3.3 AIR QUALITY

This section includes a discussion of existing air quality conditions, a summary of applicable regulations, and an analysis of potential construction and operational air quality impacts caused by potential development associated with implementation of the 2018 LRDP. Mitigation measures are recommended as necessary to reduce significant air quality impacts to the extent feasible.

Public comments on the NOP included concerns regarding the air quality impacts associated with growth planned under the 2018 LRDP, construction, toxic air contaminants (TACs) from proposed uses, and consistency with regional growth plans. Concerns related to growth focused on the potential for the 2018 LRDP to result in increased students and staff vehicles emissions because of having to live outside of the City of Davis (City) due to limited housing availability on-campus and within the City.

3.3.1 Regulatory Setting

Air quality in the vicinity of the project is regulated by the U.S. Environmental Protection Agency (EPA), the California Air Resources Board (CARB), and Yolo-Solano Air Quality Management District (YSAQMD). Each of these agencies develops rules, regulations, policies, and/or goals to comply with applicable legislation. Although EPA regulations may not be superseded, both state and local regulations may be more stringent.

Concentrations of several air pollutants—ozone, carbon monoxide (CO), nitrogen dioxide (NO_2), sulfur dioxide (SO_2), respirable particulate matter (PM_{10}), fine particulate matter ($PM_{2.5}$), and lead—indicate the quality of ambient air and are therefore the premise of air quality regulations. These pollutants are referred to as criteria air pollutants because these pollutants are the most prevalent air pollutants known to be harmful to human health. Their effects on human health have been studied and their criteria for affecting health have been documented. Acceptable levels of exposure to criteria air pollutants have been determined and ambient standards have been established for them (see Table 3.3-3).

Air quality regulations also focus on TACs (also known as hazardous air pollutants [HAPs] in federal regulations). In general, for those TACs that may cause cancer, all concentrations present some risk. In other words, there is no threshold level below which adverse health impacts may not be expected to occur. EPA and CARB regulate HAPs and TACs, respectively, through statutes and regulations that generally require the use of the maximum achievable control technology (MACT) or best available control technology for toxics (BACT) to limit emissions. These statutes and regulations, in conjunction with additional rules set forth by YSAQMD, establish the regulatory framework for TACs.

Applicable regulations associated with criteria air pollutants, TACs, and odors are described below.

FEDERAL

Criteria Air Pollutants

At the federal level, EPA implements the national air quality programs. EPA air quality mandates are drawn primarily from the federal Clean Air Act (CAA), enacted in 1970. The most recent major amendments were made by Congress in 1990.

The CAA requires EPA to establish National Ambient Air Quality Standards (NAAQS). As shown in Table 3.3-3, EPA has established NAAQS for the following criteria air pollutants: ozone, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and lead (CARB 2016a). The primary standards protect public health and the secondary standards protect public welfare. The CAA also requires each state to prepare an air quality control plan referred to as a State Implementation Plan (SIP). The federal Clean Air Act Amendments of 1990 (CAAA) added requirements for states with nonattainment areas to revise their SIPs to incorporate additional control measures to reduce air pollution. The SIP is modified periodically to reflect the latest emissions inventories, planning documents, and rules and regulations of the air basins as reported by their jurisdictional agencies. EPA reviews all state SIPs to determine whether they conform to the mandates of the CAA and its amendments and whether implementing them will achieve air quality goals. If EPA determines a SIP to be inadequate, a Federal Implementation Plan that imposes additional control measures may be prepared for the nonattainment area. If the state fails to submit an approvable SIP, sanctions may be applied to transportation funding and stationary air pollution sources in the air basins.

Hazardous Air Pollutants and Toxic Air Contaminants

TACs, or HAPs in federal parlance, are a defined set of airborne pollutants that may pose a present or potential hazard to human health. A wide range of sources, from industrial plants to motor vehicles, emit TACs. The health effects associated with TACs are quite diverse and generally are assessed locally, rather than regionally. TACs can cause long-term health effects such as cancer, birth defects, neurological damage, asthma, bronchitis, or genetic damage; or short-term acute affects such as eye watering, respiratory irritation (a cough), running nose, throat pain, and headaches.

For evaluation purposes, TACs are separated into carcinogens and non-carcinogens based on the nature of the physiological effects associated with exposure to the pollutant. Carcinogens are assumed to have no safe threshold below which health impacts would not occur. This contrasts with criteria air pollutants for which acceptable levels of exposure can be determined and for which the ambient standards have been established (Table 3.3-3). Cancer risk from TACs is expressed as excess cancer cases per one million exposed individuals, typically over a lifetime of exposure.

EPA has programs for identifying and regulating HAPs. Title III of the CAA directed EPA to promulgate national emissions standards for HAPs (NESHAP). The NESHAP may differ for major sources and for area sources of HAPs. Major sources are defined as stationary sources with potential to emit more than 10 tons per year (tpy) of any HAP or more than 25 tpy of any combination of HAPs; all other sources are considered area sources. The emissions standards are to be promulgated in two ways. First, EPA has technology-based emission standards designed to produce the maximum emission reduction achievable. These standards are generally referred to as requiring MACT for toxics. For area sources, the standards may be different, based on generally available control technology. Second, EPA also has health risk–based emissions standards, where deemed necessary, to address risks remaining after implementation of the technology-based NESHAP.

The CAA also required EPA to issue vehicle or fuel standards containing reasonable requirements that control toxic emissions of, at a minimum, benzene and formaldehyde. Performance criteria were established to limit mobile-source emissions of toxics, including benzene, formaldehyde, and 1,3-butadiene. In addition, the CAA required the use of reformulated gasoline in selected areas with the most severe ozone nonattainment conditions to further reduce mobile-source emissions.

Ultrafine Particulates

UFP refers to a subfraction of currently regulated $PM_{2.5}$ and PM_{10} size particles. UFP is most often defined as particles with an aerodynamic diameter of 0.1 microns or smaller (Health Effects Institute 2013:1; CARB 2006:2; Kleeman et al. 2007:1). Recent studies have raised concerns that exposure to UFP may lead to adverse health effects in animals and humans (Health Effects Institute 2013:2; Froines 2006) and that UFP may be more toxic than larger sized particles (Zhu et al. 2002a:4324; Li et al. 2003:455). To date, no federal agencies, including EPA, have established standards, policies, or guidance regarding concentrations of ultrafine particulates (UFP); however, UFPs may include TACs, for which there are federal standards, as discussed above.

STATE

Criteria Air Pollutants

CARB coordinates and oversees the state and local programs for controlling air pollution in California and implements the California Clean Air Act (CCAA), adopted in 1988. The CCAA requires CARB to establish California Ambient Air Quality Standards (CAAQS), which are shown in Table 3.3-3. CARB has established CAAQS for sulfates, hydrogen sulfide, vinyl chloride, visibility-reducing particulate matter, and the above-mentioned criteria air pollutants. In most cases the CAAQS are more stringent than the NAAQS. Differences in the standards are generally explained by the health effects studies considered during the standard-setting process and the interpretation of the studies. In addition, the CAAQS incorporate a margin of safety to protect sensitive individuals.

The CCAA requires that all local air districts in the state endeavor to achieve and maintain the CAAQS by the earliest practical date. The act specifies that local air districts should focus particular attention on reducing the emissions from transportation and area-wide emission sources. The act provides districts with the authority to regulate indirect sources, such as through the funding of transportation demand management programs and vehicle pooling services.

CARB also oversees local air district compliance with federal and state laws, approving local air quality plans, submitting SIPs to EPA, monitoring air quality, determining and updating area designations and maps, and setting emissions standards for new mobile sources, consumer products, small utility engines, off-road vehicles, and fuels.

Executive Order B-48-18: Zero-Emission Vehicles

In January 2018, Governor Brown signed Executive Order B-48-18 requiring all State entities to work with the private sector to have at least 5 million zero-emission vehicles (ZEVs) on the road by 2030, as well as install 200 hydrogen fueling stations and 250,000 electric vehicle (EV) charging stations by 2025. It specifies that 10,000 of the EV charging stations should be direct current fast chargers. This order also requires all State entities to continue to partner with local and regional governments to streamline the installation of ZEV infrastructure. The Governor's Office of Business and Economic Development is required to publish a *Plug-in Charging Station Design Guidebook* and update the *2015 Hydrogen Station Permitting Guidebook* (Eckerle and Jones 2015) to aid in these efforts. All State entities are required to participate in updating the *2016 Zero-Emissions Vehicle Action Plan* (Governor's Interagency Working Group on Zero-Emission Vehicles 2016) to help expand private investment in ZEV infrastructure with a focus on serving low-income and disadvantaged communities.

Toxic Air Contaminants

TACs in California are regulated primarily through the Tanner Air Toxics Act (Assembly Bill [AB] 1807 [Statutes of 1983]) and the Air Toxics Hot Spots Information and Assessment Act of 1987 (AB 2588 [Statutes of 1987]). AB 1807 sets forth a formal procedure for CARB to designate substances as TACs. This process includes research, public participation, and scientific peer review before CARB can designate a substance as a TAC. CARB has identified more than 21 TACs to date and has adopted EPA's list of HAPs as TACs. Most recently, diesel PM was added to the CARB list of TACs.

Once a TAC is identified, CARB then adopts an airborne toxics control measure for sources that emit that TAC. If a safe threshold exists for a substance at which there is no toxic effect, the control measure must reduce exposure below that threshold. If no safe threshold exists, the measure must incorporate BACT to minimize emissions.

The Hot Spots Act requires that existing facilities that emit toxic substances above a specified level prepare an inventory of toxic emissions, prepare a risk assessment if emissions are significant, notify the public of significant risk levels, and prepare and implement risk reduction measures.

CARB has adopted diesel exhaust control measures and more stringent emissions standards for various transportation-related mobile sources of emissions, including transit buses, and off-road diesel equipment (e.g., tractors, generators). Recent and upcoming milestones for transportation-related mobile sources include a low-sulfur diesel fuel requirement and tighter emissions standards for heavy-duty diesel trucks (2007) and off-road diesel equipment (2011) nationwide. Over time, the replacement of older vehicles will result in a vehicle fleet that produces substantially lower levels of TACs than under current conditions. Mobile-source emissions of TACs (e.g., benzene, 1,3-butadiene, diesel PM) have been reduced significantly over the last decade and will be reduced further in California through a progression of regulatory measures (e.g., Low Emission Vehicle/Clean Fuels and Phase II reformulated gasoline regulations) and control technologies. With implementation of CARB's Risk Reduction Plan, it is expected that diesel PM concentrations will be 75 percent less than the estimated year-2000 level in 2010 and 85 percent less in 2020. Adopted regulations are also expected to continue to reduce formaldehyde emissions from cars and light-duty trucks. As emissions are reduced, it is expected that risks associated with exposure to the emissions will also be reduced.

Ultrafine Particulate Matter

No State agencies, including CARB, have established any standards, policies, or guidance regarding UFP.

UNIVERSITY OF CALIFORNIA

There are no UC plans or policies addressing air quality that pertain to the 2018 LRDP.

LOCAL

As noted in Section 3.1.2, "University of California Autonomy," UC Davis, a constitutionally created State entity, is not subject to municipal regulations of surrounding local governments for uses on property owned or controlled by UC Davis that are in furtherance of the university's education purposes. However, UC Davis may consider, for coordination purposes, aspects of local plans and policies for the communities surrounding the campus when it is appropriate and feasible, but it is not bound by those plans and policies in its planning efforts. However, UC Davis is subject to the rules and regulations YSAQMD as a special district/local-regional planning agency that is tasked with maintaining or improving air quality and human health within the Yolo and Solano counties.

Yolo-Solano County Air Quality Management District

YSAQMD attains and maintains air quality conditions in Yolo and Solano Counties through a comprehensive program of planning, regulation, enforcement, technical innovation, and promotion of the understanding of air quality issues. The clean air strategy of YSAQMD includes the preparation of plans and programs for the attainment of ambient-air quality standards, adoption and enforcement of rules and regulations, and issuance of permits for stationary sources. YSAQMD also inspects stationary sources, responds to citizen complaints, monitors ambient air quality and meteorological conditions, and implements other programs and regulations required by the CAA, CAAA, and CCAA.

All projects are subject to adopted YSAQMD rules and regulations in effect at the time of construction. Specific rules applicable to the construction of the project may include but are not limited to the following (YSAQMD 2016a):

- Rule 2.3—(Ringelmann Chart). This rule prohibits stationary diesel-powered equipment from generating visible emissions that would exceed the rule's visibility threshold.
- Rule 2.5—(Nuisance). This rule prohibits any source from generating air contaminants or other materials that would that would cause injury, detriment, nuisance, or annoyance to the public; endanger the comfort, repose, health, or safety of the public; or damage businesses or property.

  Under Rule 2.6, the provisions of Rule 2.5. do not apply to odors emanating from agricultural operations in the growing of crops or raising of fowl, animals, or bees.
- Rule 2.11—(Particulate Matter Concentration). This rule prohibits any source that would emit dust, fumes, or total suspended particulate matter from generated emissions that would exceed the rule's established emission concentration limit.
- Rule 2.14—(Architectural Coatings). This rule establishes volatile organic compound (VOC) content limits for all architectural coatings supplied, sold, offered for sale, applied, solicited for application, or manufactured within YSAQMD's jurisdiction.
- Rule 2.16—(Fuel Burning Heat or Power Generators). This rule prohibits operation of non-mobile fuel burning equipment, such as boilers, generators, and furnaces, that exceed 200 lb per hour of sulfur compounds, 140 lb per hour of nitrous oxides (NO_X), or 40 lb per hour of PM emissions from exhaust. This rule exempts emergency generators.
- Rule 2.28—(Cutback and Emulsified Asphalts). This rule establishes organic compound limits for cutback and emulsified asphalts manufactured, sold, mixed, stored, used, and applied within YSAQMD's jurisdiction.
- Rule 2.37—(Natural Gas-Fired Water Heaters and Small Boilers). This rule establishes NO_X emission limits for natural gas-fired water heaters with a rated heat input capacity less than 1,000,000 British Thermal Units per hour—(Btu/hr) manufactured, offered for sale, sold, or installed within YSAQMD's jurisdiction.
- Rule 2.40—(Wood Burning Appliances). This rule prohibits installation of open hearth wood burning fireplaces in any new development (residential or commercial, single or multi-family units). New developments may only use either a pellet-fueled heater, an EPA Phase II certified wood burning heater or a gas fireplace.
- Rule 2.43—(Biomass Boilers). This rule establishes NO_X and CO emissions limits for biomass boilers and requires regular emissions monitoring, testing, and reporting to ensure the applicable boilers continue to meet the emissions limits.
- Rule 3.1—(General Permit Requirements). This rule establishes permitting processes (i.e., Authority to Construct and Permit to Operate) to review new and modified sources of air pollution.
- Rule 3.4—(New Source Review). This rule would require any new or modified stationary source that generates emissions that exceed established emissions limits for each pollutant (i.e., reactive organic gases [ROG], NO_X, sulfur oxides [SO_X], PM_{10}, CO, and lead) to comply with BACT and emissions offset requirements.
- Rule 3.8—(Federal Operating Permits). This rule establishes the requirement for facilities to obtain permits associated with requirements under Title V of the CAA. The most common type of Title V source is one that meets YSAQMD's threshold as a "major source." Currently, YSAQMD's thresholds for a major source are:
  - 100 tons per year of any pollutant subject to regulation
  - 25 tons per year of volatile organic compounds or nitrous oxides
  - 10 tons per year of any single hazardous air pollutant
  - 25 tons per year of all hazardous air pollutants

- Rule 3.13—(Toxics New Source Review). This rule requires the installation of best available control technology for toxics (T-BACT) at any constructed or reconstructed major source of TACs.
- Rule 9.9—(Asbestos). This rule limits the emission of asbestos to the atmosphere and requires appropriate work practice standards and waste disposal procedure, applicable to all non-exempt renovations or demolitions.

