For the year 2025-26, the total developed square footage was estimated at approximately 20,258,340, an increase of 9,852,600 square feet. Accordingly, it was assumed that the on-site fuel usage and usage of other substances in support of daily operations (such as gasoline dispensing) would increase by approximately 95 percent by 2025-26.

Emissions from use of laboratory chemicals in science classrooms were estimated based on the University Laboratory/Research category reported in the 2004-2005 Air Emissions Report. Current laboratory space was assumed to be located in engineering and science buildings on campus. To estimate increases in laboratory chemical use and emissions due to expansion of laboratory space, it was assumed that chemical usage would be proportional to the increases in engineering/science building space. Current engineering and science buildings comprise approximately 3,103,000 gross square feet of space on campus. The 2007 LRDP proposes an increase in engineering, science, and research and development space to approximately 7,444,000 gross square feet, for an increase of approximately 4,341,000 gross square feet. Accordingly, it was assumed that the university/laboratory research chemical usage would increase by approximately 140 percent by 2025-26.

In addition to the emissions associated with daily operations as characterized under existing conditions, UCI is proposing an expansion of their Central Plant to add a natural gas-fired combustion turbine unit equipped with selective catalytic reduction (SCR) to control emissions. Emissions were estimated based on information supplied by UCI in support of the permit application for the combustion turbine.

To estimate maximum daily emissions, it was assumed that the total annual emissions would be divided by 365 days per year. Based on these assumptions, criteria pollutant emissions from stationary sources are summarized in Table 5-3. Toxic air contaminant emissions are evaluated in the *Air Toxics Health Risk Assessment - University of California Irvine 2007 Long Range Development Plan* (SRA 2006).

Table 5-3
Summary of Estimated Operational Stationary Source Emissions

Existing						
Emission Source	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Natural Gas Combustion – Central Plant Boilers	138.57	2.72	18.70	0.51	6.46	6.40
Natural Gas Combustion – Unpermitted Boilers	36.50	1.39	43.45	0.26	3.30	3.27
Diesel Combustion - Engines	0.52	0.19	2.39	0.04	0.17	0.17
VOC Emissions – Wood and Metal Coating	-	0.07	-	-	-	-
Gasoline and Diesel Storage and Dispensing	-	0.50	-	-	-	-
PM Emissions – Spray Booth	-	-	-	-	0.007	0.007
Laboratory Chemical Use	-	9.02	-	-	-	-
Total	**175.59**	**13.89**	**64.54**	**0.81**	**9.94**	**9.85**
Significance Threshold (lbs/day)	***550***	***55***	***100***	***150***	***150***	***150***
Above Threshold?	**No**	**No**	**No**	**No**	**No**	**No**
	Annual Emissions (tons/year)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Natural Gas Combustion – Central Plant Boilers	25.29	0.49	3.41	0.09	1.18	1.17
Natural Gas Combustion – Unpermitted Boilers	6.66	0.26	7.93	0.05	0.60	0.59
Diesel Combustion - Engines	0.09	0.03	0.44	0.01	0.03	0.03
VOC Emissions – Wood and Metal Coating	-	0.013	-	-	-	-
Gasoline and Diesel Storage and Dispensing	-	0.09	-	-	-	-
PM Emissions – Spray Booth	-	-	-	-	0.001	0.001
Laboratory Chemical Use	-	1.65	-	-	-	-
Total	**32.04**	**2.53**	**11.78**	**0.15**	**1.81**	**1.79**
Significance Threshold (tons/year)[2]	***100***	***10***	***10***	***100***	***70***	***100***
Above Threshold?	**No**	**No**	**Yes**	**No**	**No**	**No**

Table 5-3 (continued)
Summary of Estimated Operational Stationary Source Emissions

Future						
Emission Source	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Natural Gas Combustion – Central Plant Turbine	41.11	43.07	45.02	3.66	46.66	46.19
Natural Gas Combustion – Central Plant Boilers	270.22	5.30	36.47	0.99	12.60	12.47
Natural Gas Combustion – Unpermitted Boilers	71.17	2.71	84.73	0.51	6.44	6.38
Diesel Combustion - Engines	1.01	0.20	4.66	0.07	0.18	0.18
VOC Emissions – Wood and Metal Coating	-	0.14	-	-	-	-
Gasoline and Diesel Storage and Dispensing	-	0.98	-	-	-	-
PM Emissions – Spray Booth	-	-	-	-	0.014	0.014
Laboratory Chemical Use	-	21.65	-	-	-	-
Total	**383.51**	**74.05**	**170.88**	**5.23**	**65.89**	**65.23**
Significance Threshold (lbs/day)	***550***	***55***	***100***	***150***	***150***	***55***
Above Threshold?	**No**	**Yes**	**Yes**	**No**	**No**	**Yes**
	Annual Emissions (tons/year)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Natural Gas Combustion – Central Plant Turbine	7.5	7.9	8.2	0.7	8.5	8.4
Natural Gas Combustion – Central Plant Boilers	49.31	0.97	6.66	0.18	2.30	2.28
Natural Gas Combustion – Unpermitted Boilers	12.99	0.49	15.46	0.09	1.18	1.16
Diesel Combustion - Engines	0.18	0.04	0.85	0.01	0.03	0.03
VOC Emissions – Wood and Metal Coating	-	0.03	-	-	-	-
Gasoline and Diesel Storage and Dispensing	-	0.18	-	-	-	-
PM Emissions – Spray Booth	-	-	-	-	0.002	0.002
Laboratory Chemical Use	-	3.96	-	-	-	-
Total	**69.98**	**13.57**	**31.17**	**0.98**	**12.01**	**11.87**
Significance Threshold (tons/year)[2]	***100***	***10***	***10***	***100***	***70***	***10***
Above Threshold?	**No**	**Yes**	**Yes**	**No**	**No**	**Yes**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources.
[2]Annual emissions threshold based on Title V major source threshold for the SCAB.

5.3 Vehicular Emissions

Implementation of the UCI 2007 LRDP will result in increases in traffic due to increased enrollment at UCI. Traffic increases are projected in the *University of California Irvine Long Range Development Plan Update Traffic Study* (Austin-Foust Associates, Inc. 2007). According to the Traffic Study, implementation of the LRDP update, as compared with the existing conditions, is anticipated to result in 69,490 additional average daily trips (ADTs).

Emissions associated with vehicular traffic were estimated using the URBEMIS2002 model. Input data to URBEMIS2002 include incremental vehicle trips, vehicle fleet percentage, winter and summer temperatures, variable start information, mitigation measures (including the presence of mass transit, bike lanes, pedestrian facilities, mixed land uses), and model year. Traffic emissions were estimated based on a 2025 vehicle mix, based on a 4-year university. To evaluate the net increase in vehicle trips, the current 2005-2006 enrollment of 24,434 students was increased to 37,000 students for a net increase of 12,566 students. To account for the increase in average daily trips projected in the Traffic Study, a total of 5.53 trips per student were assumed; this amount accounts for student, faculty, and staff trips. Table 5-4 presents a summary of vehicular emissions associated with implementation of the UCI 2007 LRDP.

Table 5-4
Summary of Estimated Operational Vehicular Emissions

Emission Source	**Maximum Daily Emissions (lbs/day)**					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Vehicular Emissions	1456.27	180.61	143.54	3.45	602.52	150.30
Significance Threshold (lbs/day)	***550***	***55***	***55***	***150***	***150***	***55***
Above Threshold?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**
	Annual Emissions (tons/year)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Vehicular Emissions	259.46	30.55	28.37	0.61	109.96	27.46
Significance Threshold (tons/year)	***100***	***10***	***10***	***100***	***70***	***10***
Above Threshold?	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources; road dust is 21% of PM_{10}.

5.4 Summary

Table 5-5 presents a summary of the total estimated incremental operational air emissions associated with implementation of the UCI 2007 LRDP, in comparison with the significance thresholds identified in Section 3.0. To provide perspective regarding the significance of operational emissions, Table 5-5 also compares the estimated emissions of pollutants with the ARB projections for Orange County for the year 2020. The ARB's Almanac does not provide projections for years after 2020.

Table 5-5
Summary of Total Estimated Operational Emissions

Emission Source	Maximum Daily Emissions (lbs/day)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Area Sources	50.04	72.18	59.62	0.00	0.12	0.12
Stationary Sources	383.51	74.05	170.88	5.23	65.89	65.23
Vehicular Emissions	1456.27	180.61	143.54	3.45	602.52	150.30
Total	**1889.82**	**326.84**	**374.04**	**8.68**	**668.53**	**215.65**
Significance Threshold (lbs/day)	***550***	***55***	***55***	***150***	***150***	***55***
Above Threshold?	**Yes**	**Yes**	**Yes**	**No**	**Yes**	**Yes**
	Annual Emissions (tons/year)					
	CO	**VOCs**	**NO_x**	**SO_x**	**PM_{10}**	**$PM_{2.5}$[1]**
Area Sources	8.50	13.08	10.87	0.00	0.02	0.02
Stationary Sources	69.98	13.57	31.17	0.98	12.01	11.87
Vehicular Emissions	259.46	30.55	28.37	0.61	109.96	27.46
Total	**337.94**	**57.20**	**70.41**	**1.59**	**121.99**	**39.35**
Significance Threshold (tons/year)	***100***	***10***	***10***	***100***	***70***	***10***
Above Threshold?	**Yes**	**Yes**	**Yes**	**No**	**No**	**Yes**
Total (tons/day)	**0.94**	**0.16**	**0.19**	**0.0043**	**0.33**	**0.11**
Projected 2020 County Emissions (tons/day)	**761.20**	**134.96**	**156.70**	**3.89**	**53.10**	**17.24**

[1]Based on SCAQMD guidelines, $PM_{2.5}$ is 99% of PM_{10} for combustion sources; road dust is 21% of PM_{10}.

As shown in Table 5-5, maximum daily and annual emissions associated with implementation of the UCI 2007 LRDP would above the daily significance thresholds for CO, VOCs, NOx, PM_{10}, and $PM_{2.5}$, and above the annual significance thresholds for CO, VOCs, and NOx. The main source of pollutants is from vehicular traffic generated by increased student enrollment at UCI.

As discussed in the following section (Section 6.0), air dispersion modeling was conducted to further evaluate the potential for significant impacts to the ambient air quality. In accordance with the LST methodology, emissions of CO, NOx, PM_{10} and $PM_{2.5}$ were further evaluated to address offsite impacts. To address impacts from stationary sources, the ISCST3 model was used. The main emitters of CO, NOx, PM_{10}, and $PM_{2.5}$ on campus would be combustion sources (i.e., boilers, turbines, and emergency generators). Emissions from boilers and emergency generators were estimated based on growth projections for the campus, and emissions were modeled as point sources at their locations on campus.

For the gas turbines, the impacts predicted in the air quality impact analysis that was conducted in support of the Permit to Construct were utilized to assess potential significance of impacts (ENVIRON 2006). The analysis was conducted using the SCREEN3 model, which provides a conservative estimate of impacts associated with turbine operation. For conservative purposes, the maximum predicted impacts from the turbine were added to the maximum predicted impacts from the stationary sources on site.

Finally, to address vehicular emissions, an evaluation of the potential for pollutant "hot spots" was conducted. In general, exceedances of the CO standard are associated with traffic congestion. Provided traffic at congested locations (i.e., intersections operating at LOS E or F) does not result in an exceedance of the CO standards, significant impacts would not result. In addition to addressing CO "hot spots", NOx, PM_{10}, and $PM_{2.5}$ emissions from traffic were also modeled. The "hot spots" evaluation is described in detail in Section 6.0.

Table 5-6 presents the results of the evaluation of stationary source impacts on the ambient air quality. As shown in the table, the impacts would be below the Rule 1303, Table A-2 thresholds, and would not cause or contribute to a violation of an ambient air quality standard.

Table 5-6
Stationary Source Impacts

Pollutant	Period	Turbine Impact $\mu g/m^3$	Boilers/ Generators Impact $\mu g/m^3$	Total Impact $\mu g/m^3$	Rule 1303 Table A-2 Threshold $\mu g/m^3$	Above Threshold?
CO	1-hr	1.5	35.54	37.04	1,100	NO
CO	8-hr	1.1	24.14	25.24	500	NO
NO_2	1-hr	1.7	10.36[1]	12.06	20	NO
NO_2	Annual	0.13	0.687[1]	0.82	1	NO
PM_{10}	24-hr	0.7	0.93	0.75374	2.5	NO
PM_{10}	Annual	0.1	0.17	0.14152	1	NO
$PM_{2.5}$	24-hr	0.69	0.92	0.7462	2.5[2]	NO
$PM_{2.5}$	Annual	0.099	0.168	0.1401	1[2]	NO

[1]Per LST guidance, a NOx to NO_2 ratio of 0.388 was used to adjust annual NOx impacts (1.77 $\mu g/m^3$) to represent maximum impacts at 810 meters from the source, based on linear interpolation between the ratio for 500 meters (0.258) and 1000 (0.467) meters downwind. A NOx to NO_2 ratio of 0.353 meters was used to adjust 1-hour NOx impacts (29.35 $\mu g/m^3$) to represent a maximum impact at 728 meters from the source, based on linear interpolation between the ratio for 500 meters (0.258) and 1000 meters (0.467) downwind.
[2]$PM_{2.5}$ thresholds assumed to be the same as PM_{10} per LST guidelines for $PM_{2.5}$ (SCAQMD 2006).

