APPENDIX C-1

Revised Health Risk Assessment

HEALTH RISK ASSESSMENT
for the
McKinley Village Project
City of Sacramento, California

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Health Risk Assessment for the McKinley Village Project

SUMMARY

The McKinley Village Project (proposed project) consists of a 328-unit residential development, a neighborhood recreation center, parks, and associated infrastructure on an approximately 48.75-acre site within the East Sacramento Community Plan Area located in the City of Sacramento, California (City). The project site is situated along the south side of the Business 80/State Route 51 freeway (Capital City Freeway), north of the Union Pacific Railroad (UPRR) tracks, largely east of Alhambra Boulevard, and largely west of Lanatt Street.

The purpose of this health risk assessment (HRA) is to determine the potential cancer risk to the future residents of the proposed project due to diesel particulate matter (DPM) emissions resulting from diesel truck traffic on the Capital City Freeway and locomotives operating on the UPRR tracks. The dispersion modeling conducted for this assessment was conducted using the American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD). The analysis considers a 70-year exposure scenario consistent with guidance from the Sacramento Metropolitan Air Quality Management District (SMAQMD). A 70-year exposure period is very conservative (i.e., health protective) and assumes residents would be exposed continuously to diesel particulate matter (DPM) emissions from the freeway and UPRR rail lines for an assumed lifetime of 70 years. This assumption is a standard worst-case exposure scenario for the purposes of assessing health effects associated with exposure to toxic air contaminants as recommended by the California Environmental Protection Agency Office of Environmental Health Hazard Assessment (OEHHA) and air districts.

The SMAQMD's Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways (Roadway Protocol) (SMAQMD 2011) recommends the use of an evaluation criterion to assess the cancer risk to sensitive receptors near high-traffic roadways. The criterion is the level of increased individual risk corresponding to a 70% reduction relative to the highest roadway cancer risk in Sacramento County. This analysis is not required under the California Environmental Quality Act (CEQA), but it is provided for discussion purposes.

Per the SMAQMD Roadway Protocol, the evaluation criterion is a cancer risk value based on the reasonable worst-case siting situation within the boundaries of the SMAQMD. For 2011 and later evaluations, the evaluation criterion is a cancer risk of 276 in 1 million. It is the level of increased individual risk corresponding to a 70% reduction from the highest roadway risk in Sacramento County: (100% - 70%) × 919 in 1 million = 276 in 1 million (SMAQMD 2011). As noted in the Roadway Protocol, the evaluation criterion does not represent an acceptable cancer risk or a threshold of significance.

This Health Risk Assessment (HRA) finds that residents in nearly all of the project site would be exposed to a cancer risk of approximately 80 in 1 million or less with a maximum of 120 in 1 million under a 70-year exposure scenario. While it is not suggested as a criterion in the Roadway Protocol, the HRA further evaluates the cancer burden (the estimated number of theoretical cancer cases in a defined population resulting from lifetime exposure to carcinogenic TACs [OEHHA 2003]) that could occur in the project area. The estimated cancer burden would be much less than 1.0. The cancer burden indicates that less than one person could contract cancer assuming a 70-year exposure under the modeled scenario of DPM emissions and provided that other factors related to an individual's susceptibility to contracting cancer would occur. It is important to note that emissions from trucks and locomotives will improve over time due to more stringent state and federal standards for air pollutants and from turnover as older trucks and locomotives are replaced. Furthermore, most residents would not live at the same location for 70 years. People tend to live at a given location for approximately 9 years (average) to 30 years (95th percentile).[1] Thus, the estimated cancer risk would be lower for more typical residency periods. However, as discussed above a 70-year exposure rate is a standard worst-case exposure scenario for the purposes of assessing health effects associated with exposure to toxic air contaminants as recommended by the California OEHHA and air districts.

[1] The alternative 9-year and 30-year periods for evaluating cancer risk per the OEHHA guidance manual for health risk assessments prepared under the Air Toxics "Hot Spots" program (OEHHA 2003) are based on the U.S. Environmental Protection Agency (EPA) Exposure Factors Handbook (EPA 1997). This handbook indicates that 9 years is the average "population mobility" and 30 years is the 95th percentile value. In other words, only 5% of residents live at any given location for more than 30 years.