Criteria Air Pollutants

The CCAA requires districts to submit air quality attainment plans (AQAP) for areas that do not meet state standards for ozone, CO, SO_2, NO_2, PM_{10}, and $PM_{2.5}$. YSAQMD has attained all standards with the exception of ozone and PM (YSAQMD 2016b). The CCAA does not currently require attainment plans for PM. As a part of the Sacramento federal ozone nonattainment area, YSAQMD works with the Sacramento Metropolitan Air Quality Management District (SMAQMD) to develop a regional air quality management plan under CAA requirements. The 2017 Sacramento Regional 2008 8-Hour Ozone Attainment and Further Reasonable Progress Plan was approved by CARB on November 16, 2017. The previous 2013 Update to the 8-Hour Ozone Attainment and Reasonable Further Progress Plan was approved and promulgated by EPA for the 1997 8-hour Ozone Standard. EPA has not released notice of approval and promulgation of the 2017 SIP (CARB 2017a).

Additionally, YSAQMD issues Emission Reduction Credits (ERCs) to businesses to reduce their emissions beyond what is required by district, state, or federal requirements. YSAQMD typically only requires ERCs in permit applications with substantial new criteria pollutant emissions. Sources who are required to offset their proposed emissions with ERCs can use their own banked ERCs or purchase them from another ERC holder. (YSAQMD 2016c)

Toxic Air Contaminants

At the local level, air pollution control or management districts may adopt and enforce CARB's control measures. Under YSAQMD Rule R3-1 ("General Permit Requirements"), Rule R3-4 ("New Source Review"), and Rule R3-8 ("Federal Operating Permits"), all sources that possess the potential to emit TACs are required to obtain permits from the district. Permits may be granted to these operations if they are constructed and operated in accordance with applicable regulations, including new-source review standards (see Rule R3-4 above) and air-toxics control measures. YSAQMD limits emissions and public exposure to TACs through many programs. YSAQMD prioritizes the permitting of TAC-emitting stationary sources based on the quantity and toxicity of the TAC emissions and the proximity of the facilities to sensitive receptors and land uses.

Sources that require a permit are analyzed by YSAQMD (e.g., health risk assessment [HRA]) based on their potential to emit toxics. If it is determined that the project will emit toxics in excess of YSAQMD's threshold of significance for TACs (see Section 3.3.3, below), sources have to implement BACT for TACs to reduce emissions. If a source cannot reduce the risk below the threshold of significance even after BACT has been implemented, YSAQMD will deny the permit required by the source. This helps to prevent new problems and reduces emissions from existing older sources by requiring them to apply new technology when retrofitting with respect to TACs. Although YSAQMD regulates sources that generate TACs, but does not regulate land uses that may be sited in locations exposed to TACs. The decision on whether to approve projects in TAC-exposed locations is typically the responsibility of the lead agency charged with determining whether to approve a project.

Ultrafine Particulate Matter

YSAQMD has not established rules, policies, or guidance regarding UFP.

3.3.2 Environmental Setting

The project site is located in an unincorporated area of Yolo County, California, which is within the Sacramento Valley Air Basin (SVAB). The SVAB also includes all of Butte, Colusa, Glenn, Sacramento, Shasta, Sutter, Tehama, Yolo, and Yuba counties; and the eastern portion of Solano County.

The ambient concentrations of air pollutant emissions are determined by the amount of emissions released by the sources of air pollutants and the atmosphere's ability to transport and dilute such emissions. Natural factors that affect transport and dilution include terrain, wind, atmospheric stability, and sunlight. Therefore, existing air quality conditions in the area are determined by such natural factors as topography, meteorology, and climate, in addition to the amount of emissions released by existing air pollutant sources, as discussed separately below.

CLIMATE, METEOROLOGY, AND TOPOGRAPHY

The SVAB is a relatively flat area bordered by the north Coast Ranges to the west and the northern Sierra Nevada to the east. Air flows into the SVAB through the Carquinez Strait, the only breach in the western mountain barrier, and moves across the Sacramento–San Joaquin Delta (Delta) from the San Francisco Bay area.

The Mediterranean climate type of the SVAB is characterized by hot, dry summers and cool, rainy winters. During the summer, daily temperatures range from 50 degrees Fahrenheit (°F) to more than 100°F. The inland location and surrounding mountains shelter the area from most of the ocean breezes that keep the coastal regions moderate in temperature. Most precipitation in the area results from air masses that move in from the Pacific Ocean, usually from the west or northwest, during the winter months. More than half the total annual precipitation falls during the winter rainy season (November through February); the average winter temperature is a moderate 49°F. Also, characteristic of SVAB winters are periods of dense and persistent low-level fog, which are most prevalent between storms. The prevailing winds are moderate in speed and vary from moisture-laden breezes from the south to dry land flows from the north.

The mountains surrounding the SVAB create a barrier to airflow, which entraps air pollutants when meteorological conditions are unfavorable for transport and dilution. Poor air movement is most frequent in the fall and winter when high-pressure cells are present over the SVAB. The lack of surface wind during these periods, combined with the reduced vertical flow caused by a decline in surface heating, reduces the influx of air and leads to the concentration of air pollutants under stable meteorological conditions. Surface concentrations of air pollutant emissions are highest when these conditions occur in combination with agricultural burning activities or with temperature inversions, which hamper dispersion by creating a ceiling over the area and trapping air pollutants near the ground.

May through October is ozone season in the SVAB. This period is characterized by poor air movement in the mornings until the arrival of the Delta sea breeze from the southwest in the afternoons. In addition, longer daylight hours provide a plentiful amount of sunlight to fuel photochemical reactions between ROG and NO_X, which result in ozone formation. Typically, the Delta breeze transports air pollutants northward out of the SVAB; however, a phenomenon known as the Schultz Eddy prevents this from occurring during approximately half of the time from July to September. The Schultz Eddy phenomenon causes the wind to shift southward and blow air pollutants back into the SVAB. This phenomenon exacerbates the concentration of air pollutant emissions in the area and contributes to the area violating the ambient air quality standards.

The local meteorology of the project site and surrounding area is represented by measurements recorded at the "Davis 2 WSW Exp Farm" weather station located in Davis, CA. The normal annual precipitation is approximately 18 inches. January temperatures range from a normal minimum of 37°F to a normal maximum of 54°F. July temperatures range from a normal minimum of 55°F to a normal maximum of 94°F (Western Regional Climate Center [WRCC] 2017a). The predominant wind direction and speed, measured at the Sacramento Executive Airport, is from the south at 7 miles per hour (WRCC 2017b). Wind data were not available from the “Davis 2 WSW Exp Farm” weather station.

Exhibit 3.3-1 shows the predominant wind direction and wind speeds (in meters per second [m/s]) in the project area based on five years of meteorological data collected at the Sacramento International Airport.

CRITERIA AIR POLLUTANTS

Concentrations of ozone, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and lead are used as indicators of ambient air quality conditions and are referred to as criteria air pollutants. Criteria air pollutants are air pollutants for which acceptable levels of exposure can be determined and for which an ambient air quality standard has been set by EPA and CARB.

A brief description of each criteria air pollutant’s source types and health effects is provided below in Table 3.3-1. Additional information, including future trends and monitoring data at those monitoring stations located closest to the project site, is provided for ozone, NO_2, and PM, the key criteria air pollutants associated with the project analysis.

Table 3.3-1 Sources and Health Effects of Criteria Air Pollutants

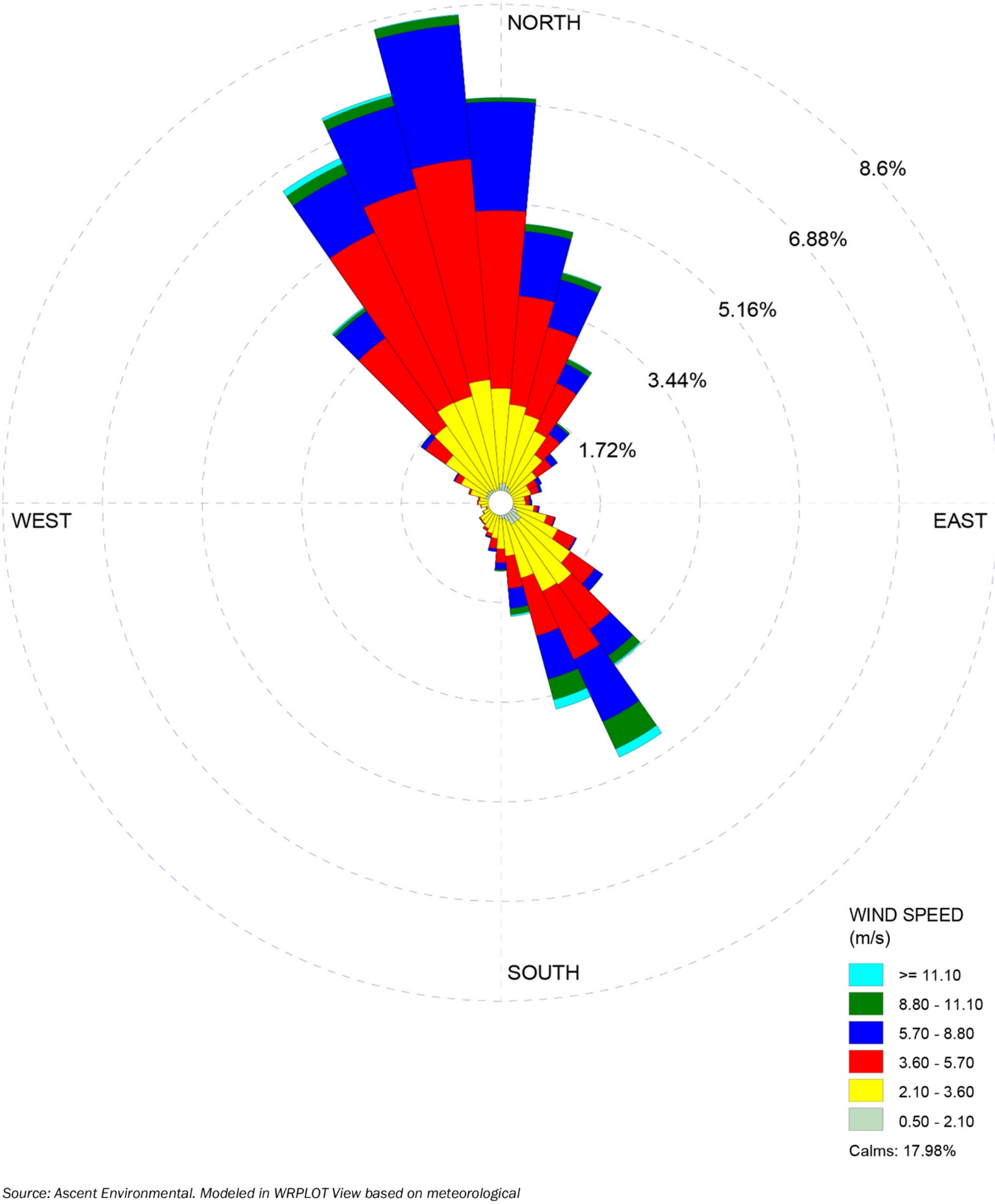
Pollutant	Sources	Acute[1] Health Effects	Chronic[2] Health Effects
Ozone	Secondary pollutant resulting from reaction of ROG and NO_X in presence of sunlight. ROG emissions result from incomplete combustion and evaporation of chemical solvents and fuels; NO_X results from the combustion of fuels	Increased respiration and pulmonary resistance; cough, pain, shortness of breath, lung inflammation	Permeability of respiratory epithelia, possibility of permanent lung impairment
Carbon monoxide (CO)	Incomplete combustion of fuels; motor vehicle exhaust	Reduced capacity to pump oxygenated blood; headache, dizziness, fatigue, nausea, vomiting, death	Permanent heart and brain damage
Nitrogen dioxide (NO_2)	Combustion devices (e.g., boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines), industrial processes, and fires	Coughing, difficulty breathing, vomiting, headache, eye irritation, chemical pneumonitis or pulmonary edema; aggravation of existing heart disease leading to death	Chronic bronchitis, emphysema, decreased lung function
Sulfur dioxide (SO_2)	Combustion devices (e.g., boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines), industrial processes, and fires	Irritation of upper respiratory tract, increased asthma symptoms, aggravation of existing heart disease leading to death	Chronic bronchitis, emphysema
Respirable particulate matter (PM_{10}), Fine particulate matter ($PM_{2.5}$)	Fugitive dust, soot, smoke, mobile and stationary sources, construction, fires and natural windblown dust, and formation in the atmosphere by condensation and/or transformation of SO_2 and ROG	Breathing and respiratory symptoms, aggravation of existing respiratory and cardiovascular diseases, premature death	Alterations to the immune system, carcinogenesis
Lead	Metal processing, piston-engine aircraft or other vehicles operating on leaded fuel	Reproductive/developmental effects (fetuses and children)	Numerous effects including neurological, endocrine, and cardiovascular effects

Notes: NO_X = oxides of nitrogen; ROG = reactive organic gases

[1] “Acute” refers to effects of short-term exposures to criteria air pollutants, usually at fairly high concentrations.

[2] “Chronic” refers to effects of long-term exposures to criteria air pollutants, usually at lower, ambient concentrations.

Source: EPA 2017a



Source: Ascent Environmental. Modeled in WRPLOT View based on meteorological data from the Sacramento International Airport, 2010-2014.

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UNIVERSITY OF CALIFORNIA

Exhibit 3.3-1: Wind Speed (meters/second) Flow Vector (24-hour, blowing to)

Ozone
Ozone is a photochemical oxidant (a substance whose oxygen combines chemically with another substance in the presence of sunlight) and the primary component of smog. Ozone is not directly emitted into the air in large quantities, but is formed through complex chemical reactions between precursor emissions of (ROG and NO_X in the presence of sunlight (EPA 2017a). ROG are volatile organic compounds that are photochemically reactive. ROG emissions result primarily from incomplete combustion and the evaporation of chemical solvents and fuels. NO_X are a group of gaseous compounds of nitrogen and oxygen that result from the combustion of fuels. Emissions of the ozone precursors ROG and NO_X have decreased over the past two decades because of more stringent motor vehicle standards and cleaner burning fuels (CARB 2014a:3-4 and 4-46).