Emissions of VOCs and NOx can contribute to elevated levels of ozone in the ambient air, because VOCs and NOx react in the atmosphere to form ozone. To develop its SIP and demonstrate that the air basin will attain and maintain the ozone standards, the SCAQMD utilizes growth projections and traffic projections developed by the Southern California Association of Governments (SCAG) and local municipalities. Projects that are consistent with the SCAG projections and with local General Plans would be accounted for in the SCAQMD's attainment demonstration, and would not contribute to a violation of the ozone standard. Should a project's projected growth in traffic exceed traffic projections developed by SCAG and accounted for in the SIP and the attainment demonstration, the project may contribute elevated levels of ozone and may conflict with existing air quality plans.

UCI is part of the UC system, a constitutionally created entity of the State of California. As a constitutional entity, UC is not subject to municipal regulations such as the City's General Plan or the surrounding community plans. The applicable land use plan is the campus' LRDP. The proposed 2007 update of the UCI LRDP, if adopted, would become the applicable campus land use plan. UC is the only agency with local land use jurisdiction over campus projects. Therefore, all development occurring consistent with the 2007 LRDP would have no land use impact under this threshold and impacts would be less than significant. Nevertheless, the City of Irvine General Plan and Zoning Code, and the City of Newport Beach General Plan have been reviewed for this analysis because the campus is interested in coordinating campus projects with the city and neighboring communities, to evaluate whether the 2007 LRDP is compatible with local community plans within the city and neighboring communities. Upon review of these plans, none contain specific policies or regulations that address the development of the campus in relation to adjacent off-campus land uses. Therefore, impacts with regard to applicable land use plans, policies, and regulations, are less than significant. The 2007 LRDP would be compatible with these community plans because it would not propose growth that is unanticipated in local planning projections. Furthermore, the 2007 LRDP would contribute to the UC's ability to serve the growing population in the State of California and, therefore, on a statewide scale is not considered growth inducing but rather responds to the demand of an increased population. Thus air emissions associated with growth at UCI would be consistent with current growth projections.

Emissions of particulate matter (PM_{10} and $PM_{2.5}$) from implementation of the 2007 LRDP were mainly attributable to vehicular emissions. Mitigation measures for operational impacts are discussed in Section 9.

As discussed in Section 2.0, the SCAQMD is in the process of preparing a new attainment plan to develop plans and programs to attain and maintain the newly adopted 8-hour NAAQS for O_3. That process will include development of new emissions projections for future years. It is not anticipated that the emissions associated with implementation of the UCI 2007 LRDP would substantially contribute to the overall emissions in the SCAB, and given that implementation of the LRDP is consistent with growth projections for the air basin, the emissions from the project will be accounted for in the attainment demonstrations contained in the updated SIP.

6.0 "HOT SPOTS" EVALUATION

Projects involving increases in traffic and/or traffic congestion may result in localized increases in pollutant concentrations. To further evaluate whether the project would result in a significant impact, additional modeling was conducted to assess whether the increases in traffic attributable to implementation of the UCI 2007 LRDP would result in localized CO impacts.

Projects involving traffic impacts may result in the formation of locally high concentrations of CO, known as CO "hot spots." To verify that the project would not cause or contribute to a violation of the CO standard, a screening evaluation of the potential for CO "hot spots" was conducted. The Traffic Study evaluated whether or not there would be a decrease in the level of service at the roadways and/or intersections affected by the Project. The potential for CO "hot spots" was evaluated based on the results of the Traffic Study. The Caltrans ITS Transportation Project-Level Carbon Monoxide Protocol (Caltrans 1998) was followed to determine whether a CO "hot spot" is likely to form due to Project-generated traffic. In accordance with the Protocol, CO "hot spots" are typically evaluated when (a) the level of service (LOS) of an intersection or roadway decreases to a LOS E or worse; (b) signalization and/or channelization is added to an intersection; and (c) sensitive receptors such as residences, commercial developments, schools, hospitals, etc. are located in the vicinity of the affected intersection or roadway segment.

The Traffic Impact Analysis (Austin-Foust Associates 2007) evaluated a total of 241 intersections in the project vicinity both on and off campus to evaluate whether the project would affect traffic. Study intersections included both on- and off-campus, and evaluated impacts to intersections in the City of Irvine and the City of Newport Beach. No on-campus intersections would degrade due to project traffic. For off-campus intersections, the following intersections would have a significant impact where the LOS would be below LOS E due to project traffic:

- Carlson Avenue and Campus Drive
- Carlson Avenue and Michelson Drive
- Harvard Avenue and Michelson Drive
- University Drive and Campus Drive
- University Drive and California Avenue
- Culver Drive and Michelson Drive
- Culver Drive and University Drive
- Von Karman Avenue and Campus Drive
- Jamboree Road and Campus Drive
- Jamboree Road and Birch Street
- MacArthur Boulevard and Jamboree Road
- Jamboree Road and Bristol Street S.
- MacArthur Boulevard and San Joaquin Hills Road
- Bonita Canyon and Newport Coast Drive

To evaluate the potential for CO "hot spots," the procedures in the Caltrans ITS Transportation Project-Level Carbon Monoxide Protocol (Caltrans 1998) were used. As recommended in the Protocol, CALINE4 modeling was conducted for the intersections identified above for the scenario without Project traffic, and the Project scenarios. Modeling was conducted based on the guidance in Appendix B of the Protocol to calculate maximum predicted 1-hour CO concentrations. Predicted 1-hour CO concentrations were then scaled to evaluate maximum predicted 8-hour CO concentrations using the recommended scaling factor of 0.7 for urban locations.

Inputs to the CALINE4 model were obtained from the *University of California Irvine Long Range Development Plan Update Traffic Study* (Austin-Foust Associates, Inc. 2007. As recommended in the Protocol, receptors were located at locations that were approximately 3 meters from the mixing zone, and at a height of 1.8 meters. For conservative purposes, emission factors for low speeds (1 mph) were used to estimate emissions in the CALINE4 model, as low speeds provide a worst-case evaluation of emissions.

In accordance with the Caltrans ITS Transportation Project-Level Carbon Monoxide Protocol, it is also necessary to estimate future background CO concentrations in the project vicinity to determine the potential impact plus background and evaluate the potential for CO "hot spots" due to the project. As a conservative estimate of background CO concentrations, the existing maximum 1-hour background concentration of CO that was measured at the Anaheim monitoring station for the period 2003 – 2005 of 6.1 ppm was used to represent future maximum background 1-hour CO concentrations. The existing maximum 8-hour background concentration of CO that was measured at the Anaheim monitoring station during the period from 2003 - 2005 of 4.09 ppm was also used to provide a conservative estimate of the maximum 8-hour background concentrations in the project vicinity. CO concentrations in the future may be lower as inspection and maintenance programs and more stringent emission controls are placed on vehicles.

The CALINE4 model outputs are provided in Appendix A of this report. Table 6-1 presents a summary of the predicted CO concentrations (impact plus background) for the intersections evaluated. As shown in Table 6-1, the predicted CO concentrations would be substantially below the 1-hour and 8-hour NAAQS and CAAQS for CO shown in Table 2-1 of this report. Therefore, no exceedances of the CO standard are predicted, and the project would not cause or contribute to a violation of this air quality standard.

Table 6-1
CO "Hot Spots" Evaluation
Predicted CO Concentrations, ppm

Intersection	**UCI LRDP**	
Maximum 1-hour Concentration Plus Background, ppm CAAQS = 20 ppm; NAAQS = 35 ppm; Background 6.1 ppm		
	am	***pm***
Carlson Avenue and Campus Drive	6.4	6.4
Carlson Avenue and Michelson Drive	6.5	6.6
Harvard Avenue and Michelson Drive	6.6	6.7
University Drive and Campus Drive	6.5	6.6
University Drive and California Avenue	6.5	6.6
Culver Drive and Michelson Avenue	6.6	6.7
Culver Drive and University Avenue	6.6	6.8
Von Karman Avenue and Campus Drive	6.4	6.5
Jamboree Road and Campus Drive	6.7	6.8
Jamboree Road and Birch Drive	6.7	6.7
MacArthur Boulevard and Jamboree Road	6.8	6.9
Jamboree Road and Bristol Street S	6.8	6.8
MacArthur Boulevard and San Joaquin Hills Road	6.8	6.8
Bonita Canyon and Newport Coast Drive	6.6	6.4
Maximum 8-hour Concentration Plus Background, ppm CAAQS = 9.0 ppm; NAAQS = 9 ppm; Background 4.09 ppm		
Carlson Avenue and Campus Drive	4.30	
Carlson Avenue and Michelson Drive	4.44	
Harvard Avenue and Michelson Drive	4.51	
University Drive and Campus Drive	4.44	
University Drive and California Avenue	4.44	
Culver Drive and Michelson Avenue	4.51	
Culver Drive and University Avenue	4.58	
Von Karman Avenue and Campus Drive	4.37	
Jamboree Road and Campus Drive	4.58	
Jamboree Road and Birch Drive	4.51	
MacArthur Boulevard and Jamboree Road	4.65	
Jamboree Road and Bristol Street S	4.58	
MacArthur Boulevard and San Joaquin Hills Road	4.58	
Bonita Canyon and Newport Coast Drive	4.44	

7.0 ODOR IMPACTS

Assessing odor impacts depends upon such variables as wind speed, wind direction, and the sensitivities of receptors to different odors. To have an odor impact, the perception of an odor in ambient air depends on the properties of the substance emitted, its concentration in emissions, and dilution of emissions between the emissions point and the receptors.

Certain amounts of odor emissions would be generated from vehicles and/or equipment tailpipe exhaust emissions during construction and operations associated with implementation of the UCI 2007 LRDP. Odors are generally attributable to unburned hydrocarbons in exhaust, concentrations of which are small. Small amounts of substances that may have some perceptible odors may be emitted from other on-campus activities such as laboratory uses and combustion of fuels; however, the UCI campus is not considered a category of land use that would generate significant odor impacts. The new developments proposed under the UCI 2007 LRDP would include institutional and residential land uses and would not be considered major sources of odors that would result in a significant impact to receptors.

8.0 CUMULATIVE IMPACTS

Because the SCAB is currently considered a nonattainment area for ozone, CO, PM_{10}, and $PM_{2.5}$, cumulative development could violate an air quality standard or contribute to an existing or projected air quality violation. The SCAQMD has established its cumulative context as all projects within a one mile radius of a proposed project that are considered under the same Program. Thus the LRDP would be considered the cumulative context in which to evaluate significance of impacts. If a project exceeds established thresholds accepted by the SCAQMD on a project specific basis, then the project is cumulatively significant and provides a cumulatively considerable contribution. If it does not exceed thresholds, then it is cumulatively less than significant. Therefore this is considered to be a significant cumulative impact. For the purposes of this analysis, individual construction projects that exceed the SCAQMD daily significance thresholds would be considered to cause a cumulatively considerable increase in emissions for those pollutants for which the SCAB is in nonattainment.

As discussed in Section 4.0, the short-term construction emissions would be above the significance criteria for CO, VOCs, NOx, and PM_{10}, and would therefore result in a temporary significant impact on the ambient air quality. As discussed in Section 5.0, maximum daily and annual emissions associated with implementation of the UCI 2007 LRDP would be above the daily and annual significance thresholds for CO, VOCs, NOx, PM_{10}, and $PM_{2.5}$. However, a comparison with emission projections contained in the ARB's Almanac indicates that these emissions would be less than 0.2 percent of the daily emission projections for all pollutants for all time periods. Furthermore, the 2007 LRDP is consistent with growth projections for Orange County and the City of Irvine that are the basis for the attainment demonstrations in the SIP. Thus the operational emissions associated with implementation of the 2007 LRDP would not be anticipated to adversely affect the air basin's ability to demonstrate continuing reductions and progress toward attainment of the ambient air quality standards.

The “hot spots” evaluation summarized in Section 6.0 of this analysis takes into account cumulative traffic generated due to implementation of the UCI 2007 LRDP and other projects considered in the cumulative traffic projections. As discussed in Section 6.0, project-related traffic would not result in an exceedance in an ambient air quality standard when added to existing CO background concentrations. Thus localized CO cumulative impacts associated with the LRDP would not be significant.