1.0 INTRODUCTION

1.1 Purpose

This HRA presents the results of an evaluation of DPM emissions associated with diesel truck traffic traveling along the Capital City Freeway and locomotives operating on the UPRR tracks in the vicinity of the proposed project in Sacramento, California, and potential cancer risk to future residents.

1.2 Project Description

The proposed project is located within the East Sacramento Community Plan Area located in the City of Sacramento, California. The project consists of the construction and operation of a 328-unit residential development, a neighborhood recreation center, parks, and associated infrastructure on an approximately 48.75-acre site located northeast of downtown Sacramento (see Figure 1, Regional Map). The project site is situated along the south side of Capital City Freeway, north of the UPRR tracks, largely east of Alhambra Boulevard, and largely west of Lanatt Street (see Figure 2, Project Location Map).

A variety of residences are proposed on different lot sizes (see Figure 3, Conceptual Site Plan). Second units or "granny flats" would be offered as an option on some of the home plans. The overall density of the proposed project is approximately 10.9 residential units per acre. The project is anticipated to generate a total population of approximately 656 new residents at buildout, based on the City's persons per household rate of 2.0.

The project site is currently designated Planned Development (PD) in the City's 2030 General Plan and zoned Heavy Industrial (M-2). The project site is currently vacant with a fallow field dominated by non-native grasses, trees, and shrubs along with four freestanding billboards and overhead utility lines and poles.

The proposed project would include a 30-foot-wide landscape/sound buffer/easement adjacent to the northern boundary of the site, adjacent to the freeway, with a sound barrier of approximately 13 to 18.5 feet tall (depending on location and final design) above the proposed building pads, consisting of a soil berm topped with a sound wall. The sound barrier would be set back between approximately 43 feet along the eastern end of the site to 125 feet along the western end of the site from the freeway edge of pavement. Landscaping, including coniferous trees, would be provided on both sides of the barrier. The distance to the closest residences located adjacent to the freeway along the eastern boundary of the site would be approximately 58 feet from the edge of the pavement (if a fourth eastbound lane is added to the Capital City Freeway, the distance would be approximately 50 feet). In addition, an 8-foot-wide landscape buffer/easement is proposed along the southern portion of the site adjacent to the UPRR ROW.

1.3 Toxic Air Contaminants

A substance is considered toxic if it has the potential to cause adverse health effects in humans, including increasing the risk of cancer upon exposure, or acute and/or chronic noncancer health effects. A toxic substance released into the air is considered a toxic air contaminant (TAC). Examples include certain aromatic and chlorinated hydrocarbons, Diesel Particulate Matter (DPM), certain metals, and asbestos. TACs are generated by a number of sources, including stationary sources such as dry cleaners, gas stations, combustion sources, and laboratories; mobile sources such as automobiles; and area sources such as landfills. Adverse health effects associated with exposure to TACs may include carcinogenic (i.e., cancer-causing) and noncarcinogenic effects. Noncarcinogenic effects typically affect one or more target organ systems and may be experienced either on short-term (acute) or long-term (chronic) exposure to a given TAC.

California’s air toxics control program began in 1983 with the passage of the Toxic Air Contaminant Identification and Control Act, Assembly Bill (AB) 1807, better known as the Tanner Bill. The Tanner Bill established a regulatory process for the scientific and public review of individual toxic compounds. When a compound becomes listed as a TAC under the Tanner process, the California Air Resources Board (CARB) normally establishes minimum statewide emission-control measures to be adopted by air quality management districts and air pollution control districts. By 1992, 18 of the 189 federal hazardous air pollutants had been listed by the CARB as state TACs. In April 1993, the CARB added 171 substances to the state program to make the state TAC list equivalent to the federal list of hazardous air pollutants. In 1998, CARB designated diesel engine exhaust particulate matter (DPM) as a TAC (CARB 1998). The exhaust from diesel engines is a complex mixture of gases, vapors, and particles, many of which are known human carcinogens.

The second major component of California’s air toxics program, supplementing the Tanner process, was provided by the passage of AB 2588, the Air Toxics “Hot Spots” Information and Assessment Act of 1987. AB 2588 currently regulates over 600 compounds, including all of the Tanner-designated TACs.