Carbon Monoxide
CO is an odorless and invisible gas. It is a non-reactive pollutant that is a product of incomplete combustion of gasoline in automobile engines. CO is a localized pollutant, and the highest concentrations are found near the source. Ambient carbon monoxide concentrations generally follow the spatial and temporal distributions of vehicular traffic and are influenced by wind speed and atmospheric mixing. CO concentrations are highest in flat areas on still winter nights when temperature inversions trap the carbon monoxide near the ground. When inhaled at high concentrations, carbon monoxide reduces the oxygen-carrying capacity of the blood, which, in turn, results in reduced oxygen reaching parts of the body.

Nitrogen Dioxide
NO_2 is a brownish, highly reactive gas that is present in all urban environments. The major human-made sources of NO_2 are combustion devices, such as boilers, gas turbines, and mobile and stationary reciprocating internal combustion engines. Combustion devices emit primarily nitric oxide (NO), which reacts through oxidation in the atmosphere to form NO_2. The combined emissions of NO and NO_2 are referred to as NO_X and are reported as equivalent NO_2. Because NO_2 is formed and depleted by reactions associated with photochemical smog (ozone), the NO_2 concentration in a geographical area may not be representative of the local sources of NO_X emissions (EPA 2017a).

Sulfur Dioxide
SO_2 is produced by such stationary sources as coal and oil combustion, steel mills, refineries, and pulp and paper mills as well as by the combustion of fuel containing sulfur. The major adverse health effects associated with SO_2 exposure pertain to the upper respiratory tract. SO_2 is a respiratory irritant with constriction of the bronchioles occurring with inhalation of SO_2 at 5 ppm or more (CDC 1978). On contact with the moist mucous membranes, SO_2 produces sulfurous acid, which is a direct irritant. Concentration rather than duration of the exposure is an important determinant of respiratory effects. Exposure to high SO_2 concentrations may result in edema of the lungs or glottis and respiratory paralysis.

Particulate Matter
PM_{10} consists of particulate matter emitted directly into the air, such as fugitive dust, soot, and smoke from mobile and stationary sources, construction activity, fires and natural windblown dust, and particulate matter formed in the atmosphere by reaction of gaseous precursors (CARB 2014a:1-13 and 3-6). $PM_{2.5}$ includes a subgroup of smaller particles that have an aerodynamic diameter of 2.5 micrometers or less. PM_{10} emissions are dominated by emissions from area sources, primarily fugitive dust from vehicle travel on unpaved and paved roads, farming operations, construction and demolition, and particles from residential fuel combustion. Direct emissions of PM_{10} have increased slightly over the last 20 years and are projected to continue to increase slightly through 2035 (CARB 2014a:3-7).

$PM_{2.5}$ emissions have remained relatively steady over the last 20 years and are projected to decrease slightly through 2035 (CARB 2014a:3-6).

Lead

Lead is a metal found naturally in the environment as well as in manufactured products and is a potent neurotoxin that can cause increased chances of cancer and non-cancer health effects for adults and children. Lead is known to negatively affect child brain development and function. The major sources of lead emissions have historically been mobile and industrial sources, but can occur in dust created by demolition or deterioration of lead-based paint. Lead-based paint is present on buildings built before EPA's ban on the use of such paint in 1978. EPA also phased out leaded fuels as of December 1995 resulting in an 89 percent decline in lead emissions from mobile sources between 1980 and 2010 (EPA 2016; ARB 2001).

Monitoring Station Data and Attainment Area Designations

Criteria air pollutant concentrations are measured at several monitoring stations in the SVAB. The Davis-UC Davis campus station is in the western portion of the 2018 LRDP area and is the closest monitoring station with recent data for ozone and $PM_{2.5}$. The next closest monitoring station that reports PM_{10} concentrations is the Woodland-Gibson Road monitoring station located approximately 7 miles north and upwind of the UC Davis campus. In general, the local ambient air quality measurements from this station are representative of the air quality near the project given its similar meteorological conditions and urban surroundings. Table 3.3-2 summarizes the air quality data for the three most recent calendar years for which data are available (2014-2016).

Table 3.3-2 Summary of Annual Data on Local Ambient Air Quality (2014-2016)

	2014	2015	2016
OZONE[1]			
Maximum concentration (1-hr/8-hr avg, ppm)	0.081/0.067	0.081/0.071	0.082/0.072
Number of days state standard exceeded (1-hr/8-hr)	0/0	0/1	0/1
Number of days national standard exceeded (8-hr)	0	1	1
FINE PARTICULATE MATTER ($PM_{2.5}$)[1]			
Maximum concentration ($\mu g/m^3$)	27.9	36.3	20.5
Number of days national standard exceeded (calculated[2])	*	*	*
RESPIRABLE PARTICULATE MATTER (PM_{10})[2]			
Maximum concentration ($\mu g/m^3$)	47.5	69.4	68.7
Number of days state standard exceeded (calculated[3])	0	2	2
Number of days national standard exceeded (calculated[3])	0	0	0

Notes: µg/m3 = micrograms per cubic meter; ppm = parts per million, * = There was insufficient (or no) data available to determine the value.

1 Measurements from the Davis-UC Davis Campus monitoring station.

2 Measurements from the Woodland-Gibson Road monitoring station.

3 Measured days are those days that an actual measurement was greater than the level of the state daily standard or the national daily standard. Measurements are typically collected every 6 days. Calculated days are the estimated number of days that a measurement would have been greater than the level of the standard had measurements been collected every day. The number of days above the standard is not necessarily the number of violations of the standard for the year.

Source: CARB 2017b, data compiled by Ascent Environmental in 2018.

Both CARB and EPA use this type of monitoring data to designate areas according to their attainment status for criteria air pollutants. The purpose of these designations is to identify those areas with air quality problems and thereby initiate planning efforts for improvement. The three basic designation categories are “nonattainment,” “attainment,” and “unclassified.” “Unclassified” is used in an area that cannot be classified based on available information as meeting or not meeting the standards. In addition, the California designations include a subcategory of the nonattainment designation, called “nonattainment-transitional.” The nonattainment-transitional designation is given to nonattainment areas that are progressing and nearing attainment. Attainment designations for the years 2014 through 2016 in Yolo County are shown in Table 3.3-3 for each criteria air pollutant.

Table 3.3-3 Ambient Air Quality Standards and Designations for Yolo County

Pollutant	Averaging Time	California		National Standards [1]	
		Standards[2, 3]	Attainment Status[4]	Primary[3]	Attainment Status[6]
Ozone	1-hour	0.09 ppm (180 μg/m^3)	N	–	N (Severe)
	8-hour	0.070 ppm (137 μg/m^3)		0.075 ppm (147 μg/m^3)	N (Severe)
Carbon Monoxide (CO)	1-hour	20 ppm (23 mg/m^3)	A	35 ppm (40 mg/m^3)	U/A
	8-hour	9 ppm (10 mg/m^3)		9 ppm (10 mg/m^3)	
	8-hour (Lake Tahoe)	6 ppm (7 mg/m^3)		–	
Nitrogen Dioxide (NO_2)	Annual Arithmetic Mean	0.030 ppm (57 μg/m^3)	A	0.053 ppm (100 μg/m^3)	U/A
	1-hour	0.18 ppm (339 μg/m^3)		0.100 ppm	
Sulfur Dioxide (SO_2)	Annual Arithmetic Mean	–	A	0.030 ppm (80 μg/m^3)	U
	24-hour	0.04 ppm (105 μg/m^3)		0.14 ppm (365 μg/m^3)	
	3-hour	–		0.5 ppm (1300 μg/m^3)[5]	
	1-hour	0.25 ppm (655 μg/m^3)		0.075 ppm	
Respirable Particulate Matter (PM_{10})	Annual Arithmetic Mean	20 μg/m^3	N	–	U
	24-hour	50 μg/m^3		150 μg/m^3	
Fine Particulate Matter ($PM_{2.5}$)	Annual Arithmetic Mean	12 μg/m^3	U	12.0 μg/m^3	N (Moderate)
	24-hour	–		35 μg/m^3	
Lead [7]	30-day Average	1.5 μg/m^3	A	–	–
	Calendar Quarter	–		1.5 μg/m^3	U/A
	Rolling 3-Month Avg	–		0.15 μg/m^3	U/A
Sulfates	24-hour	25 μg/m^3	A	No National Standards	
Hydrogen Sulfide	1-hour	0.03 ppm (42 μg/m^3)	U		
Vinyl Chloride [7]	24-hour	0.01 ppm (26 μg/m^3)	Not Available		
Visibility-Reducing Particle Matter	8-hour	Extinction coefficient of 0.23 per kilometer — visibility of 10 mi or more	U		

Notes: μg/m^3 = micrograms per cubic meter; ppm = parts per million; EPA=U.S. Environmental Protection Agency; CAAQS=California Ambient Air Quality Standards; CCAA=California Clean Air Act; CARB=California Air Resources Board

1 National standards (other than ozone, PM, and those based on annual averages or annual arithmetic means) are not to be exceeded more than once a year. The ozone standard is attained when the fourth highest 8-hour concentration in a year, averaged over 3 years, is equal to or less than the standard. The PM_{10} 24-hour standard is attained when 99 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. The $PM_{2.5}$ 24-hour standard is attained when 98 percent of the daily concentrations, averaged over 3 years, are equal to or less than the standard. Contact the EPA for further clarification and current federal policies.

2 California standards for ozone, CO (except in the Lake Tahoe Basin), SO_2 (1- and 24-hour), NO_2, PM, and visibility-reducing particles are values that are not to be exceeded. All others are not to be equaled or exceeded. CAAQS are listed in the Table of Standards in Section 70200 of Title 17 of the California Code of Regulations.

3 Concentration expressed first in units in which it was promulgated [i.e., ppm or μg/m^3]. Equivalent units given in parentheses are based upon a reference temperature of 25°C and a reference pressure of 760 torr. Most measurements of air quality are to be corrected to a reference temperature of 25°C and a reference pressure of 760 torr; ppm in this table refers to ppm by volume, or micromoles of pollutant per mole of gas. Secondary national standards are also available from EPA.

4 Unclassified (U): a pollutant is designated unclassified if the data are incomplete and do not support a designation of attainment or nonattainment.

Attainment (A): a pollutant is designated attainment if the state standard for that pollutant was not violated at any site in the area during a 3-year period.

Table 3.3-3 Ambient Air Quality Standards and Designations for Yolo County

Nonattainment (N): a pollutant is designated nonattainment if there was a least one violation of a state standard for that pollutant in the area. Non-attainment designations for ozone are classified as marginal, serious, severe, or extreme depending on the magnitude of the highest 8-Hour ozone design value at a monitoring site in a non-attainment area.

Nonattainment/Transitional (NT): is a subcategory of the nonattainment designation. An area is designated nonattainment/transitional to signify that the area is close to attaining the standard for that pollutant.

[5] Secondary Standard

[6] Nonattainment (N): any area that does not meet (or that contributes to ambient air quality in a nearby area that does not meet) the national primary or secondary ambient air quality standard for the pollutant.

Attainment (A): any area that meets the national primary or secondary ambient air quality standard for the pollutant.

Unclassifiable (U): any area that cannot be classified on the basis of available information as meeting or not meeting the national primary or secondary ambient air quality standard for the pollutant.

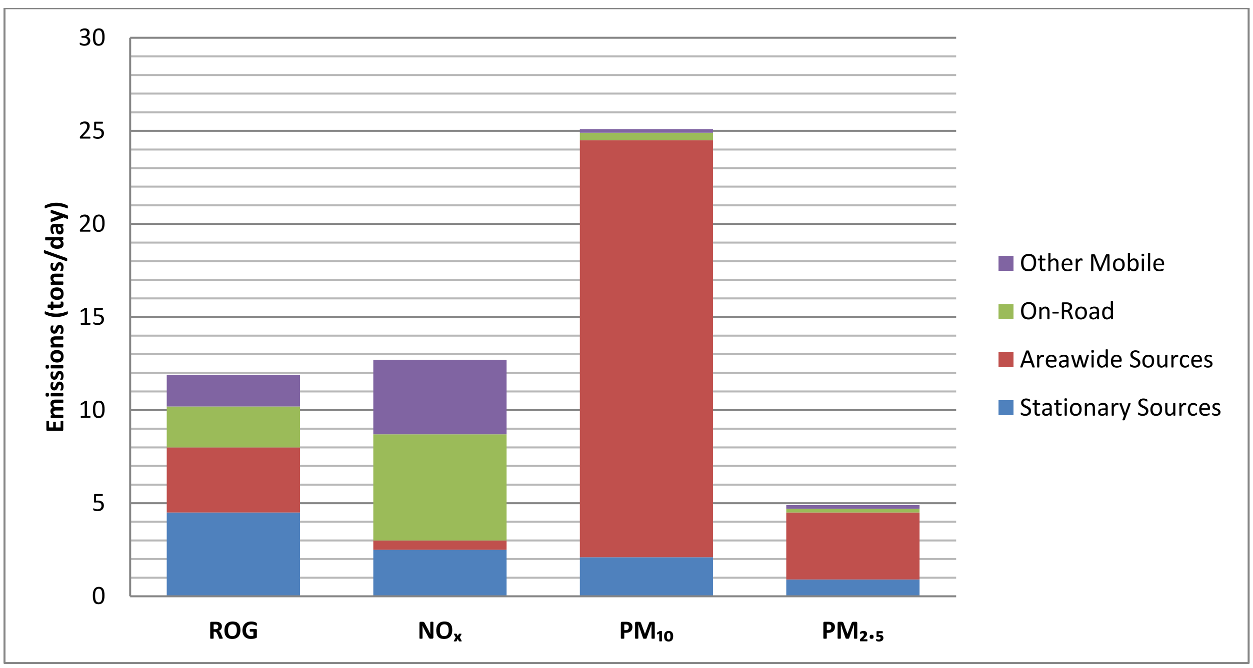
Maintenance (M): any area previously designated nonattainment pursuant to the CAAA of 1990 and subsequently redesignated to attainment subject to the requirement to develop a maintenance plan under Section 175A of the CAA, as amended.

[7] CARB has identified lead and vinyl chloride as toxic air contaminants with no threshold of exposure for adverse health effects determined. These actions allow for the implementation of control measures at levels below the ambient concentrations specified for these pollutants.

Source: CARB 2016b; EPA 2017b; data compiled by Ascent Environmental in 2018.

EMISSIONS INVENTORY

Exhibit 3.3-2 summarizes an estimated emissions inventory of criteria air pollutants projected for Yolo County for various source categories in 2015 based on the 2016 SIP Emissions Projection Data from CARB. According to the emissions inventory, mobile sources are the largest contributor to the estimated daily air pollutant levels of ROG and NO_X, accounting for approximately 33 percent and 76 percent of the total daily emissions, respectively. Area-wide sources (i.e., sources that occur over a large area rather than at a point source [e.g., smoke stack] or mobile-source [e.g., tailpipe]) account for approximately 89 percent and 73 percent of the county's PM_{10} and $PM_{2.5}$ emissions, respectively (CARB 2016c), due in part to the agricultural and semi-rural conditions in Yolo County. This is the most current emissions inventory available for Yolo County.



Source: CARB 2016c, data compiled by Ascent Environmental, Inc. in 2018.