Cumulative development is not expected to result in a significant impact in terms of conflicting with, or obstructing implementation of, the AQMP. The AQMP was prepared to accommodate growth and to reduce the levels of pollutants within the areas under the jurisdiction of the SCAQMD. Growth considered to be consistent with the AQMP would not interfere with attainment because this growth is included in the projections utilized in the formulation of the AQMP. Consequently, provided growth is consistent with AQMP projections for the UC system, implementation of the AQMP would not be obstructed, and the implementation of the 2007 LRDP would not result in a significant impact due to inconsistency with local and regional air quality plans.

Cumulative development would not have a significance impact in terms of the creation of objectionable odors affecting a substantial number of people. Odors resulting from the construction associated with the 2007 LRDP would not be likely to affect a substantial number of people in that construction would be short-term and is not generally considered to be a source of objectionable odors. Land uses at UCI do not constitute significant sources of odors and would thus also not result in cumulatively considerable odor impacts.

9.0 MITIGATION MEASURES

This section presents proposed mitigation measures to address significant impacts for both construction and operation due to implementation of the 2007 LRDP.

9.1 Construction Mitigation Measures

As discussed in Section 4.0, impacts associated with short-term construction activities would be above the significance thresholds. Based on the results of the calculations presented in Tables 4-4 through 4-6, the emissions of NOx would be above the significance threshold for the maximum daily emissions scenario for the all construction phases, and emissions of VOCs would be above the significance threshold for the later construction phase. There are no feasible mitigation measures that could reduce the project's emissions to below a level of significance. However, all available measure to reduce impacts should be implemented.

Accordingly, the following mitigation measure is proposed to reduce short-term construction impacts:

AQ-1: Prior to the commencement of construction activities on each project component, UCI will require the principal construction contractor to develop a construction emissions mitigation plan. The elements of such a plan, to be approved by UCI or its designee, and implemented and supervised by the managing contractor, will include the following:

1. During grading and site preparation activities, exposed soil areas will be watered a minimum of twice daily. During windy days or when fugitive dust can be observed leaving the construction site, additional applications of water will be required to maintain a minimum 12 percent moisture content in exposed soils. Under windy conditions where wind velocities are forecast to exceed 25 miles per hour, all ground disturbing activities will be halted until the winds are forecast to be less than 25 miles per hour.

2. Areas at the construction site that will remain inactive for three months or longer should be revegetated to prevent fugitive dust generation.

3. Unpaved access roads should be stabilized using frequent watering, chemical stabilization, or paving.

4. Trucks transporting materials to and from the site should allow for at least two feet of freeboard (i.e., minimum vertical distance between the top of the load and the top of the trailer). Alternatively, trucks transporting materials may be covered.

5. All vehicles on the construction site traveling on unpaved roads will be restricted to 15 mph or less.

6. Where visible soil material is carried on to adjacent public paved roads, the paved roads should be swept or washed down at the end of the day.

7. Install wheel washers where vehicles enter and exit unpaved roads onto paved roads, or wash off trucks and any equipment leaving the site each trip

8. All material stockpiles subject to wind erosion during construction activities that will not be used within 3 days should be stabilized with a nontoxic chemical stabilizer or covered with a plastic or alternative cover.

9. Diesel powered construction equipment should be maintained in accordance with manufacturer's requirements.

10. Heavy duty diesel trucks and gasoline powered equipment will restrict idling to 5 minutes or less.

11. Where feasible, the construction contractor should use alternatively-fueled construction equipment, such as electric or natural gas-powered equipment.

12. The construction contractor should develop a construction traffic management plant that includes the following:

    a. Rerouting construction trucks off congested streets
    b. Scheduling heavy-duty truck deliveries to avoid peak traffic time periods
    c. Consolidating truck deliveries
    d. Providing dedicated turn lanes for movement of construction trucks and equipment on- and off-site.

13. The construction contractor will support and encourage ridesharing and transit incentives for the construction crew.

14. Where possible, the construction contractor will provide a lunch shuttle or on-site lunch service for construction workers.

15. The construction contractor should, to the extent possible, use pre-coated architectural materials that do not require painting. Water-based or low VOC coatings will be used that are compliance with SCAQMD Rule 1113. Spray equipment with high transfer efficiency such as the high volume-low pressure (HVLP) spray method, or manual coatings application will be used to reduce VOC emissions to the extent possible.

16. The construction contractor will encourage the use of heavy construction equipment that has been retrofit with diesel particulate filters where available and practicable.

17. The construction contractor will maintain signage along the construction perimeter with the name and telephone number of the individual in charge of implementing the construction emissions mitigation plan, and with the telephone number of the SCAQMD's complaint line. The contractor's representative will maintain a log of public complaints and corrective actions taken to resolve complaints.

Even with implementation of Mitigation Measure AQ-1, impacts would remain significant.

9.2 Operational Mitigation Measures

As discussed in Section 5.0, maximum daily and annual operational emissions associated with implementation of the UCI 2007 LRDP would above the daily significance thresholds for CO, VOCs, NOx, PM_{10}, and $PM_{2.5}$, and above the annual significance thresholds for CO, VOCs, and NOx. The main source of pollutants is from vehicular traffic generated by increased student enrollment at UCI.

There are no feasible mitigation measures that could reduce the project's emissions to below a level of significance. However, all available measure to reduce impacts should be implemented.

Accordingly, the following mitigation measure is proposed to reduce operational impacts:

AQ-2: UCI should implement transportation control measures to encourage the use of alternative transportation and carpooling. These transportation control measures should include the following:

1. UCI operates twenty-one comfortable, air conditioned vanpools that transport employees, graduate students and undergraduate students to the UC Irvine campus each day. UC Irvine vanpools provide transportation to the campus Monday through Friday. Vanpool service should be continued and expanded with implementation of the 2007 LRDP.

2. UCI maintains an employee and graduate student carpool program that provides for preferential parking for carpool participants. The student carpool program was suspended for lack of funding. UCI also maintains a Carpool Matching website that connects potential carpoolers. The carpool program should be continued and expanded to reinstate the student carpool program with implementation of the 2007 LRDP.

3. UCI operates a shuttle service that includes five main shuttle services. These shuttles serve the Main Campus, the East Campus, Vista del Campo Housing, Vista del Campo Norte, and the Parkwest area. The shuttle service should be maintained with implementation of the 2007 LRDP.

4. UCI offers incentives to both employees and students who use the train to commute. Employees and students who commute by train (to the campus) and do not purchase long term parking permits (one month or longer) may register to receive a monthly subsidy of 20% off of their monthly pass or their 10-trip ticket. The OCTA operates a bus service from the Tustin train station to the UCI campus. The train incentives should be continued and expanded with implementation of the 2007 LRDP.

5. UCI offers a free University Pass that provides unlimited free access to the Orange County Transportation Authority's (OCTA) bus system. The University Pass program should be continued with implementation of the 2007 LRDP.

6. Alternative transportation, including bicycling, should be encouraged with bike lanes and bicycle storage provided with campus growth.

7. UCI should meet its plan to procure 20 percent of its electricity needs from renewable sources by 2017 and to use energy efficiency retrofit programs to reduce system-wide growth by 10 percent by 2014.

Even with implementation of Mitigation Measure AQ-2, impacts would remain significant.

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Air Toxics Health Risk Assessment

University of California Irvine
2007 Long Range Development Plan

Prepared for:

PBS&J

Prepared by:

Scientific Resources Associated

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January 9, 2007

EXECUTIVE SUMMARY

The UCI 2007 LRDP would increase emissions of toxic air contaminants (TACs) due to increased usage of chemicals, combustion of fuel to provide campus power, and vehicle operations associated with the project. Sensitive receptors located on and near the UCI campus include residents, students, day care centers, clinics, and recreational areas could be exposed to TACs through inhalation. The purpose of this human health risk assessment (HRA) was to evaluate the potential for adverse health effects due to exposure to the TACs emitted from the project.

The HRA was conducted in accordance with the latest guidance from the California Office of Environmental Health Hazard Assessment (OEHHA). According to OEHHA, the four steps involved in the risk assessment process are 1) hazard identification, 2) exposure assessment, 3) dose-response assessment, and 4) risk characterization. The principal elements of this HRA following the OEHHA guidance, and are listed below:

- Estimation of toxic air contaminant (TAC) emissions from project operational sources (hazard identification);
- Air dispersion modeling to predict maximum concentrations of TACs using the SCAQMD and OEHHA approach (exposure assessment/exposure concentrations);
- Risk assessment approach to predict incremental cancer risks, chronic non-cancer, and acute non-cancer health risks, using the OEHHA guidance and/or the HotSpots Assessment and Reporting Program (HARP) (exposure assessment/dose and dose-response assessment);
- Risk characterization for the project; and
- Findings and conclusions.

Methods used in this HRA are conservative in that the methodology is more likely to overestimate than underestimate potential human health impacts. For example, exposed individuals are assumed to live or work at locations where TAC concentrations are predicted to be highest, and are also assumed to be present at these locations for 24 hours per day, 7 days per week, for 70 years (residential exposure), and for 8 hours per day, 5 days per week, for 46 years (occupational exposure). Employing these assumptions results in conservative estimates of the amount of TACs these individuals might inhale, and in conservative estimates of the potential individual health risks. The conservative methodology results in estimates of human health risks that are protective of individuals living or working in the vicinity of the UCI campus.

Estimation of TAC Emissions

As discussed above, the first step in the HRA was to estimate emissions of TACs from future UCI operations due to the implementation of the UCI 2007 LRDP. The main sources of TAC emissions include laboratory operations, fuel combustion, and vehicular emissions. TAC emissions from these sources were estimated based on current TAC emissions inventories and accounting for projected campus-wide growth. Diesel particulate from vehicles was estimated using the emission factors from the EMFAC2002 model for the truck distribution anticipated for the project.

Air Dispersion Modeling

The purpose of air dispersion modeling is to predict, based on emissions of TACs, to what concentration of TACs receptors would be exposed. The HARP, which is the OEHHA's approved model for conducting air toxics risk assessments, was used to evaluate risk to receptors. The HARP software contains the EPA's regulatory model, the Industrial Source Complex model (ISCST3), which was used to perform a refined dispersion modeling assessment to estimate Project-related pollutant concentrations from on-campus sources. The ISCST3 program provides estimates of one-hour and annual downwind concentrations. The ISCST3 thus provide an estimate of the amount of TACs to which receptors would be exposed due to operations on the UCI campus.

Both short-term (1-hour) and long-term (annual) downwind concentrations were estimated on-campus and in the vicinity of the UCI campus. A 100-meter grid was used to locate the point of maximum impact, the maximally impacted residential receptor, and the maximally impacted occupational receptor. Risks were then calculated for each receptor as discussed below.

Risk Characterization

Risk characterization involves the evaluation of potential health risks based on the amount of exposure to TACs in exposed individuals, and the exposure scenario (i.e., the environment in which receptors are exposed). For this HRA, the main exposure pathway is inhalation. In accordance with the OEHHA guidelines, the inhalation pathway must be evaluated for all TACs emitted. A small subset of TACs are subject to deposition on to the soil, plants, and water bodies. These substances should be evaluated by the appropriate noninhalation pathways as well as by the inhalation pathways. In general, the risks associated with the inhalation pathway dominated the HRA results. Noninhalation pathways were considered and eliminated from further consideration due to their insignificant contribution to predicted health risks.

The OEHHA guidelines recommend that the average and high-end risks be calculated. Both average and high-end risks were calculated for each receptor based on the predicted downwind concentration of TACs, the toxicity of each TAC, and the exposure scenario (residential, occupational, schoolchildren, etc.). Incremental cancer risks (i.e., cancer risks above background levels) and non-cancer hazards were calculated for over 2,600 receptors in the UCI campus vicinity.

Incremental health risks were compared with the SCAQMD's significance thresholds as shown in Table ES-1 below.

Table ES-1
Health Impact Significance Thresholds

Health Risk Criterion	Significance Threshold
Excess Cancer Risk	10 in a million
Population Cancer Burden	0.5
Acute Noncancer Hazard Index	1.0
Chronic Noncancer Hazard Index	1.0

Risk Assessment Results

Results of the risk assessment are summarized in Table ES-2.

Table ES-2
Summary of Risk Assessment Results

Receptor	Incremental Cancer Risk	Chronic Non-Cancer Hazard Index	Acute Non-Cancer Hazard Index
Maximally Exposed Onsite Resident Adult	6.56 in a million	0.00752	0.0534
Maximally Exposed Onsite Resident Child	1.26 in a million	0.00752	0.0534
Maximally Exposed Onsite Student	0.931 in a million	0.00752	0.0534
Maximally Exposed Individual Worker (MEIW)	8.99 in a million	0.0471	0.0613
Maximally Exposed Offsite Resident Adult	3.08 in a million	0.00567	0.0368
Maximally Exposed Offsite Resident Child	0.604 in a million	0.00567	0.0368
Significant Risk Threshold	10 in a million	1.0	1.0

As discussed above, two types of health effects were evaluated in this HRA: cancer risk, which represents the potential for increased risk of cancer in a lifetime associated with exposure to emissions from the implementation of the UCI 2007 LRDP, and non-cancer hazards (both chronic and acute) which represent the potential for a non-cancer health effect due to exposure on either a chronic or short-term basis to emissions from the UCI 2007 LRDP.