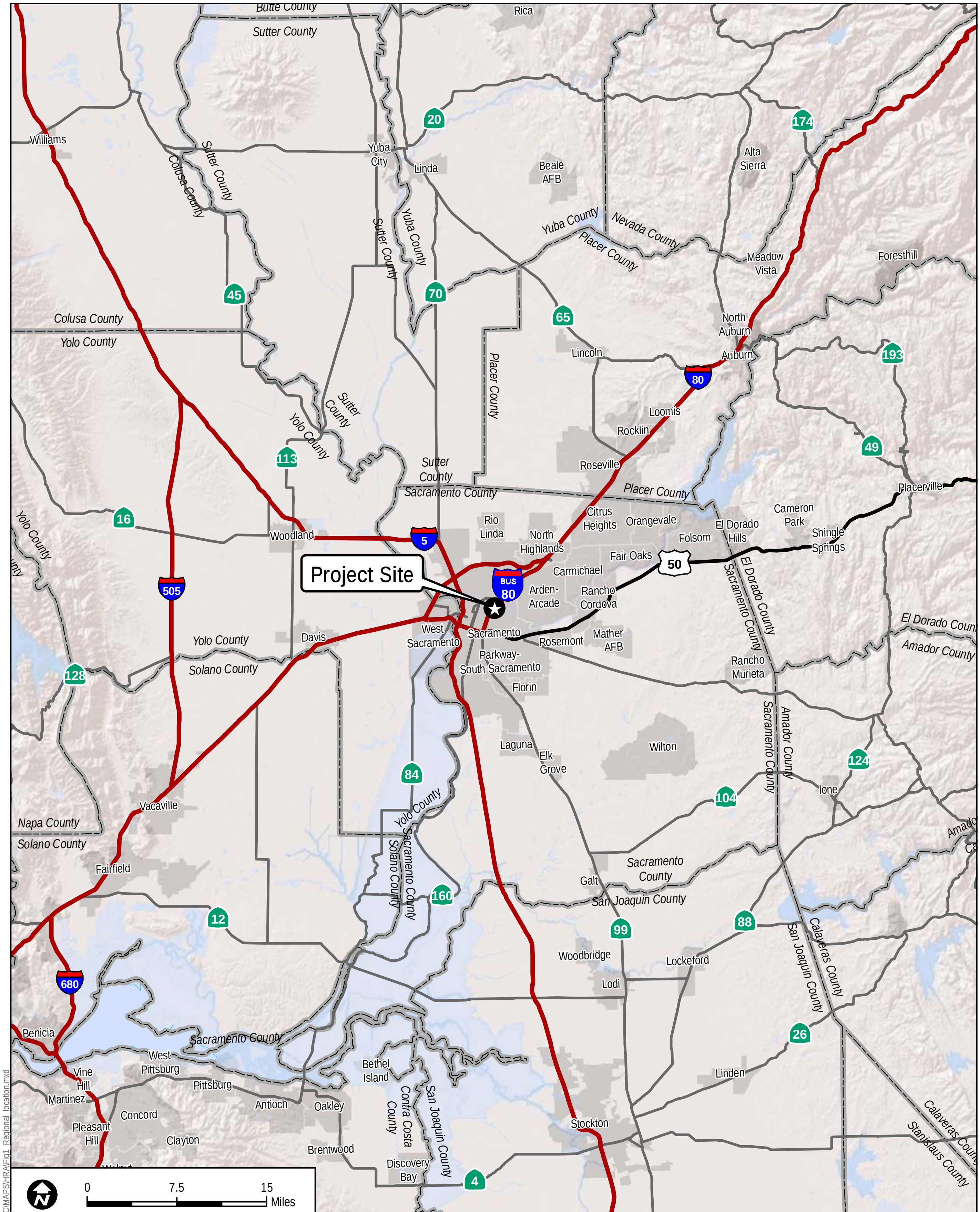

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FIGURE 1

Regional Map

HEALTH RISK ASSESSMENT FOR THE MCKINLEY VILLAGE PROJECT