Exhibit 3.3-2: Yolo County 2015 Criteria Air Pollutant Emissions Inventory

TOXIC AIR CONTAMINANTS

TACs are also used to indicate the quality of ambient air. A TAC is defined as an air pollutant that may cause or contribute to an increase in mortality or in serious illness, or that may pose a hazard to human health. TACs are usually present in minute quantities in the ambient air; however, their high toxicity or health risk may pose a threat to public health even at low concentrations.

According to the California Almanac of Emissions and Air Quality (CARB 2010),[1] the majority of the estimated health risks from TACs can be attributed to relatively few compounds, the most important being particulate matter from diesel exhaust (diesel PM). Diesel PM differs from other TACs in that it is not a single substance, but rather a complex mixture of hundreds of substances. Although diesel PM is emitted by diesel-fueled internal combustion engines, the composition of the emissions varies depending on engine type, operating conditions, fuel composition, lubricating oil, and whether an emissions control system is being used. Unlike the other TACs, no ambient monitoring data are available for diesel PM. However, CARB has made preliminary concentration estimates based on a PM exposure method. This method uses the CARB emissions inventory's PM_{10} database, ambient PM_{10} monitoring data, and the results from several studies to estimate concentrations of diesel PM. In addition to diesel PM, the TACs that pose the greatest existing ambient risk in California, for which data are available, are benzene, 1,3-butadiene, acetaldehyde, carbon tetrachloride, hexavalent chromium, para-dichlorobenzene, formaldehyde, methylene chloride, and perchloroethylene. Sources of these TACs vary considerably and include (but are not limited to) consumer products, gasoline dispensing stations, auto repair and auto body coating shops, dry cleaning establishments, chrome plating and anodizing shops, welding operations, and other stationary sources.

Diesel PM poses the greatest health risk among the 10 TACs mentioned. Based on receptor modeling techniques, CARB estimated its health risk to be 360 excess cancer cases per million people in the SVAB in the year 2000, which when coupled with the average health risk within the SVAB of 160 cancer cases per million people yields a total health risk of 520 cancer cases per million people. Since 1990, the health risk associated with diesel PM has been reduced by 52 percent. Overall, levels of most TACs, except para-dichlorobenzene and formaldehyde, have decreased since 1990 (CARB 2010:3-2).

According to the CARB Air Toxics "Hot Spots" Program (see Regulatory Setting above), stationary facilities that emit toxic substances above a specified level are required to prepare an inventory of toxic emissions, prepare a risk assessment if emissions are significant, notify the public of significant risk levels, and prepare and implement risk reduction measures. There are approximately 50 existing facilities that meet the reporting criteria and are in the same Davis zip code (95616) as the 2018 LRDP (CARB 2015). Minor stationary sources of TACs may also be in the project vicinity and could include, but are not limited to: gasoline dispensing stations, auto body coating operations, and research and development facilities.

Major highways and roadways are also considered sources of TAC emissions, associated with the presence of diesel PM emissions from vehicle exhaust. Interstate 80 (I-80) passes along the southern border of UC Davis Campus and State Route (SR) 113 runs north-south through the campus. The annual average daily traffic volume on this segment of I-80 in the 2018 LRDP vicinity is approximately 128,800 vehicles per day (California Department of Transportation [Caltrans] 2017). The project site is also located adjacent to an active Union Pacific Rail Road line that carries both freight and passenger rail. Trains in Yolo County account for 10 percent of mobile diesel sources (CARB 2014).

[1] Although a more recent version of the almanac was available in 2013, this 2009 version of the almanac is the latest version that contains TAC information.

Ultrafine Particulate Matter

UFP refers to a subfraction of currently regulated $PM_{2.5}$ and PM_{10} size particles. UFP is most often defined as particles with an aerodynamic diameter of 0.1 microns or smaller (Health Effects Institute 2013:1; CARB 2006:2; Kleeman et al. 2007:1).

Although UFP contribute only a small amount to total PM mass they have a large surface area and often high number concentrations. Because of its small size, a given mass of UFP contains thousands to tens of thousands more particles, with a correspondingly larger surface area, than an equivalent mass of $PM_{2.5}$ or PM_{10}. This means that a given mass of UFP can impact a larger surface area of lung tissue than equal mass of $PM_{2.5}$ or PM_{10}, thus increasing exposure (Delfino et al. 2005:934). UFP behaves much like a gas and may be inhaled more deeply into the lung than larger particles (Oberdörster 2001:1).

Both laboratory and epidemiological studies indicate that exposure to UFP may lead to adverse health effects in animals and humans (Health Effects Institute 2013:2; Froines 2006) and toxicological studies have concluded that UFP is more toxic than larger sized particles (Zhu et al. 2002a:4324; Li et al. 2003:455). Experimental studies suggest that the adverse health effects of exposure to UFPs differ from those of larger particles. Because of their physical characteristics, inhaled UFPs differ from larger particles in their deposition patterns in the lung, their clearance mechanisms, and in their potential for translocation from the lung to other tissues in the body (Health Effects Institute 2013:3). UFP passes rapidly into the human circulatory system, increasing the number of particles in the blood and thus increasing exposure to other organs (Nemmar et al. 2002:411). They have also been shown to contain many toxic components such as metals, carbon, and organic compounds which may initiate or play a role in many types of harmful tissue-level oxidant processes that can damage the heart, lung, and other organs (CARB 2006:3-4; Oberdörster 2001:1; Donaldson et al. 2001:526; Stölzel et al. 2007:458). UFP has also been found to be more potent than $PM_{2.5}$ and PM_{10} in inducing cellular damage (Li et al. 2003:455 to 456). Observed effects in selected studies include lung function changes, airway inflammation, enhanced allergic responses, vascular thrombogenic effects, altered endothelial function, altered heart rate and heart rate variability, accelerated atherosclerosis, and increased markers of brain inflammation (Health Effects Institute 2013:3, 36, 39, 45, 65).

The predominant source of UFP is combustion by on-road vehicles, off-road vehicles, and stationary sources (Health Effects Institute 2013:1; CARB 2006:3; Kleeman et al. 2007:1). Concentrations of UFP have been found to be substantially higher at locations proximate to and downwind of high-volume roadways, particularly roadways travelled by diesel-powered vehicles (Health Effects Institute 2013:3; Hagler et al. 2009:1229; Ham and Kleeman 2011:3988; Zhu et al. 2002a:4323). Studies have identified a strong correlation between ischemic heart disease and segments of Interstate 5 that regularly experience and stop-and-go traffic conditions with heavy vehicle braking (Cahill et al. 2011a:1129; Cahill et al. 2011b:1135). These studies found evidence that the UPF at these locations contain a substantial portion of transition metals, including nickel and copper, which result from brake and tire wear. The potential for health impacts of ultra-fine metals associated with cars braking and accelerating during meteorological inversion conditions is a serious health concern based on recent epidemiological studies (Cahill et al. 2011a:1135; Denier van der Gong et al. 2013:136). These transition metals have been identified as TACs by the Office of Environmental Health Hazard Assessment (OEHHA) (OEHHA 2014:4).

Concentrations of UFP often do not correlate well with concentrations of $PM_{2.5}$ and PM_{10} (CARB 2003a:4). Because of its smaller size UFP has different dispersion properties than $PM_{2.5}$ and PM_{10}. As aerosols, UFP does not undergo gravitational settling like $PM_{2.5}$ and PM_{10}. Because of coagulation processes wherein individual UFP particles collide with one another and adhere to form larger particles, there will be a continuous decrease in number concentration coupled with an increase in particle size. Thus, the combination of coagulation and dilution experienced by UFP results in a rapid decrease in concentration with downwind distance (Zhou and Levy 2007:93; Zhu et al. 2002a:4323). For these reasons, the concentration of UFP at a particular location is more a function of the proximity to a local source, and less a function of background levels, than is the case for $PM_{2.5}$ and PM_{10} (Zhou and Levy 2007:93). UFP number concentration measured at 300 meters (984 feet) downwind from a freeway was indistinguishable from upwind background concentration (Zhu et al. 2002a:4323; Zhou and Levy 2007:96).

Relatively low temperature and high humidity are associated with higher rates of new particle formation and slower atmospheric dispersion, indicating that UFP concentrations will generally be higher in the winter than in the summer (Sioutas et al. 2005:951; Cahill et al. 2011a:173; Cahill et al. 2014:173).

Numerous field studies indicate that both diesel PM and UFP concentrations are substantially higher near heavily travelled roadways (Health Effects Institute 2013:3). Therefore, it is inferred that vehicles traveling on I-80 are the primary source of UFPs at and near the 2018 LRDP area. Some of the characteristics of the segment of I-80 that passes by the 2018 LRDP area site suggest that the area may be exposed to higher UFP concentrations than is typical for areas adjacent to freeways. First, as shown in the wind rose presented in Exhibit 3.3-1, the predominant wind direction is from I-80 and toward the UC Davis campus. There are also periods when the wind direction is nearly parallel to I-80 such that the 2018 LRDP area is exposed to vehicle emissions from multiple segments of the freeway at the same time—a concept referred to as “linear enhancement.” Linear enhancement has been shown to occur on I-80 upwind of the 2018 LRDP area using the National Ocean and Atmospheric Administration’s Hybrid Single Particle Lagrangian Integrated Trajectory Model (Cahill, pers. comm., 2015:16-17). A portion of the adjacent I-80 segment is elevated and field studies found that freeway-generated pollutant concentrations can be the same level as far as 1,000 feet from the freeway as they are at the freeway edge (Feeney et al. 1975:1147; Cahill, pers. comm., 2015:19). Parts of the 2018 LRDP area, particularly those south of Putah Creek, are located within 1,000 feet of the I-80. Also, I-80 frequently experiences heavy congestion as traffic from nearby SR 113 and east-bound I-80 merge and cause heavy braking by trucks and other vehicles. This type of congestion often occurs during the afternoon/evening commute period. As discussed above, multiple field studies have found that brake and tire wear emissions include transitional metals that are considered TACs. Moreover, the stop-and-go traffic conditions also result in more exhaust emissions than free flowing traffic.

Naturally Occurring Asbestos

Asbestos is the common name for a group of naturally occurring fibrous silicate minerals that can separate into thin but strong and durable fibers. Naturally occurring asbestos, which was identified as a TAC by CARB in 1986, is located in many parts of California and is commonly associated with serpentine soils and rocks. According to two reports by the California Department of Conservation, Division of Mines and Geology, the project area is not likely to contain naturally occurring asbestos (California Department of Conservation 2000).

Odors

Odors are generally regarded as an annoyance rather than a health hazard. However, manifestations of a person’s reaction to foul odors can range from psychological (e.g., irritation, anger, or anxiety) to physiological (e.g., circulatory and respiratory effects, nausea, vomiting, and headache).

With respect to odors, the human nose is the sole sensing device. The ability to detect odors varies considerably among the population and is subjective. Some individuals can smell minute quantities of specific substances; others may not have the same sensitivity but may have sensitivities to odors of other substances. In addition, people may have different reactions to the same odor; an odor that is offensive to one person may be acceptable to another (e.g., fast food restaurant). It is important to also note that an unfamiliar odor is more easily detected and is more likely to cause complaints than a familiar one. This is because of the phenomenon known as odor fatigue, in which a person can become desensitized to almost any odor and recognition only occurs with an alteration in the intensity.

Quality and intensity are two properties present in any odor. The quality of an odor indicates the nature of the smell experience. For instance, if a person describes an odor as flowery or sweet, then the person is describing the quality of the odor. Intensity refers to the strength of the odor. For example, a person may use the word strong to describe the intensity of an odor. Odor intensity depends on the odorant concentration in the air. When an odorous sample is progressively diluted, the odorant concentration decreases. As this occurs, the odor intensity weakens and eventually becomes so low that the detection or recognition of the odor is quite difficult. At some point during dilution, the concentration of the odorant reaches a detection threshold. An odorant concentration below the detection threshold means that the concentration in the air is not detectable by the average human.

Land uses that are major sources of odor typically include wastewater treatment and pumping facilities, sanitary landfills, transfer stations, recycling and composting facilities, major livestock facilities, and various industrial uses such as chemical manufacturing and food processing. Currently, the UC Davis Dairy Facility is located within the project site boundaries. Wind patterns in the area tend to carry odors from the UC Davis Dairy Facility in a north-northwesterly direction toward existing student apartments located along the west side of La Rue Road south of Russell Boulevard.

Three other major sources currently surrounding the UC Davis campus include the UC Davis Feedlot and Swine Facility, located one mile west of SR 113 adjacent to the University Airport; the Animal Science Beef Barn, located just west of SR 113 along Garrod Drive; and the UC Davis Renewable Energy Anaerobic Digester (READ) facility, located just west of Pedrick Road north of Putah Creek. These odor sources are located over 1,000 feet away from the main campus boundary; or, the crosswind would prevent odors from these sources from reaching the main campus.

Sensitive Land Uses

Sensitive land uses generally include uses where prolonged exposure to pollutants could result in health-related risks to individuals. Residential dwellings and places where people recreate or congregate for extended periods of time such as parks or schools are of primary concern because of the potential for increased and prolonged exposure of individuals to pollutants. Sensitive receptors on these land uses include, but are not limited to, children, the elderly, those with respiratory conditions, and those using outdoor athletic facilities where occupants have a relatively higher breathing rates.

A number of existing sensitive land uses are located adjacent to or within to the UC Davis campus, including multi-family residential dwellings, medical facilities, outdoor athletic facilities, child care facilities, worship centers, and outdoor playgrounds. There are five child care centers on the UC Davis campus, including the Early Childhood Lab School at the Center for Child and Family Studies, Hutchinson Child Development Center, LaRue Park Child Development Center, the Russell Park Child Development Center, and the Perfect Tender Infant Care cooperative at King Hall. Families with small children may also reside in on-campus student apartments.

3.3.3 Environmental Impacts and Mitigation Measures

SIGNIFICANCE CRITERIA

Based on Appendix G of the State CEQA Guidelines, an air quality impact is considered significant if implementation of the project would do any of the following:

- conflict with or obstruct implementation of the applicable air quality plan;
- violate any air quality standard or contribute substantially to an existing or projected air quality violation (Table 3.3-3);
- result in a cumulatively considerable net increase of any criteria air pollutant for which the project region is in nonattainment under any applicable National or State ambient air quality standards (including releasing emissions that exceed quantitative standards for ozone precursors);
- expose sensitive receptors to substantial pollutant concentrations (including TACs/HAPs); or
- create objectionable odors affecting a substantial number of people.

As stated in Appendix G of the State CEQA Guidelines, the significance of criteria established by the applicable air quality management or air pollution control district may be relied upon to make the above determinations. For local plans, such as the 2018 LRDP, YSAQMD recommends demonstrating consistency with the YSAQMD's AQAP and SIP strategies in order to claim a less-than-significant impact on air quality (YSAQMD 2007:7). According to discussions with YSAQMD, the 2017 SIP does not account for the growth anticipated under the 2018 LRDP and, as such, YSAQMD's project-level thresholds may be used in place of the plan-level thresholds (Jones, pers. comm., 2018b). This approach is also consistent with the 2003 LRDP EIR which also used project-level thresholds recommended by YSAQMD at that time. Thus, the plan would result in a potentially significant impact on air quality if it would result in the following during either short-term construction of projects under or long-term implementation of the 2018 LRDP:

- cause criteria air pollutant or precursor emissions to exceed 10 tpy for ROG, 10 tpy for NO_X, 80 pounds per day (lbs/day) of PM_{10}, or substantially contribute to CO emissions concentrations that exceed the CAAQS; and/or
- cause odorous emissions in such quantities as to cause detriment, nuisance, or annoyance to any considerable number of persons or to the public, or which may endanger the comfort, repose, health, or safety of any such person or the public, or which may cause, or have a natural tendency to cause, injury or damage to business or property. (YSAQMD 2007).