Cancer Risks

Incremental cancer risks are driven by exposure to hexavalent chromium, (accounting for 89 percent of the incremental cancer risk for the maximally exposed), with contributions from cadmium (accounting for 6.36 percent of the risk) and polycyclic aromatic hydrocarbons (PAHs) (accounting for 5.52 percent of the risk). The incremental cancer risks are below the SCAQMD significance level of 10 in a million for all receptors and all exposure scenarios. The population cancer burden, based on diesel particulate (the risk driving TAC) was calculated to be 0.0003612, which is well below the SCAQMD's acceptable cancer burden of 0.5. The emissions associated with implementation of the UCI 2007 LRDP would therefore not pose a significant incremental cancer risk to the surrounding populations.

Chronic Non-Cancer Hazards

Chronic non-cancer hazards are driven by exposure to cadmium (accounting for 83.4 percent of the hazard index) and beryllium (accounting for 13.7 percent of the risk). Chronic non-cancer hazards are below the significance threshold of 1.0 for all receptors. The emissions associated with implementation of the UCI 2007 LRDP would therefore not pose a chronic hazard to the surrounding populations.

Acute Non-Cancer Hazards

Acute non-cancer risks were driven by exposure to formaldehyde (accounting for 61.3 percent of the hazard index) and ammonia (accounting for 36.7 percent of the hazard index). The acute hazard index is below the significance threshold of 1.0 for all receptors. The emissions associated with implementation of the UCI 2007 LRDP would therefore not pose an acute hazard to the surrounding populations.

1.0 INTRODUCTION

This air toxics human health risk assessment (HRA) was prepared for the Environmental Impact Report (EIR) for the University of California Irvine (UCI) 2007 Long Range Development Plan (LRDP). The following sections present a description of the project and its vicinity and a discussion of the approach to the HRA.

1.1 Project Description

The UCI campus is located in the southern portion of the City of Irvine, Orange County, California. UCI is adjacent to the City of Newport Beach, and the City of Costa Mesa is located approximately 0.5 mile to the west of the campus. The Cities of Santa Ana and Lake Forest are situated approximately 2.5 miles to the north and 5 miles to the east, respectively. The UCI campus is bounded generally by Campus Drive and Jamboree Road on the north, Culver Drive on the east, Bonita Canyon Drive on the south, and SR-73 and MacArthur Boulevard on the west. Regional access is provided to UCI via Interstate 405 (I-405), State Route 55 (SR-55), and SR-73. Newport Coast Drive provides access to and from the beach communities to the south. The toll road extension of SR-73 provides access from areas in southern Orange County.

UCI is located in the South Coast Air Basin (SCAB). The SCAB includes Los Angeles and Orange Counties, as well as the western portions of San Bernardino and Riverside Counties.

A Long Range Development Plan (LRDP) is defined by statute as "a physical development and land use plan to meet the academic and institutional objectives for a particular campus or medical center of public higher education" (Public Resources Code Section 21080.09). UCI prepared an LRDP and a related program-level Environmental Impact Report (EIR) that were adopted by The Regents of the University of California in September 1989. The 1989 LRDP identifies the physical development and land use plan for UCI through the horizon year 2005-06. Since its adoption, the 1989 LRDP has been amended eight times, most notably the LRDP Circulation and Open Space Amendment in 1995. The 1989 LRDP and LRDP EIR, as amended, are on file with UCI and are hereby incorporated by reference into this EIR for the proposed project.

The proposed project involves updating the UCI LRDP to reflect student enrollment projections through the horizon year 2025-26. Under the state Master Plan for Higher Education, the University of California (UC) accepts students from the top 12.5 percent of California's high school graduating class each year. Demographic projections of high school graduates indicate that enrollment at UC would continue to grow steadily over the next decade. The 2007 LRDP sustains the Master Plan's principle of universal access to qualified students by providing a framework to accommodate projected enrollment growth at UCI.

The UCI campus is currently comprised of approximately 1,475 acres. Approximately 770 acres (52 percent) of the campus is currently developed, with most development focused in the central academic core. The primary areas of undeveloped property remain in the outer campus areas. The LRDP land use plan includes ten land use categories: academic and support, campus support services student housing, faculty/staff housing, housing reserve, mixed use, income-producing Inclusion Area, parking and roadways, open space – athletics and recreation, and open space - general.

This HRA was prepared as part of the UCI 2007 LRDP EIR, pursuant to the California Environmental Quality Act (CEQA). The federal and state ambient air quality standards were used to evaluate impact levels associated with the 2007 LRDP. The analysis addresses toxic air pollutant emissions and health risk impacts. Criteria pollutant impacts are evaluated in the *Air Quality Assessment - University of California Irvine 2007 Long Range Development Plan* (SRA 2006).

1.2 Risk Assessment Approach

This HRA was prepared in accordance with the California Office of Environmental Health Hazard Assessment's (OEHHA) *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (OEHHA 2003), the SCAQMD's *Risk*

Assessment Procedures for Rules 1401 and 212, Version 7.0 (SCAQMD 2005a), and the *HotSpots Analysis and Reporting Program Users Guide* (California Air Resources Board 2003). As recommended by the SCAQMD and in California Air Resources Board (ARB) guidance (ARB 2003a), the HotSpots Analysis and Reporting Program (HARP) was used to conduct the HRA. The HARP program is based on the latest ARB and OEHHA guidance, utilizing the updated health values developed by OEHHA (OEHHA 2005).

The primary objective of this HRA is to estimate upper-bound incremental excess cancer risks and non-cancer health hazards associated with implementation of the UCI 2007 LRDP. According to OEHHA, the four steps involved in the risk assessment process are 1) hazard identification, 2) exposure assessment, 3) dose-response assessment, and 4) risk characterization. The principal elements of this HRA following the OEHHA guidance, and are listed below:

- Existing conditions (Section 2)
- Estimation of toxic air contaminant (TAC) emissions from project operational sources (hazard identification) (Section 3);
- Air dispersion modeling to predict maximum concentrations of TACs using the SCAQMD and OEHHA approach (exposure assessment/exposure concentrations) (Section 4);
- Risk assessment approach to predict incremental cancer risks, chronic non-cancer, and acute non-cancer health risks, using the HARP modeling approach (exposure assessment/dose and dose-response assessment) (Section 5);
- Risk characterization (Section 6);
- Uncertainty analysis (Section 7).

References used for this HRA are listed in Section 8. Supporting information on project emissions estimation and printouts of model input/output files are presented as attachments.

2.0 EXISTING CONDITIONS

Toxic air contaminants are gases, liquids, or particles that are emitted into the atmosphere and, under certain conditions, may cause adverse health effects, including cancer, acute non-cancer, and chronic non-cancer effects. The OEHHA has compiled the health effects and health values for all toxic air pollutants into one document entitled *Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values* (OEHHA 2005), and has included these values in the Hot Spots Assessment and Reporting Program (HARP).

In March of 2000, the SCAQMD released its final report entitled *Multiple Air Toxics Exposure Study (MATES-II) in the South Coast Air Basin* (SCAQMD 2000). MATES-II contains extensive general information regarding regional ambient air toxics levels in the SCAB, and detailed information on the findings.

Two monitoring programs were conducted in the MATES-II study: the regional program and the microscale program. In the regional program, MATES-II estimates that the average excess cancer risk level from exposure to air toxics for the SCAB as a whole is approximately 1,400 in one million. According to the study, "mobile sources (e.g., cars, trucks, trains, ships, aircraft, etc.) represent the greatest contributor. About 70 percent of all risk is attributed to diesel particulate emissions; about 20 percent to other toxics associated with mobile sources; and about 10 percent of all risk is attributed to stationary sources." These estimates were based on the monitoring data collected at ten fixed sites from April 1998 through March 1999. The closest fixed-site location to the UCI campus was at 1010 South Harbor Blvd., Anaheim. Measured cancer risk, including diesel particulate, is estimated at 1,120 in a million versus high-end measured risks of 1,740 at the Los Angeles, Burbank, Huntington Park, and Pico Rivera monitoring sites. The modeled estimated cancer risk at the Anaheim station is approximately 1,330 in one million versus a modeled average of 1228 in one million in the SCAB.

As part of the overall objectives of the MATES-II, a regional model study was conducted. According to the SCAQMD (SCAQMD 2000), the regional model results "show similar levels of carcinogenic risk across the SCAB as does the monitoring data. The model results, which are more complete in describing risk levels across the SCAB than is possible with the monitored data, show that the higher risk levels occur in the south-central Los Angeles area, in the harbor area, and near freeways". The model results suggest that the basin-wide excess cancer risk level may be 16 percent lower than the corresponding risk levels estimated from the regional monitoring sites (SCAQMD 2000).

MATES-II identifies long-term downward trends of cancer risk levels in the SCAB. MATES-II states: "Data from all sites have shown a pronounced decrease in toxic levels in the Basin from 1990 through 1997. In fact, the increased probability of cancer incidence (often referred to as "carcinogenic risk") associated with exposure to air toxics has decreased by about 50 percent during this period" (SCAQMD 2000). In general, MATES-II notes a downward trend in air toxics since 1990, which has resulted in a 44 to 63 percent reduction in excess cancer risk. For the Long Beach area (the nearest MATES-II monitoring station for which comparative data were presented), the risk reduction was greater than 50 percent (SCAQMD 2000).

Diesel particulates were identified in the MATES-II study as the primary contributor to the predicted cancer risks, but MATES-II notes that trends for diesel particulates are not available from the ARB data reference entitled "Trends in Fine Particle Concentration and Chemical Composition in Southern California "(Christoforou, et al., 2000). The article indicates a decrease in elemental carbon (a surrogate for diesel particulates) from the early 1980s to the early 1990s.

3.0 TOXIC AIR CONTAMINANT EMISSIONS

According to OEHHA, air toxics sources hazard identification involves identifying if a hazard exists, and if so, identifying the exact pollutant(s) of concern and whether a pollutant is a potential human carcinogen or is associated with other types of adverse health effects. The emitted substances that should be addressed in a HRA are listed by the ARB in the California Code of Regulations, under the *Emission Inventory Criteria and Guidelines Regulations (Title 17, California Code of Regulations, Sections 93300-93300.5), and the Emission Inventory Criteria and Guidelines Report* (California Code of Regulations 2006). The list of substances also identifies those substances that are considered human carcinogens or potential human carcinogens, as well as substances that could have a non-cancer health effect.

3.1 Emissions Quantification

Toxic air contaminant emissions associated with implementation of the UCI 2007 LRDP would be expected from the following stationary sources:

- Central utilities cogeneration turbines
- Central utilities boilers
- Academic laboratory uses
- Research laboratories
- Paint spray booth
- Painting operations
- Gasoline storage and dispensing
- Refrigerant use and recovery
- Diesel-fueled emergency engines

TACs generated from these sources were estimated based on the University of California Irvine's Annual Emission Report for the year 2004-2005 as calculated by the SCAQMD. A review of the Annual Emission Report identified three processes listed above for which TAC emissions are negligible: paint spray operations, painting operations, and refrigerant use and recovery. As TAC emissions from these processes were negligible, they were not included in the HRA.

To estimate increases in stationary source emissions, it was assumed that emissions would be proportional to the developed square footage on campus. The total existing square footage was estimated at approximately 9,131,000 gross square feet based on current development and housing estimates. For the year 2025-26, the total developed square footage was estimated at approximately 20,090,000, an increase of 10,959,000 square feet, or approximately 120 percent. Accordingly, it was assumed that the on-site fuel usage in internal combustion engines and gasoline dispensing would increase by approximately 120 percent by 2025-26.

Emissions from use of laboratory chemicals in science classrooms were estimated based on the University Laboratory/Research category reported in the 2004-2005 Air Emissions Report. Current laboratory space was assumed to be located in engineering and science buildings on campus. To estimate increases in laboratory chemical use and emissions due to expansion of laboratory space, it was assumed that chemical usage would be proportional to the increases in engineering/science building space. Current engineering and science buildings comprise approximately 3,103,000 gross square feet of space on campus. The 2007 LRDP proposes an increase in engineering, science, and research and development space to approximately 7,444,000 gross square feet, for an increase of approximately 4,341,000 gross square feet, or approximately 140 percent. Accordingly, it was assumed that the university/laboratory research chemical usage would increase by approximately 140 percent by 2025-26.

In addition to the emissions associated with daily operations as characterized under existing conditions, UCI is proposing an expansion of their Central Plant to add a natural gas-fired combustion turbine unit equipped with selective catalytic reduction (SCR) to control emissions. Therefore operation of the natural gas-fired boilers in the Central Plant would not increase as increased energy demand would be met by the Central Plant expansion. TAC emissions were estimated based on information supplied by UCI in support of the permit application for the combustion turbine.

To estimate maximum daily emissions, it was assumed that the total annual emissions would be divided by 365 days per year. Based on these assumptions, TAC emissions from stationary sources are summarized in Table 3-1.