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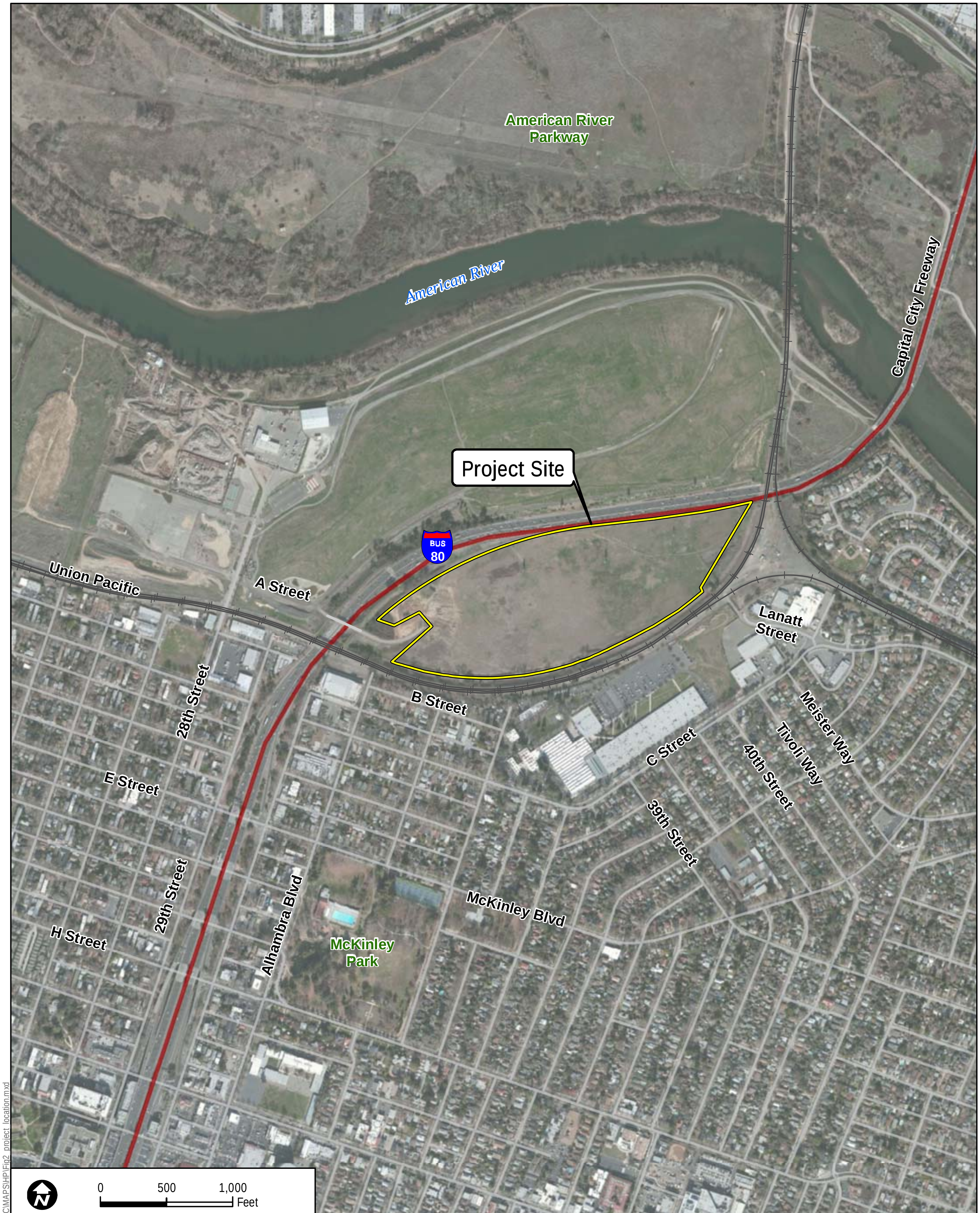

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SOURCE: ESRI; County of Sacramento 2012