For the evaluation of CO impacts, YSAQMD developed the following screening criteria above which a project would be considered to have the potential to violate the CO standard.

- A traffic study for the project indicates that the peak-hour Level of Service (LOS) on one or more streets or at one or more intersections in the project vicinity will be reduced to an unacceptable LOS (typically LOS E or F); or
- A traffic study indicates that the project will substantially worsen an already existing peak-hour LOS F on one or more streets or at one or more intersections in the project vicinity. "Substantially worsen" includes situations where delay would increase by 10 seconds or more when project-generated traffic is included.

For the evaluation of TAC emissions, YSAQMD considers proposed development projects that have the potential to expose the public to TACs from stationary sources in excess of the following thresholds to have a significant impact. These thresholds are based on YSAQMD's Risk Management Policy (YSAQMD 2007:7).

- Probability of contracting cancer for the Maximally Exposed Individual (MEI) equals to 10 in one million or more.
- Ground-level concentrations of non-carcinogenic TACs would result in a Hazard Index (HI) equal to or greater than 1 for the MEI.

Although YSAQMD has not developed thresholds of significance for evaluating the exposure of sensitive receptors to mobile-source TACs, YSAMQD recommends applying the TAC thresholds for stationary sources to apply to all potential sources, including mobile sources (YSAQMD 2007:7; Jones pers. comm., 2017a), such as when development of residential dwelling units is proposed in close proximity to a high-volume roadway.

YSAQMD, like all other air districts in California, has not identified a threshold of significance for UFPs.

- On a cumulative basis, YSAQMD finds that any exceedance of project-level thresholds would also result in a significant cumulative impact. In addition, YSAQMD considers combined CO impacts from the project and other existing projects (i.e., background concentration) that exceed air quality standards as cumulatively significant. A screening criteria method may be used to determine if cumulative development could cause a violation of the CAAQS.

ANALYSIS METHODOLOGY

Construction

Construction-related emissions of criteria air pollutants and precursors were calculated using the California Emissions Estimator Model (CalEEMod) Version 2016.3.2 computer program (SCAQMD 2017), as recommended by YSAQMD. Modeling was based on project-specific information (e.g., land use types, traffic modelling, building sizes), where available, reasonable assumptions based on typical construction activities, and default values in CalEEMod that are based on the project's location and land use type. CalEEMod accounts for known policies and regulations that may affect emissions calculations, such as state and federal emission standards for diesel offroad equipment and local air district architectural coating VOC limits (SCAQMD 2017b). For a detailed description of model input and output parameters, and assumptions, refer to Appendix C.

The 2018 LRDP does not specify the timing of potential construction activities other than for the construction of the West Village Expansion and Orchard Park Redevelopment components, which are analyzed in Volumes 2 and 3. The construction of the West Village Expansion and Orchard Park Redevelopment components are assumed to occur simultaneously starting as early as August 2018 and lasting through fall of 2020. Construction of additional academic building space under the 2018 LRDP could begin as soon as 2019. It is assumed that an average of 200,000 square feet (sf) of academic building space would be constructed per year under the 2018 LRDP. Other components of the 2018 LRDP, such as recreational space and infrastructure, would be constructed starting in 2021 after the completion of the West Village Expansion and Orchard Park Redevelopment components. See Table 3.3-4 for a general summary of the construction schedule that would occur under the 2018 LRDP.

Table 3.3-4 2018 LRDP General Construction Schedule

Project Component	2018[a]	2019–2020	2021–2031
West Village Expansion	X	X	
Orchard Park Redevelopment	X	X	
Academic Building Space (200,000 sf./year)		X	X
Campus Recreation & Intercollegiate Athletics			X
Other Residential Land Use Designations[b]			X
Infrastructure		X	X

Notes: "X" indicates year or years in which the construction of a project component would occur

[a] Construction would begin in September
[b] Excludes those in the West Village Expansion and Orchard Park Redevelopment

Source: Data compiled by Ascent Environmental in 2018.

For construction years 2018 through 2019, annual and maximum daily construction emissions are based on the combined results of CalEEMod runs for the construction of West Village Expansion and Orchard Park Redevelopment in addition to the model results from construction of 200,000 sf of academic building space per year in 2019 and 2020. For construction years 2021 through 2031, the exact construction schedule of the remainder of the 2018 LRDP components (e.g., recreational space) is unknown. To simplify the analysis of construction emissions in these years, the construction activity of the remaining housing, academic building space, recreational space, and infrastructure are amortized over the remaining 10 years to estimate average annual construction activity, associated annual emissions, and maximum daily emissions that may occur within a year of construction. Consistent with the assumptions made in the 2010 UC Davis Climate Action Plan, modeling assumes that an average of 100,000 sf of building space would be removed per year (UC Davis 2010:28). However, in order to present a reasonable conservative assessment of potential construction under the 2018 LRDP and to account for more demolition in one year than another, this analysis assumes that up to 200,000 sf of building space could be demolished/removed in a given year.

Construction-related emissions of TACs were evaluated based on the mass of $PM_{2.5}$ exhaust emitted by heavy-duty construction equipment, which is considered a surrogate for diesel PM, the duration of equipment use at any single location, the proximity of nearby sensitive receptors.

Table 3.3-5 summarizes the project-related activities for which emissions were estimated; the model, protocol, and source of emission factors used; and the key input parameters on which each activity's emissions were determined. Operational emissions include those stationary-source emissions generated by activity under the 2018 LRDP.

Operation

Operation-related emissions of criteria air pollutants and precursors from building energy use, area sources (i.e., architectural coating, consumer products, and landscaping), stationary sources, and mobile sources were calculated using a variety of models and reports. CalEEMod Version 2016.3.2 was used to estimate emissions from building energy use, area sources, and combustion-based stationary sources. CalEEMod also accounts for policies that may affect operational emissions factors, such as state and federal vehicle emission standards, discussed further below. These policies are accounted for in modeling results, unless otherwise noted.

Table 3.3-5 Parameters Used to Estimate Project-Related Construction and Operational Emissions of Criteria Air Pollutants and Precursors

Land use/Source	Model/Protocol/ Source of Emission Factors	Key Input Parameter(s)
Construction Emissions		
West Village Expansion	See Volume 2 for details	See Volume 2 for details
Orchard Park Redevelopment	See Volume 3 for details	See Volume 3 for details
Academic and Administrative Designated Land Use	CalEEMod	200,000 asf/year of Research and Development land use type
Other Land Use Types (recreational, additional housing, infrastructure)	CalEEMod	27,600 sf health club space/year 4.20 acres of city park area/year 49 single family homes/year 179 sf general heavy industry/year 136 mid-rise apartments/year
Operational Emissions		
Building Energy - Natural Gas	CalEEMod	Assumes buildings are 20% more efficient than Title 24 standards
Stationary Source – Laboratories[a]	UC Berkeley laboratory study, consistent with method used in 2003 LRDP	Assumes new laboratory or other stationary sources would operate in up to 52 campus buildings.
Stationary Source – Composting Facility[a]	CARB's Emissions Inventory Methodology for Composting Facilities	Assumes 20,000 tons per year of material by 2030. Uses CARB emission factors.
Stationary Source – Expanded WWTP[a]	BAAQMD Permit Handbook (Chapter 8.2) for wastewater treatment facilities	Assumes maximum increase of 1,682 MG/year
Stationary Source – Diesel Emergency Generators	CalEEMod	22 new 700-hp diesel generators operating 12 hours per year
Stationary Source – Biomass Boiler	CalEEMod	CalEEMod does not have emission factors for biomass boilers. A 200-kW diesel boiler was modeled in its place as a conservative proxy.
Area Source	CalEEMod	Default parameters based on land use inputs except for hearths. Assumed no fireplaces or wood-burning stoves.
Mobile	EMFAC 2017 and VMT data modeled by Fehr and Peers	Emission factors from EMFAC 2017 applied to VMT data provided by Fehr and Peers. VMT based on travel demand model and on-site traffic counts. Trips include Unitrans buses and campus-operated fleet.

Notes: asf = assignable square footage; BAAQMD = Bay Area Air Quality Management District; CARB = California Air Resources Board; CNG = compressed natural gas; HRA = health risk assessment; kW= kilowatt; VMT = vehicle miles travelled; LRDP = Long Range Development Plan; MG = million gallons; UC = University of California. Models: CalEEMod v.2016.3.2, EMFAC 2017

[a] See the 2018 LRDP HRA in Appendix D for more information on method sources and assumptions.

Source: Data compiled by Ascent Environmental in 2018, Yorke Engineering 2018

Process-based stationary sources, such as a potential composting facility and the wastewater treatment plant, were based on emission reports from the HRA conducted by Yorke Engineering for the 2018 LRDP (Yorke Engineering 2018). Mobile source emissions were based on emission factors from CARB's emission factor model, Emission FACtor model (EMFAC 2017) and vehicle activity estimated by Fehr and Peers for the 2018 LRDP, as shown in Section 3.16, "Transportation, Circulation, and Parking" (CARB 2017c). Modeling in all cases was based on 2018 LRDP-specific information (e.g., land use types, traffic modelling, building sizes), where available, reasonable assumptions based on typical construction activities, and default model values based on the 2018 LRDP's location and land use types. For a detailed description of model input and output parameters, and assumptions, refer to Appendix C. Operation of the 2018 LRDP is assumed to begin in 2020, the year in which West Village Expansion and Orchard Park Redevelopment components would be completed. West Village Expansion and Orchard Park Redevelopment would be the first projects to be completed under the 2018 LRDP and whose first full year of operation would occur in 2021.

With respect to building energy, only natural gas use would result in direct on-site criteria air pollutants and precursor emissions. Total natural gas use during project operation was based on defaults for the new land uses that would operate under the 2018 LRDP and accounted for reductions in existing natural gas use because of renovation of existing buildings under the 2018 LRDP. Except for the West Village Expansion, CalEEMod was used to calculate net emissions from the anticipated net change in natural gas use at implementation. Building energy use at the West Village Expansion is assumed to use electricity only, consistent with the current West Village development (UC Davis 2014).

Operational area source emissions from reapplication of architectural coating, consumer products, and landscaping were estimated using CalEEmod based on model defaults for the applied land uses. The analysis assumed the project would not include fireplaces or wood-burning stoves per YSAQMD Rule 2.40.

With respect to combustion-based stationary sources, the UC Davis indicated that up to 22 new diesel emergency generators and one biomass boiler would be operated under the 2018 LRDP in addition to existing sources. CalEEMod was used to estimate emissions from the diesel emergency generators. It was conservatively assumed that each generator would have an average rating of 700 horsepower (hp) and would operate at a maximum of one hour per day and up to 12 hours per year for maintenance and testing purposes, based on discussions with UC Davis (Pfohl, pers. comm., 2018). No changes were made to model defaults other than specifying the number of generators, fuel type, hours, and horsepower. For the biomass boiler, the biomass boiler would be rated at 200 kilowatts (268 hp). The biomass boiler would use animal bedding (e.g., wood chips, hay) and manure as fuel and would operate 24 hours per day and 365 days per year (Mitchell, pers. comm., 2017). CalEEMod does not have an option for biomass as a fuel type; therefore, diesel was selected as a proxy for biomass as a conservative approach.

Other stationary sources include potential laboratory or similar stationary sources in up to 52 campus buildings, a new composting facility, and modified wastewater treatment plant. Emissions from these sources were estimated based on results from the HRA conducted for the 2018 LRDP by Yorke Engineering used in the TAC analysis. Although the reported TACs listed in the HRA may not include all possible ROG emissions, Yorke Engineering's methods are conservative and based on operation-specific emission factors. Laboratory emissions were based on a UC Berkeley study that was also used in estimating laboratory emission in the 2003 LRDP; composting emissions were based on CARB-recommended composting emission factors; and wastewater emissions were based on factors from the Bay Area Air Quality Management District (BAAQMD) – the closest air district available with wastewater emissions factors (Yorke Engineering 2018: 11-14). ROG emissions reported in the HRA were considered the most accurate information available to estimate criteria pollutant emissions from laboratories, proposed potential composting facility, and modified wastewater treatment (Yorke Engineering 2018:Table 2-1).

With respect to mobile sources, EMFAC 2017 was used to estimate annual and daily criteria air pollutant emissions from vehicle miles travelled (VMT) generated by the project, which was available from Fehr and Peers and is provided in Section 3.16, “Transportation, Circulation, and Parking.” Fehr and Peers provided daily VMT by three vehicle categories (passenger and light duty trucks, trucks 2, and trucks 3) and by 5-mile-per-hour speed bins from 0 to 70 miles per hour. These VMT estimates were based on travel demand models and traffic counts within the campus cordon over a three-day mid-week average during fall of 2016. EMFAC 2017 is CARB’s latest update to the EMFAC model series and takes into account effects of future policies and economic forecasts. The modeled emission factors reflect the county average vehicle mix and usage rates forecast for Yolo County in 2021, the first full year of operation of West Village Expansion and Orchard Park Redevelopment, and 2030, the 2018 LRDP’s approximate implementation year. Daily VMT were adjusted to annual VMT using a conversion factor of 287 which accounts for UC Davis’s academic schedule, holidays, and enrollment levels during summer and regular academic quarters. See Appendix C for calculation details. See Section 3.16, “Transportation, Circulation, and Parking,” for additional analysis of VMT associated with the project.

With respect to impacts from CO emissions, roadway and intersection traffic volumes from the traffic analysis presented in Section 3.16, “Transportation, Circulation, and Parking,” were used to determine significance related to localized CO impacts, particularly from vehicular emissions, explained further in Impact 3.3-3.

Exposure to Toxic Air Contaminants

Health risk from construction-related emissions was assessed based on the proximity of TAC-generating construction activity to off-site sensitive receptors, the number and types of diesel-powered construction equipment being used, and the duration of potential TAC exposure.

The level of health risk exposure from operational stationary TAC sources on the UC Davis campus is evaluated based on results of the HRA conducted by Yorke Engineering for both stationary and rail and on-road mobile sources related affecting the campus currently and under 2018 LRDP implementation (Yorke Engineering 2018). The HRA was based on the impacts associated with the follow new, modified, or proposed sources under the 2018 LRDP, as shown in Table 3.3-6.

To assess the potential human health risks posed by the 2018 LRDP’s TAC emissions, the HRA followed the methodologies outlined in the OEHHA Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA 2015). Based on consultations between UC Davis, YSAQMD, and Yorke Engineering, the HRA followed methodologies outlined in the modeling protocol that was submitted to the YSAQMD on February 7, 2017 (Yorke Engineering 2018: Appendix 1). As recommended by the 2015 OEHHA guidelines, CARB’s Hotspots Analysis and Reporting Program, Version 2 was used to perform the OEHHA Tier 1 HRA for the Project. Dispersion modeling was conducted using the EPA’s Atmospheric Dispersion Model. Other model assumptions and additional details can be found in the full HRA located in Appendix D.