Table 3-1
Summary of Estimated Operational TAC Stationary Source Emissions
Lbs/year

Toxic Air Contaminant	CAS	Gas Turbine	B1-1 Boiler	B1U-1 Boiler	B1U-2 Boiler	B1U-3 Boiler	B1U-4 Boiler	B1U-5 Boiler	B2-1 ICE	B4-1 Gasoline Storage & Dispensing	B4U-1 thru B4U-33 Laboratory
Ammonia	7664417	15,182.8	5585.4	2275.2	94.68	99.18	312.46	73.26	12.95		1.54
Acetaldehyde	75070	61.1									
Acrolein	107028	11.3									
Asbestos	1332214										
Benzene	71432	21.6	1.80	1.01	0.042	0.044	0.14	0.033	0.83	4.33	5.31
Beryllium	7440417										0.081
1,3-Butadiene	106990	0.63							0.97		2.30
Cadmium	7440439								0.0067		1.28
Carbon Tetrachloride	56235										2.80
1,4-Dioxane	123911										5.87
Ethylbenzene	100414	51.8									
Ethylene Dibromide	106934										3.15
Ethylene Dichloride	107062										4.03
Ethylene Oxide	75218										0.036
Formaldehyde	50000	1,055.3							7.71		1.16
Hexane	110543	3.11									
Hexavalent Chromium	18540299		3.82	2.15	0.089	0.094	0.30	0.069	0.0004		0.50
Inorganic Arsenic	7440382								0.0071		0.0032
Lead	7439921								0.037		0.18
Methylene Chloride	75092										40.00
Nickel	7440020								0.017		0.089
Perchloroethylene	127184										1.13
PAHs		1.40							0.16		
Propylene Oxide	75569	42.8									
Toluene	108883	210.3									
Trichloroethylene	79016		0.031	0.013	0.00053	0.00055	0.0017	0.000407			8.33

Table 3-1 (continued)
Summary of Estimated Operational TAC Stationary Source Emissions
Lbs/year

Toxic Air Contaminant	CAS	Gas Turbine	B1-1 Boiler	B1U-1 Boiler	B1U-2 Boiler	B1U-3 Boiler	B1U-4 Boiler	B1U-5 Boiler	B2-1 ICE	B4-1 Gasoline Storage & Dispensing	B4U-1 thru B4U-33 Laboratory
Vinyl chloride	75014										0
1,1,1-TCA	71556										7.25
Xylene	1330207	107.8									
Naphthalene	91203	2.13							0.088		
Dichlorofluoromethane	75434										5.18

Source: 2004-2005 Annual Emissions Report, S

3.2 Vehicular Emissions

Implementation of the UCI 2007 LRDP will result in increases in traffic due to increased enrollment at UCI. Traffic increases are projected in the *University of California Irvine Long Range Development Plan Update Traffic Study* (Austin-Foust Associates, Inc. 2006). According to the Traffic Study, implementation of the LRDP update, as compared with the current LRDP, is anticipated to result in 18,222 additional average daily trips (ADTs).

Emissions associated with vehicular traffic were estimated using the URBEMIS2002 model. As projected by the URBEMIS 2002 model, less than 2 percent of the total traffic generated would be attributable to diesel truck traffic. In general, increased vehicle trips associated with implementation of the UCI 2007 LRDP would consist of personal vehicles for commuting to and from UCI. Thus implementation of the UCI 2007 LRDP would not generate or attract a substantial amount of heavy-duty diesel-fueled vehicles and a mobile source health risk assessment was not conducted.

4.0 AIR DISPERSION MODELING

Air dispersion modeling was used to predict the downwind concentration of TACs to which receptors could be exposed. Air dispersion modeling is dependent on the emissions of TACs, the location of sources, and the site-specific meteorology of the impacted area. The air dispersion modeling was performed in accordance with U.S. EPA, ARB, and SCAQMD modeling guidelines. Results of the air dispersion analysis were used in conjunction with TAC emission rates described in Section 3.0 to calculate maximum TAC concentrations to which receptors could be exposed.

ISCST3 is the U.S. EPA's recommended model as specified in Appendix A of the *Guideline on Air Quality Models (*published as Appendix W of 40 CFR Part 51). ISCST3 is used for regulatory air quality assessments of industrial facilities with multiple emission sources and is recommended in the OEHHA *Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments* (OEHHA 2003).

ISCST3 is a steady-state Gaussian plume model that can be used to assess pollutant concentrations from a wide variety of sources associated with an industrial complex. The short-term version of the model (ISCST3) accepts hourly meteorological data records to analyze the conditions of plume rise, transport, and diffusion. The model estimates hourly concentrations for each source and receptor combination included in a simulation and calculates average concentrations for various user-selected short-term periods and for annual or longer averaging periods. ISCST3 was used in the local-scale modeling analysis in the SCAQMD MATES-II study (SCAQMD 2000).

Preprocessed meteorological data for use in ISCST3 were obtained from the SCAQMD's website. Data from the Anaheim monitoring station, the closest monitoring station to the site, were used in the air dispersion modeling analysis. In this HRA, ISCST3 model options are consistent with those used by the SCAQMD MATES-II study and recommended by the SCAQMD. The model was run using regulatory default parameters as recommended by the EPA (EPA 1995), except that the "no calms" processing option was selected to address calm hours in the meteorological data set. The model was run using urban dispersion parameters.

The ISCST3 model contained within the HARP software (ARB 2003) was used to estimate downwind concentrations. The HARP model has certain limitations in how receptors can be designated. For example, the HARP model allows for only one receptor grid to be established for any single ISCST3 model run. The HARP model does not allow variation in grid spacing, nor does the model allow elimination of grid receptors located within facility boundaries. Receptor grids were established to identify the specific locations where TAC concentrations would be predicted.

Land uses in the surrounding area include residential and commercial areas in the immediate vicinity of UCI, student housing on campus, and faculty housing on campus. A receptor grid was set up in the on-campus housing areas to address on-site impacts. Figure 1 shows the on-campus sources and receptors included in the analysis. In addition, a 100-meter grid was set up to evaluate off-site risks.

The ISCST3 model predicts annual average and maximum short term ground-level concentrations at each receptor. Thus the ISCST3 model provides an estimate of the exposure to TAC emissions from the project at each receptor. The health risk calculations contained within the HARP model utilize ground-level concentrations predicted by the ISCST3 model and estimated TAC emissions for each source to estimate the exposure concentration at each receptor. Appendix A provides portions of the summaries of ISCST3 input/output files for the project. A list of the health risk assessment modeling files is provided in Appendix A.

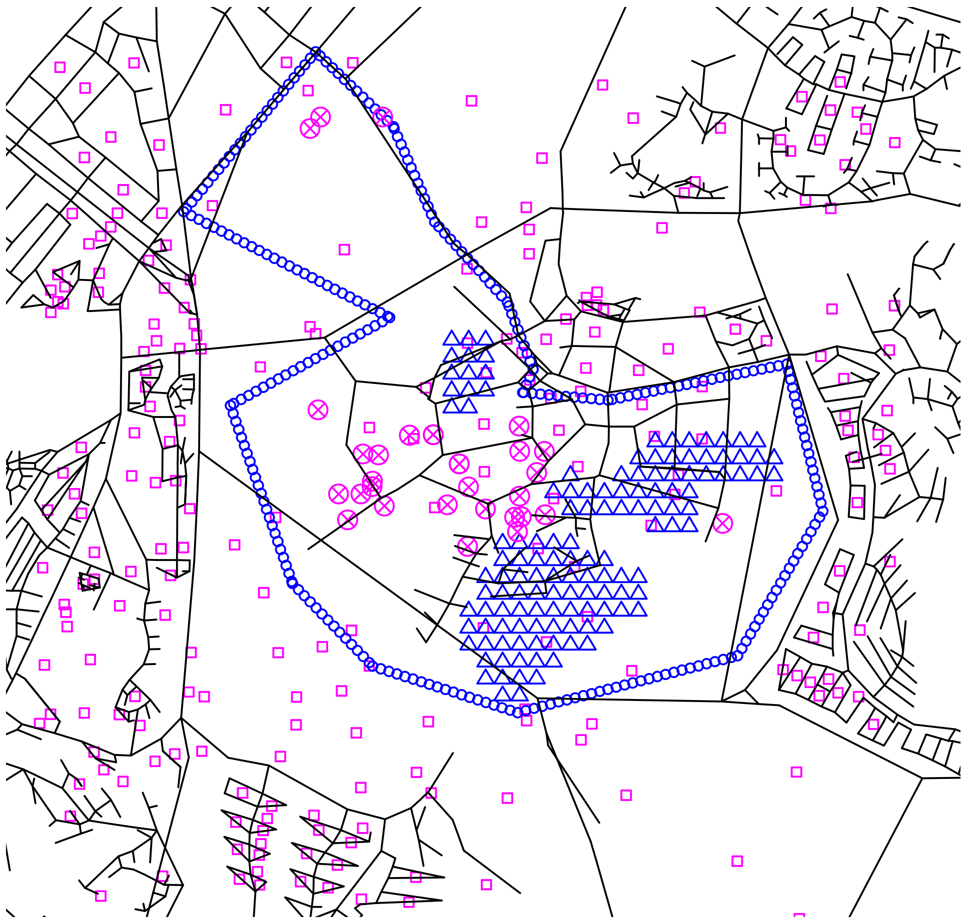

Figure 1. UCI Campus boundary, onsite Sources, sensitive receptors, and census tracts

5.0 EXPOSURE AND TOXICITY ASSESSMENT

Under the OEHHA and U.S. EPA guidance, risk assessments for TACs consist of dispersion modeling of air toxics emissions to predict their downwind concentrations at the ground level. The methodology uses the model results in estimating potential health risks associated with exposure at the predicted concentrations. This section of the report describes the exposure assessment procedures that were used to calculate the exposure point concentrations used in the HRA calculations and the resulting health risk calculations.

5.1 Exposure Assumptions

Exposure is defined in EPA human risk assessment guidelines as the contact of a human with a chemical or physical agent (EPA 1989, 1992). The exposure assessment determines the quantities or concentrations of the risk agents received by the potentially exposed populations and receptors. Exposure assessment's emphasis is on calculating risk to maximally exposed individuals or small populations based on an exposure scenario evaluation. This assessment is generally performed by separately determining the concentrations of chemicals in a medium or at a location of interest and combining this information with the time that individuals or populations contact the chemicals.

For this HRA, the exposure assumptions dictated by the OEHHA guidelines (OEHHA 2003) were used to assess potential human health risks. In order to determine the total dose to the receptor, the applicable pathways of exposure need to be identified. As stated in the guidelines, the inhalation pathway must be evaluated from all TACs emitted. In addition, a small subset of substances may be subject to deposition on the soil, plants, and water bodies. These substances must be evaluated by the appropriate noninhalation pathways (i.e., multipathway evaluation) as well as by the inhalation pathway, and the results must be presented in all HRAs.

Methods used in this HRA are conservative in that they are more likely to overestimate than underestimate the potential human health risks. For example, risks and hazards are calculated for individuals at locations where ground-level concentrations of TACs are predicted by the air dispersion modeling to be the highest. Further, individuals are assumed to be exposed in residential and occupational exposure scenarios for long durations. Resulting incremental cancer risk estimates represent upper-range predictions of exposure and therefore health risks which may be associated with exposure to emissions from UCI operations. Furthermore, the toxicity values (i.e., the values for each chemical at which an adverse health risk is predicted) are designed to be health-protective and are therefore also conservative. Thus the risks calculated for the project are anticipated to represent upper-bound risks rather than actual values for each individual.

A list of multipathway substances and the potential routes of exposure is provided in Table 5-1 of the OEHHA guidelines. The following substances were reported in the 2004-2005 Air Emissions Report: cadmium, hexavalent chromium, arsenic, beryllium, lead, and nickel. Accordingly, multi-pathway exposures (i.e., exposure through soil, dermal exposure, ingestion of plants, etc.) were considered in this risk assessment. OEHHA guidelines require that for residential exposures soil ingestion and dermal exposure be considered. It was assumed that the contribution to the overall health risks associated with the project emissions due to other pathways (i.e., ingestion of plants, fish ingestion, etc.) would be minor in comparison with the contribution to the health risks associated with the other exposure pathways.