Table 3.3-6 New and Existing Toxic Air Contaminant Sources Quantified Considered in the Health Risk Assessment

Existing Sources[a]	New Sources under 2018 LRDP
73 buildings with laboratories	Laboratory or other similar stationary sources would be added to 52 campus buildings
86 diesel-fired emergency generators	Up to 22 new diesel-fired emergency generators
19 natural gas emergency generators	1 new biomass boiler
Veterinary medicine incinerator	1 new composting facility
Environmental Services Facility (hazardous materials bulking)	Increased wastewater treatment throughput from 2017 to 2031
Campus diesel-fueled mobile sources	
Closed landfill, with landfill gas collection system	
Four digester gas turbines	
One digester gas flare	
Diesel trucks on State Route 113	
Diesel trucks on Interstate 80	

Notes: [a] Sources that will continue through 2018 LRDP implementation

Source: Yorke Engineering 2018.

Exposure to Ultrafine Particulate Matter

Potential concentrations of UFP at UC Davis are evaluated based on measured the UFP concentrations in the vicinity of UC Davis (Barnes 2015) and a review of the literature about the associated health effects of UFP exposure. Attributes unique to the 2018 LRDP area, the nearby segment of I-80, and other surrounding traffic are also considered, including the constituents of the measured UFPs; the relative orientation of the 2018 LRDP area, the freeway, and the predominant wind direction; and typical traffic conditions. Health effects associated with exposure to UFPs were based, in part, on the results of the TAC analysis included in the HRA. UFPs are a subset of PM, and the list of recognized TAC pollutants in the HRA include diesel PM and other pollutants that can manifest as PM.

ISSUES NOT EVALUATED FURTHER

All issues applicable to air quality, as outlined by the significance criteria above, are evaluated below.

IMPACTS AND MITIGATION MEASURES

Impact 3.3-1: Construction-generated emissions of ROG, NO_X, and PM_{10}.

Construction-generated emissions would potentially exceed YSAQMD's significance thresholds for ROG, NO_X, and PM_{10} during construction. Therefore, this impact would be **potentially significant.**

The construction of the 2018 LRDP would result in emissions of ROG, NO_X, and PM_{10}. Although YSAQMD does not recommend $PM_{2.5}$ thresholds, estimates of construction-related $PM_{2.5}$ emissions, which are a subset of PM_{10} emissions, are shown for information purposes only. Construction emissions are summarized in Table 3.3-7, below. Refer to Appendix C for a detailed summary of the modeling assumptions, inputs, and outputs.

Table 3.3-7 Summary of Modeled Emissions of Criteria Air Pollutants and Precursors Associated with 2018 LRDP Construction Activities – Unmitigated

Year(s) of Construction	Annual Emissions		Maximum Daily Emissions	
	ROG (ton/year)	NO_X (ton/year)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)[a]
2018	0.6	6.2	374.8	45.7 (7.0) [b]
2019	4.2	22.2	412.0	60.0 (8.4) [b]
2020	15.3	10.5	411.2	59.3 (7.7) [b]
2021 - 2031	4.2	11.4	108.5	34.0 (7.1) [b]
YSAQMD Thresholds of Significance	10	10	80	NA
Exceed Threshold of Significance?	**Yes**	**Yes**	**Yes**	NA

Notes: Modeled values represent maximum daily and annual emissions that would occur over the duration of the construction period. See Appendix C for detail on model inputs, assumptions, and project specific modeling parameters.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; lb/day = pounds per day; NA = not available; YSAQMD = Yolo Solano Air Quality Management District

[a] Although YSAQMD does not recommend $PM_{2.5}$ thresholds, estimates of construction-related $PM_{2.5}$ emissions, which are a subset of PM_{10} emissions, are shown for information purposes only.

[b] Numbers in parenthesis represent the portion of $PM_{2.5}$ emissions from exhaust. Numbers not in parenthesis represent fugitive and exhaust emissions combined.

Source: Modeling conducted by Ascent Environmental in 2018.

As shown in Table 3.3-6, construction of the 2018 LRDP components would result an exceedance of ROG emissions thresholds in 2020; NO_X thresholds in 2019 and 2021 through 2031, and PM_{10} thresholds throughout the 2018 LRDP period. The exceedance of ROG thresholds in 2020 is primarily because of the simultaneous application of architectural coatings at the West Village Expansion component, Orchard Park Redevelopment component, and academic building space throughout the campus. The exceedance of NO_X thresholds in multiple years is primarily due to exhaust from the combustion of diesel fuel in off-road construction equipment during building construction. Construction activities would result in PM_{10} emissions that are nearly five times YSAQMD's threshold for PM_{10}. Based on model outputs shown in Table 3.3-8, between 2018 and 2020, approximately 95 percent of construction-related PM_{10} emissions are because of fugitive dust generated from on-road construction worker, vendor, and hauling vehicles travelling on unpaved roads on-site. See Appendix C for further details related to the sources of construction-related emissions of ROG and NO_X.

Although the 2018 LRDP area is mostly developed and has existing paved roadways, many construction sites are undeveloped, including undeveloped areas of West Village Expansion and various open space and teaching and research fields (see Exhibit 2-3, Exhibit 2-4, and Table 2-1 in Chapter 2, "Project Description"). Based on the relatively developed area surrounding the 2018 LRDP, it is estimated that approximately one percent of roadways travelled on by construction workers, vendors, and haulers are unpaved. Despite the small percentage of unpaved roadways, the modeled frequency of worker, vendor, and hauling trips results in dust-related PM_{10} emissions significantly exceeding 80 lb/day. This exceedance is mainly because of the overlapping construction activity between construction of the West Village Expansion, Orchard Park Redevelopment, and other 2018 LRDP components as shown in Table 3.3-4.

Table 3.3-8 Sources of PM_{10} Emissions Associated with 2018 LRDP Construction Activities – Unmitigated

Year(s) of Construction	Maximum Daily PM_{10} Emissions (lb/day)				
	Fugitive Dust from on-road vehicles[a]	Fugitive Dust from off-road equipment	Diesel Exhaust from on-road vehicles[a]	Diesel Exhaust from off-road vehicles	Total
2018	368.7	0[b]	0.5	5.6	374.8
2019	385.0	18.1	0.5	8.5	412.0
2020	385.0	18.1	0.5	7.8	411.2
2021 - 2031	64.6	36.1	0.1	7.6	108.5

Notes: Modeled values represent maximum daily emissions that would occur over the duration of the construction period which would occur during building construction phases. All construction equipment is assumed to be diesel-powered. See Appendix C for detail on model inputs, assumptions, and project specific modeling parameters.

[a] Hauling, vendor, and worker vehicles.

[b] Maximum daily PM emissions are anticipated to occur only during the building construction phases. Fugitive dust emissions from off-road equipment would occur during other construction phases during this year.

PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; lb/day = pounds per day

Source: Modeling conducted by Ascent Environmental in 2018.

As discussed above, construction of the 2018 LRDP would exceed YSAQMD's ROG, NO_X, and PM_{10} thresholds starting in 2019. Estimated construction emissions associated with proposed uses in the 2018 LRDP would exceed YSAQMD thresholds. Thus, this impact would be **potentially significant.**

Mitigation Measure 3.3-1: Reduce construction-generated emissions of ROG, NO_X, and PM_{10}.

Land use development project implemented under the 2018 LRDP shall require its prime construction contractor to implement the following measures:

1) Use construction equipment with engines rated at Tier 3 or better.

2) Use no- or low-solids content (i.e., no- or low-VOC) architectural coatings with a maximum VOC content of 50 g/L.

3) Limit passenger vehicles (i.e., non-vendor and non-hauling vehicles) from being driven on extended unpaved portions of project construction sites. UC Davis shall provide off-site paved parking and compliant site-transport arrangements for construction workers, as needed.

4) Water all active construction sites at least twice daily.

5) Plant vegetative ground cover in disturbed areas as soon as possible.

6) Apply soil stabilizers on unpaved roads and inactive construction areas (disturbed lands within construction projects that are unused for at least four consecutive days).

7) Establish a 15 mile-per-hour speed limit for vehicles driving on unpaved portions of project construction sites.

UC Davis shall ensure that the implementation of this mitigation measure is consistent with the UC Davis stormwater program and the California Stormwater Quality Association *Stormwater BMP Handbook for New Development/Redevelopment* and does not result in off-site runoff as a result of watering for dust control purposes.

Significance after Mitigation

Implementation of Mitigation Measure 3.3-1 would ensure that all development under the 2018 LRDP would not generate construction-related emissions of ROG and PM_{10} that exceed YSAQMD significance criteria, but emissions of NO_X would still exceed YSAQMD significance criteria. Table 3.3-9 shows the modeled emissions after mitigation. Though NO_X emissions would only exceed YSAQMD thresholds in 2019, this analysis addresses the impact of the 2018 LRDP in its entirety, including annual emissions in 2019 which is within the plan's implementation period. Therefore, this impact would be **significant and unavoidable** even with implementation of this mitigation measure.

Table 3.3-9 Summary of Modeled Emissions of Criteria Air Pollutants and Precursors Associated with 2018 LRDP Construction Activities – Mitigated

Year(s) of Construction	Annual Emissions		Maximum Daily Emissions	
	ROG (ton/year)	NO_X (ton/year)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)[a]
2018	0.3	3.6	28.5	10.3 (4.4)[b]
2019	2.2	17.8	54.4	23.3 (7.2)[b]
2020	7.5	8.3	54.3	23.2 (7.1)[b]
2021 - 2031	1.7	8.7	40.3	21.9 (6.6)[b]
YSAQMD Thresholds of Significance	10	10	80	NA
Exceed Threshold of Significance?	No	**Yes**	No	NA

Notes: Modeled values represent maximum daily and annual emissions that would occur over the duration of the construction period. See Appendix C for detail on model inputs, assumptions, and project specific modeling parameters.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; lb/day = pounds per day; tpy = tons per year; NA = not available; YSAQMD = Yolo Solano Air Quality Management District

[a] Although YSAQMD does not recommend $PM_{2.5}$ thresholds, estimates of construction-related $PM_{2.5}$ emissions, which are a subset of PM_{10} emissions, are shown for information purposes only.

[b] Numbers in parenthesis represent the portion of $PM_{2.5}$ emissions from exhaust. Numbers not in parenthesis represent fugitive and exhaust emissions combined.

Source: Modeling conducted by Ascent Environmental in 2018 based on modeling using CalEEMod v. 2016.3.2

Impact 3.3-2: Operational emissions of criteria air pollutants and precursor emissions.

Operational activities associated with the 2018 LRDP would result in long-term project-generated emissions of criteria air pollutants, particularly ROG and NO_X. Long-term, operational emissions could exceed YSAQMD significance thresholds for ROG and NO_X but would not exceed YSAQMD thresholds for PM_{10} and $PM_{2.5}$. Thus, long-term operational emissions of ROG and NO_X could conflict with the air quality planning efforts and contribute substantially to the nonattainment status of Yolo County with respect to the NAAQS and CAAQS for ozone. This would be a **potentially significant** impact.

The 2018 LRDP would result in new stationary sources, mobile sources, and area sources of ROG, NO_X, PM_{10}, and $PM_{2.5}$ from the operation of a new composting facility, expansion of the campus wastewater treatment plant, a new biomass boiler, new residential land uses, academic building space, and recreation and athletic facilities.

Area Sources

Area sources of emissions during 2018 LRDP operation include reapplication of architectural coatings, consumer products, and landscaping equipment. Architectural coating, consumer products, and landscaping emissions result from typical residential and non-residential building operation through regular building maintenance and occupancy. Consumer products include various solvents that emit ROG through product use and include cleaning supplies, toiletries, and kitchen aerosols (SCAMQD 2017b:41). Landscaping emissions include exhaust emissions from the use of landscaping equipment such as gasoline-powered lawn mowers and leaf blowers.

Natural Gas Use

Combustion of natural gas at new facilities under the 2018 LRDP would result in increased emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$. Natural gas is used to provide space, water, and equipment heating to new buildings and academic facilities, such as laboratories.

Stationary Sources

Stationary sources during 2018 LRDP implementation could include potential future laboratory space, a composting facility, possible modifications to the wastewater treatment plant, a biomass boiler, and diesel emergency generators. Emissions from new stationary sources are controlled through YSAQMD's permitting process through Rule 3.4, New Source Review. The main campus of UC Davis is designated as a Title V federal facility within YSAQMD's jurisdiction and any new permitted sources are required to be incorporated into the facility Title V permit. As with the campus' existing permitted sources, these new sources within UC Davis would be required to apply BACT. UC Davis would also be required to purchase ERCs to offset emissions from new sources per YSAQMD guidance. The level to which emissions would be offset through ERCs would be determined at the time of the permit application process for new sources under the 2018 LRDP. As a conservative approach, emissions reductions from the purchase of ERCs are not included in this analysis.

Research activity in laboratories result in various ROG emissions including those commonly associated with cleaning solvents as well as those specific to type of research being conducted (Yorke Engineering 2018). Composting results in ROG emissions through biochemical processes during decomposition, releasing organic compounds such as alcohols, acids, and odors through fugitive mechanisms (Kumar et. al. 2011; CARB 2015). Similar biochemical processes occur during treatment of liquid organic waste at the wastewater treatment plant. The potential future biomass boiler and diesel-fueled emergency generators would result in exhaust emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$ through the combustion of biomass and diesel fuels.

Mobile Source Emissions

2018 LRDP-generated mobile-source emissions of ROG, NO_X, PM_{10}, and $PM_{2.5}$ were modeled using 2018 LRDP-specific data and applicable emission rates. Mobile-source emissions of criteria air pollutants and ozone precursors would result from employee and student commute trips, campus-operated fleet, vendors, and visitors. The 2018 LRDP would result in 250,000 more VMT per day compared to existing conditions as stated in Section 3.16, "Transportation, Circulation, and Parking."

Table 3.3-10 summarizes the modeled operation-related emissions of criteria air pollutants and precursors under implementation conditions in 2031. As shown in this table, operational emissions associated with implementation of the 2018 LRDP could exceed established YSAQMD thresholds and impacts would be **potentially significant.**

Table 3.3-10 Summary of Modeled Operational Emissions of Criteria Air Pollutants and Precursors Associated with 2018 LRDP Implementation – Unmitigated

Emissions Source	Annual Emissions		Maximum Daily Emissions	
	ROG (tpy)	NO_X (tpy)	PM_{10} (lb/day)	$PM_{2.5}$ (lb/day)[a]
West Village Expansion (starting in 2021)				
Area Source: Building Operations[b,c]	6.4	0.1	0.6	0.6
Natural Gas[d]	0.0	0.0	0.0	0.0
Mobile[e]	3.2	4.7	4.6	2.1
Subtotal	*9.6*	*4.8*	*5.2*	*2.7*
Orchard Park Redevelopment (starting in 2021)				
Area Source: Building Operations[b,c]	3.1	0.0	0.3	0.3
Natural Gas[d]	0.0	0.2	0.1	0.1
Mobile[e]	0.6	0.8	0.8	0.4
Subtotal	*3.7*	*1.1*	*1.2*	*0.7*
Other Potential New Land Uses under 2018 LRDP				
Area Source: Building Operations[b,c]	15.7	0.2	0.8	0.8
Natural Gas[d]	0.3	2.7	1.1	1.1
Stationary Source: Biomass Boiler and Emergency Generators[d]	0.2	0.6	0.0	0.0
Stationary Source: Laboratories[f]	1.2	0.0	0.0	0.0
Stationary Source: Composting Facility[f]	0.6	0.0	0.0	0.0
Stationary Source: WWTP Modifications[f]	0.3	0.0	0.0	0.0
Mobile[d]	5.5	3.6	22.2	9.0
Subtotal	*23.7*	*7.0*	*24.2*	*11.0*
All New Land Uses under 2018 LRDP				
Area Sources	25.1	0.3	1.7	1.7
Natural Gas	0.4	3.4	1.5	1.5
Stationary Sources	2.3	0.6	0.0	0.0
Mobile	9.3	9.1	27.6	11.5
TOTAL	37.0	12.9	30.5	14.4
YSAQMD Thresholds of Significance	10	10	80	NA
Exceed Threshold of Significance?	Yes	Yes	No	NA

Note: Summation may not equal totals because of rounding.

[a] Provided for informational purposes only

[b] Includes architectural coating, consumer products, and landscaping emissions

[c] Modeled in CalEEMod 2016.3.2.

[d] No natural gas usage planned for the West Village Expansion. Facilities will be powered by electricity only.

[e] Based on modeling with VMT data from Fehr and Peers and emission factors from EMFAC 2017.

[f] Based on results from HRA conducted by Yorke Engineering for the 2018 LRDP. May not include all possible ROG emissions from these sources.

ROG = reactive organic gases; NO_X = oxides of nitrogen; PM_{10} = respirable particulate matter with an aerodynamic diameter of 10 micrometers or less; $PM_{2.5}$ = respirable particulate matter with an aerodynamic diameter of 2.5 micrometers or less; tpy = tons per year; lbs/day = pounds per day; HRA = health risk assessment; LRDP = Long Range Development Plan; NA = not available; YSAQMD = Yolo County Air Quality Management District

Source: Data provided by Ascent Environmental in 2018.

Mitigation Measure 3.3-2: Reduce emissions of ROG and NO_X from mobile sources.

Mobile emissions at 2018 LRDP implementation account for nearly 10 tons per year of ROG and NO_X, respectively, with most emissions coming from trucks with two or more axles, including buses. UC Davis shall implement measures the following measures to the extent feasible:

1) Promote use of EV, carpool, transit vehicles to decrease emissions from passenger vehicles.

2) Provide carpool only parking spaces at close, desired parking locations to provide a premium parking location for carpool users and increase carpool-only parking spaces to meet demand.

3) Conversion of Unitrans buses to electric or other clean fuel to reduce criteria air pollutant emissions,

4) Promote EV or other clean fuel for vendors, especially those using trucks, to reduce ROG and NO_X emissions.

5) Work with vendors, especially those using trucks, to reduce the number of vendor trips made to the 2018 LRDP area through trip chaining, reducing the number of shipments, or other methods.

Significance after Mitigation

Implementation of Mitigation Measure 3.3-2 would reduce the 2018 LRDP's impacts, but not to a less-than-significant level because of the uncertainty associated with the effectiveness of these measures. While UC Davis has jurisdiction over cleaning supplies and other solvents purchased and used by the campus, it does not have jurisdiction over personal consumer products that emit ROG emissions. Also, UC Davis does not have jurisdiction over vendor vehicle trips and the effectiveness of Mitigation Measure 3.3-2 would depend on the cooperation of vendors serving the 2018 LRDP area. Reducing passenger vehicle emissions and campus-operated emissions may not be sufficient to reduce the 2018 LRDP's total emissions to less than YSAQMD thresholds for ROG and NO_X. Therefore, the project's impacts would be **significant and unavoidable**.

Impact 3.3-3: Mobile-source CO concentrations.

Long-term operation-related local mobile-source emissions of CO generated by the development on the 2018 LRDP area would not violate a standard or contribute substantially to an existing or projected air quality violation or expose sensitive receptors to substantial pollutant concentrations. As a result, this impact would be **less than significant**.

Local mobile-source CO emissions near roadway intersections are a direct function of traffic volume, speed, and delay. Transport of CO is extremely limited because it disperses rapidly with distance from the source under normal meteorological conditions. However, under certain specific meteorological conditions, CO concentrations near roadways and/or intersections may reach unhealthy levels at nearby sensitive land uses, such as residential units, hospitals, schools, and childcare facilities. Thus, high local CO concentrations are considered to have a direct influence on the receptors they affect.

CO concentration is a direct function of vehicle idling time and, thus, traffic flow conditions. Under specific meteorological conditions, CO concentrations near congested roadways and/or intersections may reach unhealthy levels with respect to local sensitive land-uses such as residential areas, schools, and hospitals. As a result, it is recommended that CO not be analyzed at the regional level, but at the local level.

According to the traffic study conducted by Fehr & Peers for the 2018 LRDP (refer to Section 3.16, "Transportation, Circulation, and Parking"), future campus operations under the 2018 LRDP would result in the worsening of four of the 30 intersections analyzed in the vicinity to LOS of E or F during the peak-hour when compared to the existing condition. Although this change in LOS would, in and of itself, exceed YSAQMD screening criteria identified above, intersection peak-hour volumes are relatively low (below 10,000 vehicles per hour) when compared to CO screening thresholds from other nearby air districts, including SMAQMD and BAAQMD.

YSAQMD concurs with the SMAQMD screening criteria as they relate to the magnitude of intersection volumes affected by the project and finds that development under the 2018 LRDP would meet such criteria (Jones, pers. comm., 2018a). Screening criteria for SMAQMD were developed based on a conservative analysis of local intersections and are considered appropriate for a preliminary screening analysis. As with the YSAQMD criteria, if the criteria are exceeded for the project, a detailed dispersion modeling analysis would need to be performed based on local data. These screening criteria have been developed in a manner such that, if they are met, development-generated, long-term operation-related local mobile-source emissions of CO would not violate a standard or contribute substantially to an existing or projected air quality violation or expose sensitive receptors to substantial pollutant concentrations.

According to SMAQMD, a project would result in a less-than-significant CO impact if the following criterion is met (SMAQMD 2016):

- The project would not result in an affected intersection experiencing more than 31,600 vehicles per hour.

Whereas the SMAQMD screening criteria reference intersection vehicle volumes of 31,600 vehicles per hour or more, the intersection volumes in the project vicinity do not exceed 10,000 vehicles per hour even under Cumulative with Project conditions (refer to Section 3.16, "Transportation, Circulation, and Parking").

As a result, development-generated, long-term operation-related local mobile-source emissions of CO would not violate a standard or contribute substantially to an existing or projected air quality violation or expose sensitive receptors to substantial pollutant concentrations of carbon monoxide. Thus, this impact would be **less than significant.**

Mitigation Measures

No mitigation measures are required.

Impact 3.3-4: Short-term construction emissions of toxic air contaminants.

Construction-related activities would result in temporary, short-term project-generated emissions of TACs, particularly diesel PM. Overall construction TAC emissions would likely result health risks that are below YSAQMD thresholds. However, because of the variety of sensitive receptors located on the 2018 LRDP area (e.g., child care centers, outdoor athletic facilities), and because TAC-emitting construction activity could occur adjacent to sensitive receptors within the 2018 LRDP area during plan implementation, construction-related TAC emissions could expose sensitive receptors to an incremental increase in cancer risk that exceeds 10 in one million or a HI greater than 1.0. This impact would be **potentially significant**.

Construction-related activities would result in temporary, short-term project-generated emissions of diesel PM from the exhaust of off-road, heavy-duty diesel equipment used during site preparation (e.g., demolition, clearing, grading); paving; application of architectural coatings; as well as on-road truck travel and other miscellaneous activities. For construction activity, diesel PM is the primary TAC of concern. On-road diesel-powered haul trucks traveling to and from the construction area to deliver materials and equipment are less of a concern because they would not stay on the site for long durations. Demolition and renovation of older facilities may also result in the release of airborne asbestos because of the disturbance of asbestos-containing material that may be present in older buildings.

Particulate exhaust emissions from diesel-fueled engines (i.e., diesel PM) were identified as a TAC by the CARB in 1998. The potential cancer risk from the inhalation of diesel PM, as discussed below, outweighs the potential for all other health impacts (i.e., non-cancer chronic risk, short-term acute risk) and health impacts from other TACs (CARB 2003; OEHHA 2009:A-3), so diesel PM is the focus of this discussion. Based on the emission modeling conducted and presented in Table 3.3-8 above, maximum daily diesel exhaust emissions of $PM_{2.5}$ from construction equipment would not exceed 7.2 lb/day during the most intense season of construction activity. According to the HRA results discussed under Impact 3.3-5, the estimated health risks are less than one fourth of the YSAQMD health risk thresholds and were calculated based on average daily operational emissions of 5.71 lb per day of diesel PM emissions in addition to other TACs (Yorke Engineering 2018:6,31). Thus, keeping all other TACs the same, a 26 percent higher emissions rate of diesel PM from 2018 LRDP construction activity would not likely exceed YSAQMD thresholds of 10 in one million for cancer risk and a HI of 1 for the MEI. Furthermore, diesel PM would be generated with different areas of the campus and spread out moreso across different development sites (i.e., different types of construction activities [e.g., site preparation, paving, building construction] would not occur at the same place at the same time).

The dose to which receptors are exposed is the primary factor used to determine health risk (i.e., potential exposure to TAC emission levels that exceed applicable standards). Dose is a function of the concentration of a substance or substances in the environment and the duration of exposure to the substance. Dose is positively correlated with time, meaning that a longer exposure period would result in a higher exposure level for any exposed receptor. Thus, the risks estimated for an exposed individual are higher if a fixed exposure occurs over a longer period of time. According to OEHHA, HRAs, which determine the exposure of sensitive receptors to TAC emissions, should be based on a 70- or 30-year exposure period; however, such assessments should be limited to the period/duration of activities that generate TAC emissions (OEHHA 2015:8-6). Consequently, it is important to consider that the use of off-road heavy-duty diesel equipment would be limited to the periods of construction and only during the period when new facilities are constructed.

Proximity of nearby sensitive receptors to TAC emissions is another key factor in determining health risk. Studies show that diesel PM is highly dispersive (e.g., diesel PM concentrations decrease by 70 percent at 500 feet from the source) (Zhu et al. 2002b:1032), and receptors must be in close proximity to emission sources to result in the possibility of exposure to concentrations of concern. On-campus sensitive receptors include student housing developments, student wellness centers, outdoor athletic facilities, child care centers, and outdoor playgrounds located on on-campus housing. Nearby off-campus sensitive receptors within 500 feet of the UC Davis campus include adjacent multi-family and single-family residences and worship centers. For the West Village Expansion and Orchard Park Redevelopment components, construction may occur as close as 80 feet from the nearest residence. Although it is not known where other facilities built under the 2018 LRDP may be constructed, the 2018 LRDP could result in construction activity that is directly adjacent to sensitive receptors within the campus.

In addition, renovation and demolition of existing structures would potentially result in the airborne entrainment of asbestos due to the disturbance of asbestos-containing materials. Asbestos is listed as a TAC by the CARB. The risk of disease is dependent upon the intensity and duration of exposure. Exposure to asbestos fibers may result in health issues such as lung cancer, mesothelioma (a rare cancer of the thin membranes lining the lungs, chest and abdominal cavity), and asbestosis (a non-cancerous lung disease which causes scarring of the lungs) (CARB 2017d). These activities would be subject to YSAQMD Rule 9.9 (Asbestos). The rule addresses the national emissions standards for asbestos along with some additional requirements. The rule would require UC Davis and its contractors to notify YSAQMD of any renovation or demolition activity at least 10 working days prior to commencement of demolition/renovation. When removing any Regulated Asbestos Containing Material (RACM), YSAQMD regulations must be followed. This notification includes a description of structures and methods utilized to determine whether asbestos-containing materials are potentially present. All RACM found on the site must be removed prior to renovation activity and there are specific requirements for surveying, notification, removal, and disposal of material containing asbestos. Therefore, projects under the 2018 LRDP that comply with Rule 9.9 would ensure that asbestos-containing materials would be disposed of appropriately and safely.

Although projects under the 2018 LRDP that comply with Rule 9.9 would ensure that asbestos-containing materials would be disposed of appropriately and safely and the overall health risks from construction TAC emissions would likely be below YSAQMD thresholds, construction activity under the 2018 LRDP could occur near outdoor recreational facilities and childcare centers/schools. For example, the construction of Orchard Park Redevelopment would occur adjacent to Russell Park apartments and other nearby student apartments at which outdoor playgrounds are located and where families with small children may reside. Construction activity could also occur at building sites at or adjacent to the existing child care centers throughout the campus, as part of renovations efforts under the 2018 LRDP. As such, construction activities following the implementation of the 2018 LRDP would occur near on-campus sensitive receptors, especially those with small children and infants. Thus, the implementation of the 2018 LRDP would have a **potentially significant** impact associated impacts to sensitive receptors.

Mitigation Measure 3.3-4: Reduce short-term construction-generated TAC emissions.

UC Davis shall require construction activities under the 2018 LRDP to follow YSAQMD recommended mitigation measures for construction exhaust emissions. To ensure sensitive receptors are not exposed to substantial TAC concentrations, UC Davis shall require its prime construction contractor to implement the following measures prior to project approval:

1) Locate operation of diesel-powered construction equipment as far away from sensitive receptors as possible;

2) Limit excess equipment idling to no more than 5 minutes;

3) Use construction equipment with engine ratings of Tier 3 or better (included in Mitigation Measure 3.3-1); and

4) Use electric, compressed natural gas, or other alternatively fueled construction equipment instead of the diesel counterparts, where available.

In addition, for any construction site located within 150 feet of a childcare center or park/recreation field, UC Davis shall schedule the use of heavy construction equipment to times when children are not present. Alternatively, UC Davis shall arrange for temporary relocation of childcare facilities to areas outside of a 150-foot buffer or temporarily close available park space within the 150-foot buffer during operation of heavy construction equipment.

Significance after Mitigation

Implementation of Mitigation Measure 3.3-4 would reduce TAC emissions from construction activity and reduce exposure of sensitive receptors to these emissions. Further, it would substantially reduce construction-generated emissions of TACs and exposure to more-sensitive individuals to potential health effects associated with TAC emissions. Mitigation Measure 3.3-4 would also limit exposure of on-site sensitive receptors that may be located directly adjacent to construction activity, such that construction activity is either located further away from the receptors or construction activity would not occur while adjacent sensitive receptors are present. Thus, this impact would be **less than significant**.

Impact 3.3-5: Operational emissions of toxic air contaminants.

The 2018 LRDP would result in additional sources of TACs (e.g., laboratories, boilers); however, the additional risks associated with these sources would not exceed YSAQMD thresholds of 10 in one million for cancer risk and a HI of 1 for the MEI. Therefore, this impact would be **less than significant**.