To estimate potential incremental cancer risks and the potential for adverse chronic non-cancer health hazards to exposures, the dose through inhalation of TACs were calculated for the inhalation pathway. The equation for dose through inhalation (Dose-inh) is as follows:

$$\text{Dose-inh} = (C \times DBR \times A \times EF \times ED)/(AT)$$

Where:

Dose-inh	=	Chronic daily intake, mg/kg body weight per day
C	=	Ground-level concentration of TAC to which the receptor is exposed, micrograms/cubic meter
DBR	=	Daily breathing rate, liters per kilogram body weight per day
A	=	Inhalation absorption factor (assumed to be 1)
EF	=	Exposure frequency, days/year
ED	=	Exposure duration, years
AT	=	Averaging time, days (assumed to be 25,550 days for a 70-year cancer risk)

The dose through soil ingestion and dermal absorption of TACs is based on the average concentration of a substance in soil. The average concentration of a substance in soil (Cs) is a function of the deposition, accumulation period, chemical specific soil half-life, mixing depth, and soil bulk density. The equation for concentration in soil is as follows:

$$Cs = (Dep \times X)/(K_s \times SD \times BD \times T_t)$$

Where:

Cs	=	Average soil concentration over the evaluation period, µg/kg
Dep	=	Deposition on the affected soil area per day, $\mu g/m^2/d$
X	=	Integral function
K_s	=	Soil elimination constant
SD	=	Soil mixing depth, m
BD	=	Soil bulk density, kg/m^3 (assumed to be 1,333)
T_t	=	25,550 days, or 70 years

Deposition is defined as follows:

$$Dep = (GLC \times Dep\text{-}rate \times 86{,}400)$$

Where:

Dep	=	Deposition on the affected soil area per day, $\mu g/m^2/d$
GLC	=	Ground-level concentration, $\mu g/m^3$
Dep-rate	=	Vertical rate of deposition, m/sec (0.02 meters/second for controlled sources)

The integral function is defined as follows:

$$X = [\{e^{-Ks*Tf} - e^{-Ks*T0}\}/K_s] + T_t$$

Where:

X	=	Integral function
K_s	=	Soil elimination constant
T_f	=	End of evaluation period, days (25,550 days)
T_0	=	Beginning of evaluation period, days (0 days)
T_t	=	Total days of exposure period $T_f - T_0$, days

The soil elimination constant is defined as follows:

$$K_s = 0.693/ t_{1/2}$$

Where:

K_s	=	Soil elimination constant
0.693	=	Natural log of 2
$t_{1/2}$	=	Chemical specific soil half-life, days (in OEHHA guidelines)

The dose through soil ingestion of TACs is calculated as follows:

$$\text{Dose} = (\text{Cs x GRAF x SIR x EF x ED x } 10^{-9})/\text{AT}$$

Where:

Cs	=	Average soil concentration over the evaluation period, µg/kg
GRAF	=	Gastrointestinal relative absorption fraction, unitless
SIR	=	Soil ingestion rate, mg/kg BW x day
EF	=	Exposure frequency, days/year
ED	=	Exposure duration, years
AT	=	Averaging time, days (assumed to be 25,550 days for a 70-year cancer risk)

The dose through soil dermal absorption of TACs is calculated as follows:

$$\text{Dose-dermal} = (\text{Cs x SA x SL x EF x ABS x } 10^{-9} \text{ x ED})/(\text{BW x AT})$$

Where:

Cs	=	Average soil concentration over the evaluation period, µg/kg
SA	=	Surface area of exposed skin, cm^2
SL	=	Soil loading on skin, mg/cm^2 - day
ABS	=	Fraction absorbed across skin
EF	=	Exposure frequency, days/year
ED	=	Exposure duration, years
AT	=	Averaging time, days (assumed to be 25,550 days for a 70-year cancer risk)

The exposure scenarios identified for the health risk assessment for the UCI 2007 LRDP included the following:

- Adult occupational exposure
- Adult residential exposure – 70-year exposure scenario and 9-year exposure scenario (student)
- Child residential exposure

Each exposure scenario has a unique set of exposure parameters (inhalation rates, exposure frequencies, body weights, etc.) These parameters are discussed below for each exposure scenario.

5.1.1 Adult Occupational Exposure

Adults working at UCI and at businesses near UCI could be exposed to TACs mainly through inhalation during a normal workday. In accordance with OEHHA guidelines workers are assumed to be exposed for 8 hours per day, 245 days per year, for a 40-year period. The average worker body weight and breathing rates are assumed to be greater than those for the average residential population.

5.1.2 Adult Residential Exposure

Adult residents living on campus or near the UCI campus could be exposed to TACs mainly through inhalation. As discussed above, multipathway risks would not contribute to the overall incremental cancer or non-cancer risks associated with UCI operations. In accordance with OEHHA guidelines, residents are assumed to be exposed for 24 hours per day, 350 days per year, for a 70-year period. To address UCI student exposure in on-campus residences, the 9-year adult residential exposure scenario recommended in OEHHA guidelines was used.

5.1.3 Child Residential Exposure

Children living on campus or near the UCI campus could also be exposed to TACs mainly through inhalation. In accordance with OEHHA guidelines, child residents are assumed to be exposed for 24 hours per day, 350 days per year, for a 9-year period. For conservative purposes, it was assumed that schoolchildren could be exposed in the same exposure scenario as for child residents.

Table 5-1 presents the exposure assumptions for the pathways considered in this HRA.

Table 5-1
Exposure Assumptions

Parameter	Adult Residential	Adult Student Residential	Child Residential	Occupational
Exposure Duration, years	70	9	9	40
Exposure Frequency, days/year	365	365	365	245
Body Weight, kilograms	63	63	18	70
Breathing Rate, Liters/kilogram Body Weight * day	393	393	581	149
Soil Loading, mg/cm^2 - day	1.0	1.0	1.0	1.0
Surface Area Exposed, cm^2	5,500	5,500	3,044	5,800
Soil Ingestion Rate, mg/kg BW x Day	1.7	1.7	8.7	1.4

5.2 Dose-Response Assessment

This section of the HRA presents the toxicity information for the substances emitted from UCI operations.

Dose-response assessment describes the quantitative relationship between the amount of exposure to a substance (the dose) and the incidence or occurrence of injury (the response). The process often involves establishing a toxicity value or criterion to use in assessing potential health risk. The toxicity criterion, or health guidance value, for carcinogens is the cancer potency slope (potency factor), which describes the potential risk of developing cancer per unit of average daily dose over a 70-year lifetime. Cancer potency factors are typically expressed as an upper bound probability of developing cancer assuming continuous lifetime exposure to a substance at a dose of one milligram per kilogram of body weight, and are expressed in units of inverse dose as a potency slope [i.e., $(mg/kg/day)^{-1}$]. For air toxics risk assessments, cancer inhalation and oral potency factors have been recommended by OEHHA and/or the U.S. EPA with endorsement by OEHHA.

Non-cancer health risks (chronic and acute) are characterized by comparing the exposure to a concentration or dose at or below which adverse effects are not likely to occur following specified exposure conditions. These concentrations or doses are called Reference Exposure Levels (RELs). As stated in the OEHHA guidance, it should be emphasized that exceeding the acute or chronic REL does not necessarily indicate that an adverse health effect will occur. Levels of exposure above the REL have an increasing but undefined probability of resulting in an adverse health impact. RELs are designed to take into account exposure of sensitive populations (e.g., the very young, the elderly, those with chronic respiratory disease) and are thus intended to be health protective. Chronic RELs are levels above which prolonged exposure may have an adverse health effect, and acute RELs are levels above which short-term exposure (generally one-hour, but for some substances longer averaging times are used) may have an adverse health effect. To assess whether exposure to a substance has the potential for an adverse health effect, the exposure concentration is divided by the REL to calculate a Hazard Quotient (HQ) for that substance.

For the purpose of this HRA, the estimated excess cancer risks are considered to be additive, without taking into account any difference in cancer target, or any antagonistic or synergistic effects. Likewise, for conservative purposes, the HQs for all non-cancer substances were added to calculate an overall Hazard Index (HI), regardless of target organ systems for individual substances.

OEHHA has developed a table of health data for toxic air contaminants that must be used to estimate risk for HRAs conducted in accordance with the OEHHA guidance. The most recent health data were obtained from OEHHA in August 2005 (OEHHA 2005) and are incorporated in the HARP software. Table 5-2 presents a summary of the toxicity factors for each of the emitted substances identified for UCI operations. For those substances with non-cancer health impacts, Table 5-2 also shows the target organ system.

Table 5-2
Toxicity Factors

Substance	Inhalation Unit Risk Factor $(\mu g/m^3)^{-1}$	Chronic Inhalation Reference Exposure Level $(\mu g/m^3)$	Target Organ Systems	Acute Reference Exposure Level $(\mu g/m^3)$	Target Organ Systems
Ammonia	N/A	200	RES	3,200	RES
Acetaldehyde	2.7E-06	9.0	RES	N/A	
Acrolein	N/A	0.06	E, RES	0.19	E; RES
Asbestos	1.9E-04	N/A		N/A	
Benzene	2.9E-05	60	DEV, H, CV, CNS	1,300	H, I, REP
Beryllium	2.4E-03	0.007	LIV, I, RES	N/A	
1,3-Butadiene	1.7E-04	20	REP	N/A	
Cadmium	4.2E-03	0.02	KID, RES	N/A	
Carbon Tetrachloride	4.2E-05	40	CNS, DEV, LIV	1,900	CNS, DEV, LIV, REP
1,4-Dioxane	7.7E-06	3,000	CV, LIV, KID	3,000	E, RES
Ethylbenzene	N/A	2,000	LIV, DEV, END, KID	N/A	
Ethylene Dibromide	7.1E-05	0.80	REP	N/A	
Ethylene Dichloride	2.1E-05	400	LIV	N/A	
Ethylene Oxide	8.8E-05	30	CNS	N/A	
Formaldehyde	6.0E-06	3.0	E, RES	94	E, I, RES
Hexane	N/A	7,000	CNS	N/A	
Hexavalent Chromium	1.5E-01	0.20	RES	N/A	
Inorganic Arsenic	3.3E-03	0.03	DEV, CV, CNS	0.19	REP
Lead	1.2E-05	N/A		N/A	
Methylene Chloride	1.0E-06	400	CV, CNS	14,000	CNS
Nickel	2.6E-04	0.05	H, RES	6.0	I, RES
Perchloroethylene	5.9E-06	35	LIV, KID	20,000	CNS, E, RES
PAHs	1.1E-03	N/A		N/A	
Propylene Oxide	3.7E-06	30	RES	3,100	
Trichloroethylene	2.0E-06	600	CNS, EYE	N/A	
Toluene	N/A	300	CNS, DEV, RES	37,000	
Vinyl chloride	7.8E-05	26		180,000	
1,1,1-TCA	N/A	1,000	CNS	68,000	CNS
Xylenes	N/A	700	CNS, RES	22,000	E, RES
Naphthalene	3.4E-05	9.0	RES	N/A	
Dichlorofluoromethane	N/A	700	CNS	N/A	

NOTES: CV = cardiovascular; CNS = central nervous system; DEV = developmental; END = endocrine system; E = eye irritation; H = hematopoeic system; I = immune system; KID = kidney; LIV = liver; RES = respiratory ; REP = reproductive system;

It should be noted that OEHHA has designed these toxicity values to be health-protective for sensitive subpopulations.

6.0 RISK CHARACTERIZATION

Risk characterization is the culmination of the risk assessment process; it integrates the results of the identification of chemicals of potential concern, exposure assessment, and toxicity assessment to describe the risks to individuals and populations in terms of extent and severity of probable adverse health risks under both current and future land use conditions. In this HRA, the health risk characterization process involves integrating the exposure intakes and the toxicity values to estimate two types of potential health effects: carcinogenic and noncarcinogenic. Potential adverse health effects from noncarcinogens were further divided into an assessment of potential acute and chronic exposures. Because the development of carcinogenic and noncarcinogenic effects are assumed to be caused by different mechanisms of action, different methods are used to evaluate these effects.

6.1 Risk Characterization Methodologies

The following subsections present the approach to calculating carcinogenic and noncarcinogenic risks in this HRA.

6.1.1 Carcinogenic Risk Characterization Methodology

Carcinogenic risk characterization methodology stems from the current regulatory assumption that chemicals causing cancer may not have a threshold (i.e., a carcinogen produces a risk of causing cancer at any level of exposure). It should be noted that people are exposed to numerous chemicals from natural and artificial sources, and this background exposure may exceed the risk threshold considered to be acceptable for a particular cancer-causing mechanism. Moreover, some people may be more susceptible to cancer than others, which means that background levels of exposure may already exceed the risk threshold values for those individuals and not for others that are equally exposed. On the basis of these reasons, EPA scientists emphasize that background levels of exposure to cancer-causing agents are already initiating the carcinogenic process (EPA 1989). The HRA focuses on the incremental potential cancer risk associated with exposure to facility emissions and, therefore, does not account for natural background or individual habits/occupations separate from those associated with the facility.

In assessing the carcinogenic effects resulting from exposures to environmental contaminants, the lifetime excess cancer risk, which is considered to be the risk of developing cancer above the background risk level, is calculated using the following equation:

$$\text{Inhalation Dose (mg/kg-day) x Cancer Potency (mg/kg-day)}^{-1} = \text{Cancer Risk}$$

In accordance with OEHHA guidance, a 70-year inhalation cancer risk evaluation is required for all carcinogenic risk assessments. Cancer risk is calculated by multiplying the inhalation dose by the inhalation cancer potency factor to yield the potential inhalation excess cancer risk. The cancer risk is expressed as increased chance during a 70-year exposure period of cancer. For worker exposure, the standard default assumption is that the worker is present for 5 days per week, 49 weeks per year, for 40 years. For exposure of children to TACs, the 9-year child residential exposure algorithms in the HARP software were used. These assumptions were used to evaluate risks to children in both a residential and school scenario.