The operational TAC analysis evaluates new sources associated with the 2018 LRDP implementation (e.g., increased vehicular traffic, new stationary sources) and the placement of new sensitive receptors in close proximity to existing TAC sources. Operation of new facilities could also generate new sources of TACs from research and industrial land uses (e.g., emergency generators, boilers, laboratories). New facilities that have the potential to generate stationary source emissions would be required to obtain a permit from YSAQMD. If the facility has the potential to generate health risks above established risk levels, facilities are required to distribute public notifications to both residential, nonresidential, and parents of children attending school within the area of impact and develop and implement a risk reduction plan. Future development within the 2018 LRDP could result in new stationary sources associated with academic and industrial land use development, that could result in long-term TAC exposure to existing or future planned sensitive land uses.

In addition to new stationary sources, the 2018 LRDP would result in an increase in 25,791 daily vehicle trips, distributed over the project-affected roadways and intersections. In accordance with CARB guidance, high volume roads and freeways are the primary sources of TACs within urban areas. Freeways or urban roads experiencing 100,000 or more vehicles/day could expose sensitive receptors to adverse health risks (CARB 2005). Although all project-generated trips would not occur on any single road, the project would result in a substantial increase in trips to the surrounding roadway network relative to existing conditions, up to nearly 40 percent, and therefore could result in a substantial increase to existing health risk levels associated with vehicular traffic, exposing existing and future planned land uses to increased TAC levels. Refer to Section 3.16, "Transportation, Circulation, and Parking" regarding the net increase in vehicle trips associated with implementation of the 2018 LRDP.

With regards to TAC levels under the 2018 LRDP, Yorke Engineering conducted an HRA to characterize future health risk levels at receptor sites in and around the 2018 LRDP area associated with new and existing TAC sources and receptors under the 2018 LRDP. Modeling in the HRA was based on OEHHA Tier 1 techniques published in OEHHA's 2015 Air Toxics Hot Spots Program Risk Assessment Guidelines (OEHHA 2015). The HRA estimated the TAC emissions from both existing and proposed TAC sources such as stationary sources throughout the 2018 LRDP (e.g., boilers, laboratories), traffic on existing roadways, and locomotive activity on nearby existing rail lines. The HRA concluded that the probability of contracting cancer for the MEI would not exceed 2.4 in one million and ground-level concentrations TACs would result in a HI no greater than 0.05 for the MEI (Yorke Engineering 2018:31). These results are less than YSAQMD's thresholds of 10 in one million for cancer risk and a HI of 1 for the MEI. Because YSAQMD thresholds do not apply to mobile sources of TACs and the HRA results include both stationary and mobile sources, the results of the HRA are conservative. Thus, the 2018 LRDP would not result in additional stationary and mobile sources of TACs that would significantly contribute to the existing risk level in the project area. This impact would be **less than significant.**

Mitigation Measures

No mitigation measures are required.

Impact 3.3-6: Land use compatibility with off-site sources of toxic air contaminants and ultrafine particulates.

The project would introduce receptors in close proximity to existing sources of TACs and UFPs. The level of health risk associated with exposure to TACs from on-site and surrounding off-site sources would not be substantial. However, residential receptors located closest to I-80 could be exposed to relatively high concentrations of UFPs generated by vehicles traveling on I-80 resulting in substantial levels of health risk. This would be a **potentially significant** impact.

In 2015, a California Supreme Court decision addressed CEQA requirements with regard to the effects of existing environmental conditions on a project's future users or residents. Per the Court, the effects of the environment on a project are outside the scope of CEQA unless the project would exacerbate these conditions (see California Building Industry Association v. Bay Area Air Quality Management District [2015] 62 Cal.4th 369, 377 ["we conclude that agencies generally subject to CEQA are not required to analyze the impact of existing environmental conditions on a project's future users or residents. But when a proposed project risks exacerbating those environmental hazards or conditions that already exist, an agency must analyze the potential impact of such hazards on future residents or users."]). Changes to the CEQA Guidelines to reflect this decision are in process by the State but have not been adopted.

As further concluded on remand by the appellate court, CEQA cannot be used by a lead agency to require a developer to obtain an EIR or implement mitigation measures solely because the occupants or users of a new project would be subjected to the level of emissions specified. The discussion of land use compatibility of the 2018 LRDP with off-site sources of toxic air contaminants and UFPs would fall into the category of impacts of "existing environmental conditions on a project's future users or residents." Further, the HRA conducted for the 2018 LRDP evaluated the potential incremental increase in carcinogenic risk from plan implementation, which included vehicular traffic along I-80 and SR-113. The threshold for incremental cancer risk (10 in one million) used in the HRA and suggested by YSAQMD is considered as a proxy for whether a project would “exacerbate” an environmental hazard. As noted above in Impact 3.3-5, implementation of the 2018 LRDP would not exceed 10 in one million, and thus, would not be considered to “exacerbate” existing environmental hazards. As such, further evaluation is not required within the context of CEQA or this EIR. However, UC Davis has elected to evaluate this issue as part of the 2018 LRDP EIR.

<u>Toxic Air Contaminants</u>

The HRA completed by Yorke Engineering for the 2018 LRDP also includes an analysis of the impact of all on-site and off-site sources that would expose on-campus receptors to increased cancer risk, referred to as the “cumulative scenario” in the HRA. In addition to potential sources under the 2018 LRDP, the analyzed scenario includes existing campus sources and off-site sources such as mobile sources from I-80 and diesel locomotives operating along the Union Pacific Railroad (UPRR). YSAQMD does not recommend thresholds to determine impacts related to the land use compatibility between receptors and sources. As a proxy, BAAQMD thresholds for cumulative impacts on new receptors are used. BAAQMD considered areas with a level of cancer risk that exceeds 100 in one million or a chronic risk HI of 10.0 to have a significant health risk impact on new receptors (BAAQMD 2017:2-5). According to the HRA, the impact of on- and off-site sources would not exceed a cancer risk level of 42 in one million for the MEI and a chronic HI of 0.05, which are below BAAQMD thresholds (Yorke Engineering 2018:33).

<u>Ultrafine Particulate Matter</u>

Within the vicinity of UC Davis, a 10-day measurement of UFP concentrations near I-80 was taken in 2015. The average UFP concentration was determined to be 14.6 μg/m^3 at a distance of 250 feet from I-80 (Barnes 2015). The elemental makeup of UFPs measured indicate that they contain transitional metals that are adverse to human health, including higher rates of ischemic heart disease, particularly in comparison to other freeway segments of concern in the Sacramento region (Barnes 2015:8-10).

This measurement was collected approximately 300 feet north and downwind of the northern edge of I-80. Given the dispersive properties of UFP it is likely that average concentrations are higher closer to the freeway and lower at more distant locations. While these measurements do not represent an annual average concentration or the levels of long-term, multi-year exposure, a variety of meteorological conditions did occur during the 10-day measurement period (i.e., inversions and non-inversions, varying wind speeds and directions) (Barnes 2015:10) and; therefore, the 10-day average is not representative of one meteorological regime.

The level of health risk from long-term exposure to UFP concentrations on the project site is considered to be substantial for two reasons. First, the measured concentrations of UFP near UC Davis exceed 12 μg/m^3, which is the annual CAAQS and NAAQS for $PM_{2.5}$. This means that concentrations of UFP are even greater than the regulatory standards for a larger set of particles, in this case, particulate matter with aerodynamic diameters of 2.5 microns or less. Second, both laboratory and epidemiological studies indicate that long-term exposure to UFP near roadways results in greater probability of adverse health effects than larger sized particles. Based on the aforementioned demonstrating that UFP concentrations have been shown to be relatively constant within 1,000 feet of a linear source, any sensitive receptors and residences built this distance could be exposed to the same UFP concentrations as those measured in 2015.

According to the results of the HRA, the level of health risk exposure from TACs, which may include UFPs, generated by on-site stationary sources and diesel PM generated by trains passing on the UPRR line would not be substantial. Additionally, the level of health risk exposure from pollutants generated from all on-site and surrounding off-site sources would not exceed the 100-in-a-million cancer risk level specified by BAAQMD. However, because of relatively high UFP concentrations measured near the UC Davis campus compared to the $PM_{2.5}$ standard and subsequent elemental analysis indicates that the UFPs contain transitional metals associated with severe adverse health effects, this is considered a **potentially significant** impact.

Mitigation Measure 3.3-6: Reduce exposure of residences to TACs and UFPs.

For any proposed housing within 1,500 feet of I-80, UC Davis shall:

1) During preparation of project-specific environmental review, conduct ambient air measurements at the proposed housing location between January and March (for a period of up to 12 weeks) to determine UFP concentrations at a particular site. If measured concentrations do not exceed 12 $\mu g/m^3$, no further action is necessary, or

2) If concentrations exceed 12 $\mu g/m^3$ or if no monitoring is conducted, require the air filtration systems on all residential buildings to achieve a minimal removal efficiency of 95 percent for UFP (particulate matter with an aerodynamic diameter of 0.1 microns and smaller). Achieving a minimal removal efficiency of 95 percent may include, but not be limited to, the following:

    a) strategically located air intakes pursuant to requirements and recommendations of the American Society of Heating, Refrigeration, and Air-Conditioning Engineers;
    b) double-door entrances at the main entrances to buildings;
    c) high-volume, low-pressure drop air exchange systems that cause UFP to pass through multiple filters at a slow enough speed such that they attach to the surface of standard electrostatic filters; and/or
    d) The air filtration and mechanical airflow systems shall be properly maintained and, on an annual basis, tested documented by a qualified professional to ensure that the UFP filtration system is operating at a minimum 95 percent effectiveness.

Significance after Mitigation

Locating residential buildings further from I-80 would reduce health risk exposure to residential uses where people typically spend more time than non-residential uses. It should be noted that, based on initial mapping, the majority of the current land plan for the 2018 LRDP meets the requirements of this measure. Mitigation Measure 3.3-6 is expected to result in substantial reductions to exposure levels of UFPs and TACs. Because "safe" levels of UFP exposure have not been identified by any applicable agency or by a consensus of scientific literature and without establish UFP standards, it cannot be determined that the implementation of Mitigation Measure 3.3-6 would reduce potential exposure to UFPs under the 2018 LRDP to a less-than-significant impact. Therefore, this impact would be **significant and unavoidable**.

Impact 3.3-7: Exposure of sensitive receptors to odors.

The 2018 LRDP would introduce new odor sources into the area, such as new research facilities, a composting facility, a biomass boiler, and diesel-related exhaust from delivery trucks. The new odor sources are similar to existing sources that operate in and near the Davis campus; however, depending on their location, the new potential odor sources could result in perceivable odors at nearby receptors. As a result, impacts would be **potentially significant**.

The occurrence and severity of odor impacts depends on numerous factors, including: the nature, frequency, and intensity of the source; wind speed and direction; and the sensitivity of the receptors. While offensive odors rarely cause any physical harm, they still can be unpleasant, leading to considerable distress among the public and often generating citizen complaints to local governments and regulatory agencies. Projects with the potential to frequently expose a substantial number of members of the public to objectionable odors would be deemed to have a significant impact.

In discussions with UC Davis and YSAQMD, the area surrounding the campus has not formally reported odor complaints from any particular source emanating from the campus. However, the following occasional odor complaints have occurred in the project vicinity:

- decay odors from Putah Creek and the Arboretum waterway during algal blooms or low water levels;
- the READ facility during warm summer months;
- dumpsters; and
- on-campus livestock facilities (i.e., the UC Davis Dairy facility).

New residences on campus could have similar odor complaints; however, all of the listed complaints above were infrequent and originated adjacent to the odor sources (Pfohl, pers. comm., 2017; Jones, pers. comm., 2017b).

Minor odors from the use of heavy -duty diesel equipment and the laying of asphalt during project-related construction activities would be intermittent and temporary and would dissipate rapidly from the source with an increase with distance. Although construction activities would occur over a relatively long-term period (approximately 13 years), odors resulting from construction activity would occur in different areas of the 5,300-acre campus at different times over the 2018 LRDP period and the impact of odors within 50 feet would be temporary.

Operation of uses under the 2018 LRDP would result in in various levels of odor emissions, ranging from odors associated with motor vehicle operation to food preparation to the handling of animal manure. Diesel-fueled delivery trucks and their associated exhaust odors would haul materials to and from the academic and administrative, residential, recreational, and retail areas; however, these types of sources are not different from those that currently deliver materials to existing land uses in the 2018 LRDP area. The 2018 LRDP may include operation of new restaurant kitchens, but any odors potentially generated by the kitchens are not typically considered to be objectionable and are also not different from the restaurant kitchens currently in the project vicinity.

The primary new odor sources under the 2018 LRDP include the proposed biomass boiler, composting facility, and expansion of the wastewater treatment plant, which could result in odors from open-air decomposition of organic waste. The proposed biomass boiler is anticipated to store and use animal bedding, which would include manure, wood chips, and hay as fuel for the boiler. Proposed expansion of the wastewater treatment plant would increase the potential for odors from existing wastewater treatment plant operations. Operation of a biomass boiler, compositing facility, and modified wastewater treatment plant would be subject to odor provisions under YSAQMD Rule 2.5, Nuisance.

Other potential sources of odors include research activities, such as through general laboratory research, animal handling, and handling of organic material. These odor sources would either be an expansion of existing odor sources or contained within buildings and not likely result in objectionable odors affecting a substantial number of people.

The 2018 LRDP would also relocate the UC Davis Dairy Facility away from the center of campus and move it adjacent to the existing Animal Science Beef Barn located along Garrod Drive. No sensitive receptors are currently or planned to be located over 1,900 feet from the nearest existing or proposed residential land uses. Thus, the relation of the dairy facility would reduce exposure of sensitive receptors to this odor source. Also, YSAQMD Rule 2.5, Nuisance does not apply to odors emanating from agricultural operations in raising of animals.

The location and operation details of the proposed biomass boiler and associated fuel storage is not yet known. The potential composting facility is currently envisioned to be located near the existing biodigester, because of the potential use of digestate as a wetting agent for composting. The biomass fuel storage could potentially be located close to existing or proposed residential land uses in the 2018 LRDP area or other sensitive receptors surrounding the 2018 LRDP area. Odors could also affect other campus facilities, disrupting administrative, teaching, and research operations. Thus, implementation of the 2018 LRDP would potentially result in major sources of odor that could create objectionable odors affecting a substantial number of people. This impact would be **potentially significant**.

Mitigation Measure 3.3-7: Odor control for the proposed composting facility, biomass boiler, and expanded wastewater treatment plant.

UC Davis shall implement the following measures for the development of composting facility, biomass boiler, and modifications to the wastewater treatment plant:

1. Locate new/modified facilities and any organic matter storage piles, fuel storage, or open-air processes at least 1,000 feet from and downwind of the nearest sensitive receptors and academic building space;

2. Include operational provisions to guard against anaerobic activity in organic matter storage piles; and

3. Place odor controls surrounding the organic storage piles, as feasible.

Significance after Mitigation

Implementation of this mitigation measure would reduce significant impacts associated with odors to a **less-than-significant** level by locating organic storage and burning operations away from sensitive receptors so that odors may dissipate before reaching sensitive receptors. Odors would dissipate rapidly from the source with an increase in distance.

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