For exposure to multiple chemicals or mixtures, the total risk is conservatively estimated by summing the excess cancer risks for all chemicals for all routes of exposure. The additive model is based on the assumption that the chemicals being considered independently have the same mode of action and elicit the same effects. For carcinogenic effects, the total excess cancer risk estimate might be conservative because the upper 95th percentile cancer slope factors (used to derive cancer potency factors) are not strictly additive. The assumption that all cancer risks are additive does not take into account carcinogens with different weights of evidence or tumor sites.

Two types of cancer risks were estimated in this HRA: individual excess cancer risk and population cancer burden. The individual excess cancer risk (for inhalation and multipathway exposures) represent the potential risk to a single maximally exposed individual who may be exposed over a 70-year lifetime to a facility's emissions for a residential exposure (or a 40-year work lifetime for occupational exposure). Population cancer burden is an estimate of the increased number of cancer cases in a population as a result of exposure to emitted substances. For each population unit, the cancer burden is calculated for both residential and occupational populations. The excess cancer burden for a population unit is the product of the exposed population and the estimated individual risk of that population (i.e., exposure concentrations are based on the average over that population presumed to be at the population centroid) associated with exposure through all exposure routes to emissions from the facility. A significant cancer burden would be predicted if the cancer burden is greater than 1.

6.1.2 Noncarcinogenic Risk Characterization Methodology

Noncarcinogenic impacts are determined for acute (inhalation exposure) and for both inhalation and oral chronic exposure. Estimate of health impacts from noncancer endpoints are expressed as a hazard quotient (HQ) (for individual substances) or a hazard index (HI) (for multiple substances). An HQ of one or less indicates that adverse health effects are not expected to result from exposure to emissions of that substance. For conservative purposes for this HRA, the HQs calculated for exposure to all non-cancer substances emitted from the UCI campus were summed to estimate the HI.

HQs are calculated by dividing the exposure concentration by a reference exposure level. Reference exposure levels are defined as the concentration to which a receptor could be exposed below which no adverse health effects are anticipated.

The acute HI is based on the highest short-term ground level air concentrations and acute reference exposure level. The chronic inhalation HI is based on the annual average ground level concentration divided by the chronic reference exposure level. Generally, the inhalation pathway is the largest contributor to the total dose.

6.2 Risk Assessment Results

This section of the report presents the results of the risk calculations.

As described in Section 6.1.1, both individual and population carcinogenic risks were estimated in the HRA. The approach to calculating individual excess cancer risk for the inhalation pathway involved multiplying the predicted concentration for each carcinogenic toxic air contaminant at each receptor by the breathing rate for that receptor and the cancer potency factor for that contaminant. The total excess cancer risk for an individual receptor is the sum of the excess cancer risk for each contaminant at that receptor.

The following subsections discuss the risks predicted for the maximally exposed individual worker, adult onsite resident, student onsite resident, adult offsite resident, and risks to children exposed in a residential and/or school setting both onsite and offsite.

6.2.1 Maximally Exposed Individual Worker

The maximally exposed individual worker, assumed to be onsite, would be located in the central campus area. The incremental excess cancer risk for the maximally exposed individual worker was predicted to be 8.99 in a million. This incremental cancer risk is below the SCAQMD significant risk threshold of 10 in a million.

The chronic hazard index was predicted to be 0.0471. This value is below the SCAQMD significance threshold of 1.0. The acute hazard index was predicted to be 0.0613, which is also below the SCAQMD significance threshold of 1.0.

6.2.2 Maximally Exposed Offsite Resident (Adult)

The location of the maximally exposed offsite resident is in the residential area just to the north and east of the central campus area. The incremental cancer risk predicted for the maximally exposed offsite adult resident was predicted to be 3.08 in a million. This incremental cancer risk is below the SCAQMD significant risk threshold of 10 in a million.

The chronic hazard index at this receptor was predicted to be 0.00567, which is below the SCAQMD significance threshold of 1.0. The maximally exposed offsite resident for acute risk was located to the south of the faculty housing area. The acute hazard index was predicted to be 0.0368, which is below the SCAQMD significance threshold of 1.0.

6.2.3 Maximally Exposed Offsite Resident (Child)

Incremental cancer risks and chronic non-cancer risks associated with child residential exposure based on a 9-year exposure scenario were calculated using the HARP software. The location of the residential offsite child receptor was the same as the adult residential receptor. The incremental cancer risk predicted for the maximally exposed offsite child resident was predicted to be 0.607 in a million. This incremental cancer risk is below the SCAQMD significant risk threshold of 10 in a million.

Chronic and acute hazards were not adjusted for child residential exposure.

6.2.4 Maximally Exposed Onsite Resident (Adult)

The location of the maximally exposed onsite resident is in the faculty residential area to the south of the central campus area. The incremental cancer risk predicted for the maximally exposed onsite adult resident was predicted to be 6.56 in a million. This incremental cancer risk is below the SCAQMD significant risk threshold of 10 in a million.

The chronic hazard index at this receptor was predicted to be 0.00752, which is below the SCAQMD significance threshold of 1.0. The acute hazard index was predicted to be 0.0534, which is below the SCAQMD significance threshold of 1.0.

6.2.5 Maximally Exposed Onsite Resident (Child)

Incremental cancer risks and chronic non-cancer risks associated with child residential exposure were based on a 9-year exposure scenario calculated using the HARP software. The location of the residential onsite child receptor was the same as the adult residential receptor. The incremental cancer risk predicted for the maximally exposed onsite child resident was predicted to be 1.26 in a million. This incremental cancer risk is below the SCAQMD significant risk threshold of 10 in a million.

Chronic and acute hazards were not adjusted for child residential exposure.

6.2.6 Maximally Exposed Onsite Resident (Student)

Incremental cancer risks and chronic non-cancer risks associated with student residential exposure were based on a 9-year adult exposure scenario calculated using the HARP software. The location of the maximally exposed onsite student resident is in the central campus Middle Earth residential area just to the east of the central campus area. The incremental cancer risk predicted for the maximally exposed onsite student resident was predicted to be 0.931 in a million. This incremental cancer risk is below the SCAQMD significant risk threshold of 10 in a million.

Chronic and acute hazards were assumed to be the same as for the onsite adult resident.

The results of the risk assessment are summarized in Table 6-1.

Table 6-1
Summary of Risk Assessment Results

Receptor	Incremental Cancer Risk	Chronic Non-Cancer Hazard Index	Acute Non-Cancer Hazard Index
Maximally Exposed Onsite Resident Adult	6.56 in a million	0.00752	0.0534
Maximally Exposed Onsite Resident Child	1.26 in a million	0.00752	0.0534
Maximally Exposed Onsite Student	0.931 in a million	0.00752	0.0534
Maximally Exposed Individual Worker (MEIW)	8.99 in a million	0.0471	0.0613
Maximally Exposed Offsite Resident Adult	3.08 in a million	0.00567	0.0368
Maximally Exposed Offsite Resident Child	0.604 in a million	0.00567	0.0368
Significant Risk Threshold	10 in a million	1.0	1.0

As discussed above, two types of health effects were evaluated in this HHRA: cancer risk, which represents the potential for increased risk of cancer in a lifetime associated with exposure to emissions from the implementation of the UCI 2007 LRDP, and non-cancer hazards (both chronic and acute) which represent the potential for a non-cancer health effect due to exposure on either a chronic or short-term basis to emissions from the UCI 2007 LRDP.

6.2.7 Cancer Risks

Incremental cancer risks are driven by exposure to hexavalent chromium, (accounting for 89 percent of the incremental cancer risk for the maximally exposed), with contributions from cadmium (accounting for 6.36 percent of the risk) and polycyclic aromatic hydrocarbons (PAHs) (accounting for 5.52 percent of the risk). The incremental cancer risks are below the SCAQMD significance level of 10 in a million for all receptors and all exposure scenarios. The population cancer burden, based on diesel particulate (the risk driving TAC) was calculated to be 0.0003612, which is well below the SCAQMD's acceptable cancer burden of 0.5. The emissions associated with implementation of the UCI 2007 LRDP would therefore not pose a significant incremental cancer risk to the surrounding populations. Figures 2 through 5 present the excess cancer risk contours.

6.2.8 Chronic Non-Cancer Hazards

Chronic non-cancer hazards are driven by exposure to cadmium (accounting for 83.4 percent of the hazard index) and beryllium (accounting for 13.7 percent of the risk). Chronic non-cancer hazards are below the significance threshold of 1.0 for all receptors. The emissions associated with implementation of the UCI 2007 LRDP would therefore not pose a chronic hazard to the surrounding populations.

6.2.9 Acute Non-Cancer Hazards

Acute non-cancer risks were driven by exposure to formaldehyde (accounting for 61.3 percent of the hazard index) and ammonia (accounting for 36.7 percent of the hazard index). The acute hazard index is below the significance threshold of 1.0 for all receptors. The emissions associated with implementation of the UCI 2007 LRDP would therefore not pose an acute hazard to the surrounding populations.

In conclusion, this HRA has been conducted based on the recommendations of ARB, OEHHA and the SCAQMD. It is not intended to represent an estimate of the true risks associated with potential exposures to toxic air contaminants emitted from the facility. Rather, the uncertainties inherent in the risk assessment methodology used in this HRA lead to an upper-bound estimate of potential human health risks.

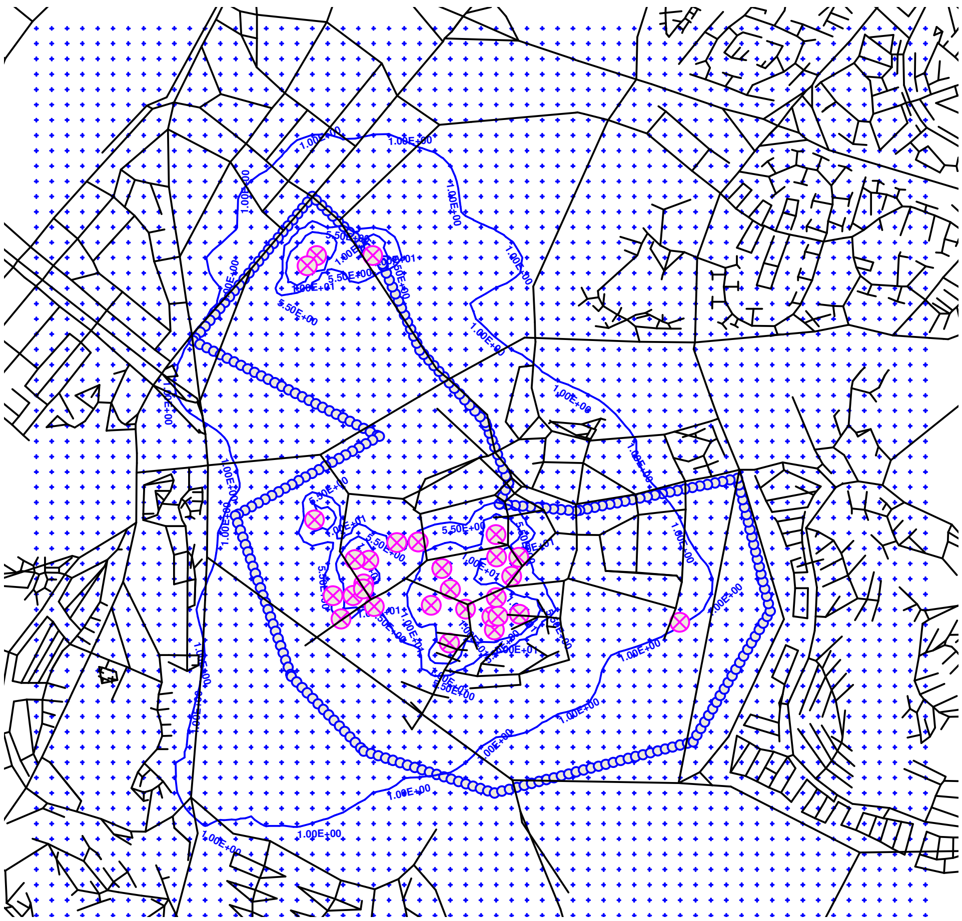

Figure 2. Excess Cancer Risk Contours, 70-year Residential Exposure Scenario

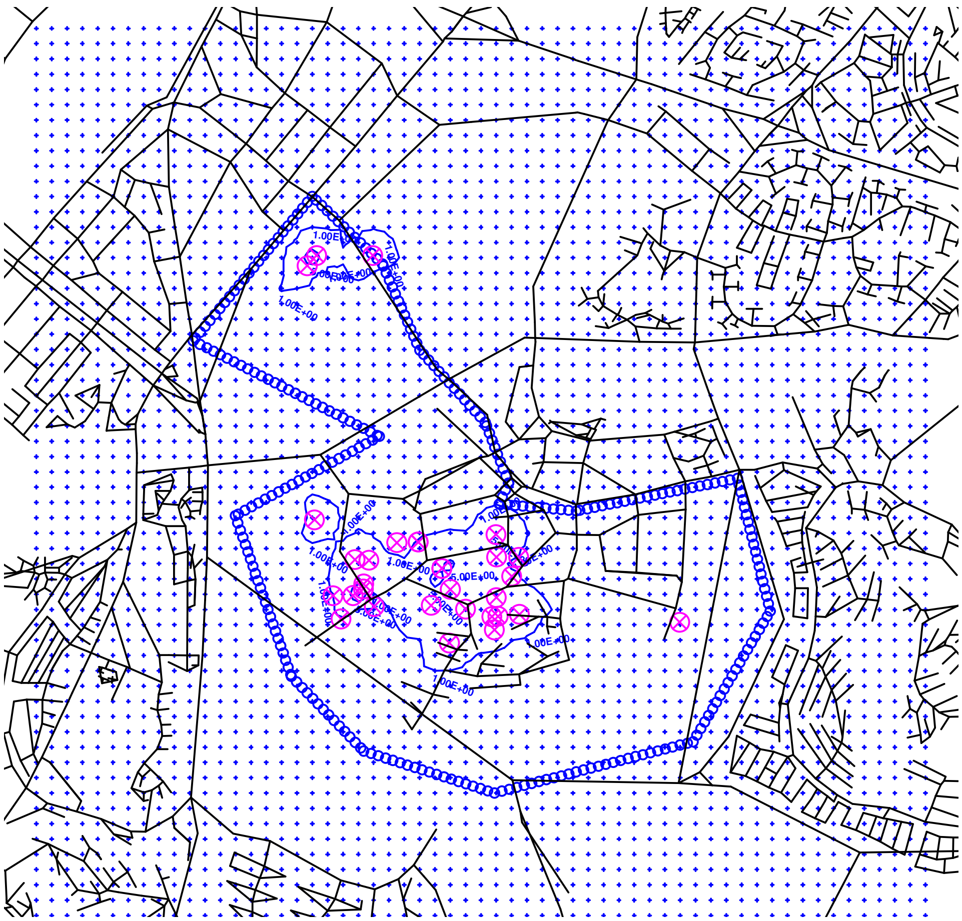

Figure 3. Excess Cancer Risk Contours, Worker Exposure Scenario

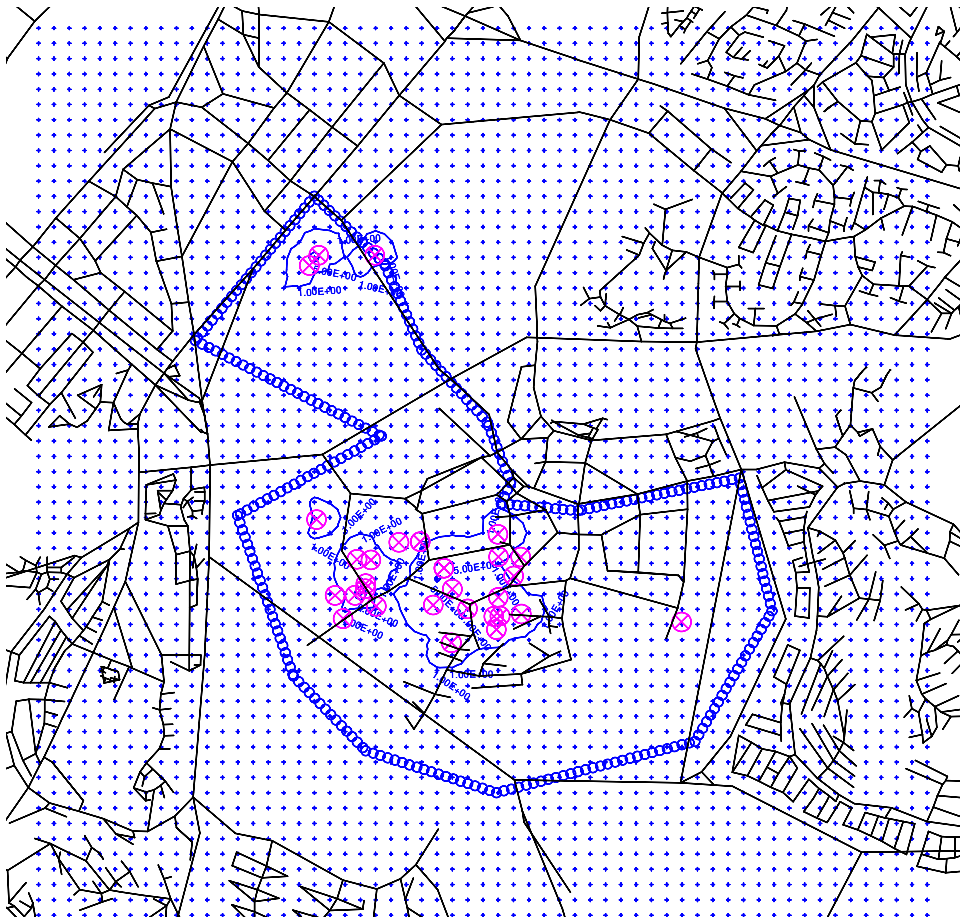

Figure 4. Excess Cancer Risk Contours, Student Exposure Scenario

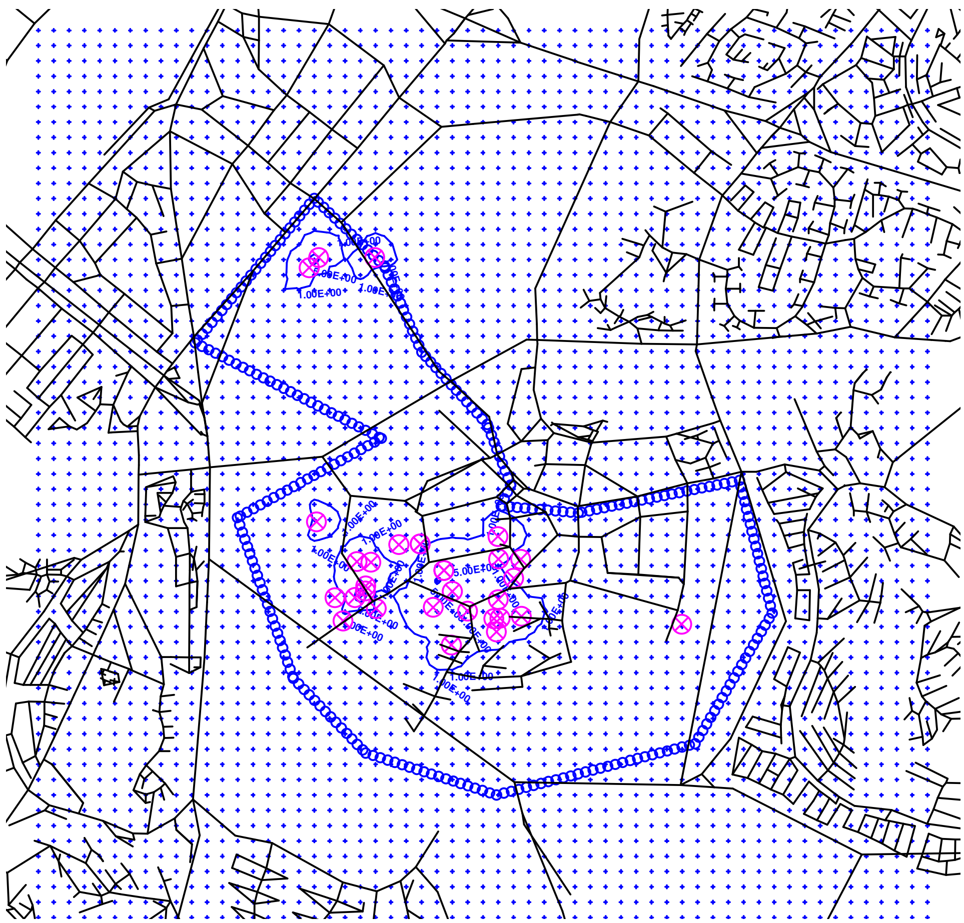

Figure 5. Excess Cancer Risk Contours, 9-year Child Exposure Scenario

7.0 UNCERTAINTY EVALUATION

Uncertainties in HRAs essentially arise from the limitations of methodologies used in estimating health risks. They are also the product of many factors affecting each component of the risk assessment process, including prediction of emission rates, air dispersion modeling uncertainties, exposure assessment, and toxicity assessment. These factors generally include, at a minimum, measurement errors, conservative exposure and modeling assumptions, and uncertainty and variability of the toxicity values used in the assessment. The compounding effects of these uncertainties can be at least two orders of magnitude or more. This section presents a qualitative discussion of the uncertainties, assumptions, and limitations in the HRA.

7.1 Emission Rates and Prediction of Ground-Level Concentrations

Uncertainty arises in the prediction of emission rates through the use of emission factors and other data or methodologies used to predict emissions. Emission calculations were based on the 2004-2005 Air Emissions Report (SCAQMD 2005b) that was submitted to the SCAQMD, and it was assumed that emissions increases would be proportional to projected growth. Emissions from the expanded Central Plant were based on emission estimates provided by UCI as evaluated by ENVIRON (ENVIRON 2006) in support of the air permit.

Dispersion models such as the ISCST3 model represent a methodology for predicting ground-level impacts but do not provide estimates of true ground-level concentrations. The ISCST3 model represents current state of the art in modeling methodology. Results provided offer the best estimates available to predict ambient concentrations of TACs. Some uncertainties are, however, inherent in dispersion modeling approaches. Model results are highly sensitive to assumptions regarding emission source parameters and meteorological data.

Meteorological data from the Anaheim meteorological station were used in the dispersion models to predict ground-level impacts. These data should provide the most accurate representation of impacts for the project. However, in general, dispersion models are more reliable for predicting long-term concentrations than for estimating short-term concentrations at specific locations. Meteorological data sets assume that wind direction, speed, and atmospheric stability are constant for a one-hour period. This assumption may lead to overestimation of one-hour impacts in the vicinity of the modeled sources. Finally, because dispersion models utilize meteorological data that have been collected and processed, they do not predict actual future concentrations at a given time and location; rather, they are appropriate for predicting the magnitude of the maximum impact without respect to a specific time of day or location.

7.2 Exposure Assessment Uncertainties

Exposure and toxicity assessment have been recognized by EPA as the largest sources of uncertainties in the risk assessment process (EPA 1992, 1997). The methodology used in this HRA follows the OEHHA and SCAQMD guidelines for the preparation of HRAs. These guidelines require the use of extremely conservative exposure assumptions; namely, that an individual adult resident would remain in the same location for 70 years, 24 hours per day, 7 days per week, for 365 days per year without leaving the site. In contrast, the EPA typically recommends the use of exposure assumptions that are far lower, especially considering exposure duration (an average duration of 9 years and an upper-bound duration of 30 years in a residential setting). Thus standard EPA exposure assumptions would lead to risk estimates that are less than half the estimates presented in this HRA.

Another source of uncertainty in calculating exposures is the assumption that individuals within a particular receptor population (or subpopulation) will receive the same intake doses. Variability in parameters such as absorption rates, breathing rates, body weight, skin surface area, and frequency of exposure will exist even in a narrowly defined age group or sensitive receptor subpopulation (EPA 1992). This range of uncertainty and variability is difficult to assess. In this HRA, OEHHA standard default factors representing the upper limit of these exposure parameters will generally overestimate risks. Thus the risks reported in this HRA represent an upper bound of estimated risk.

7.3 Toxicity Assessment Uncertainties

Uncertainties in this HRA are also related to the use of OEHHA-recommended toxicity values. For chemical risk drivers, animal data serve as the principal basis of toxicity values for the substances evaluated in this HRA. Extrapolation from animals exposed to high doses to humans potentially exposed to much lower doses is a major source of uncertainty influencing chemical toxicity and, consequently, the evaluation of risks.

OEHHA adopts a policy of developing cancer risk factors and reference concentrations that provide an adequate margin of safety to protect sensitive individuals and populations. Accordingly, the toxicity assessment provides a conservative estimate of anticipated halth impacts associated with exposure to a particular TAC.

7.4 Summary of HRA Uncertainties

In summary, the HRA is designed to present an upper-bound calculation of risks to individual receptors on and in the vicinity of the UCI campus. Uncertainties in the emission estimates, dispersion modeling, exposure assessment, and toxicity assessment are designed to provide health-protective estimates of human health risks. Actual risks are likely to be lower than the upper-bound risks presented in this HRA. The findings of the uncertainty evaluation add confidence to the conclusions that the potential incremental cancer risks will not exceed the significance threshold of 10 in a million, and that chronic and acute non-cancer hazards would be below the significant HI of 1.

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