FIGURE 2
Project Location Map

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HEALTH RISK ASSESSMENT FOR THE MCKINLEY VILLAGE PROJECT

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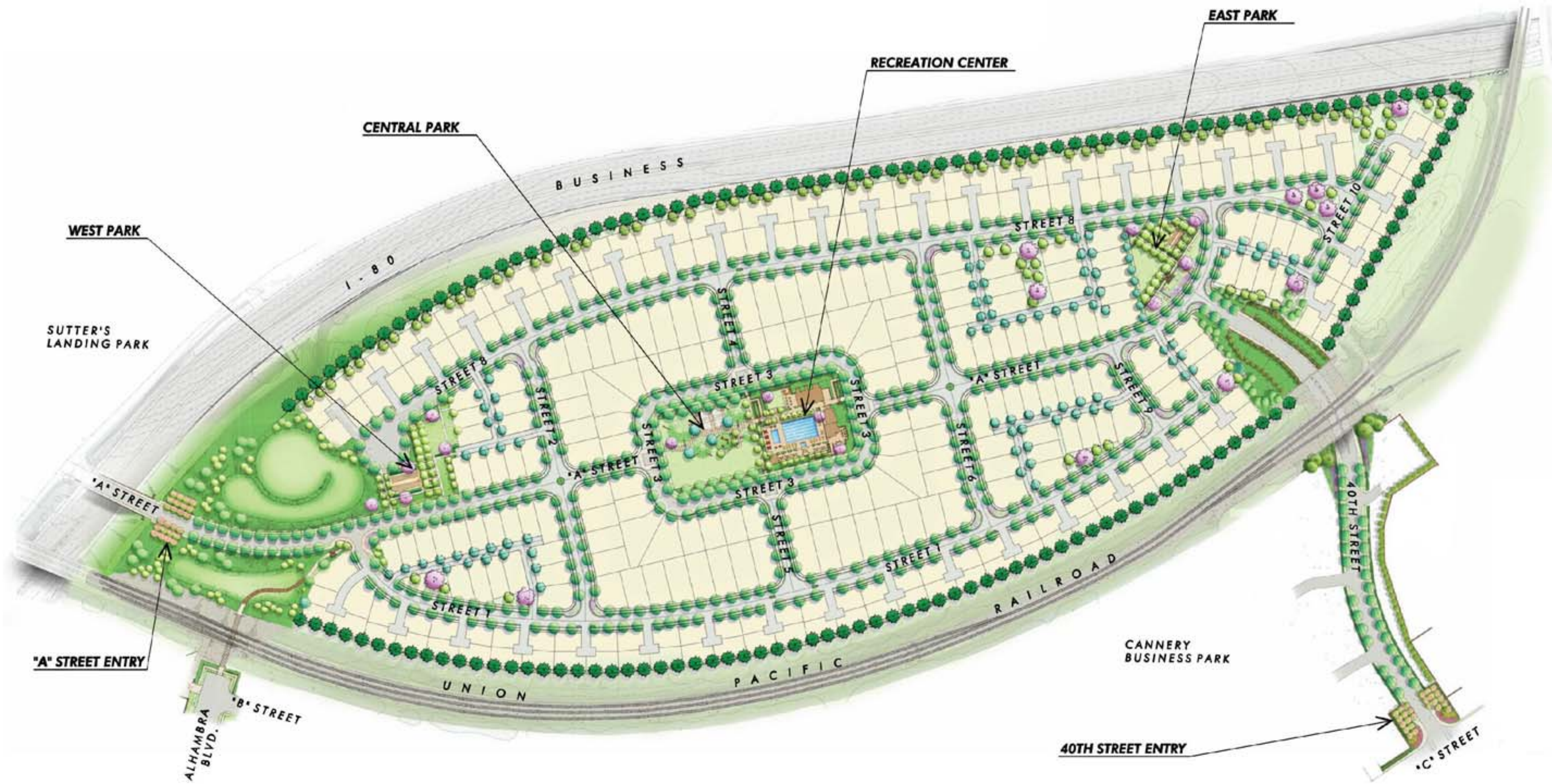

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SOURCE: Woodley Architectural Group 2013

FIGURE 3

Conceptual Site Plan

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HEALTH RISK ASSESSMENT FOR THE MCKINLEY VILLAGE PROJECT

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Additionally, Proposition 65, passed by California voters in 1986, required that a list of carcinogenic and reproductive toxicants found in the environment be compiled, the discharge of these toxicants into drinking water be prohibited, and warnings of public exposure by air, land, or water be posted if a significant adverse public health risk is posed. The emission of any of the listed substances by a facility would require a public warning unless health risks could be demonstrated to be less than significant. For carcinogens, Proposition 65 defines the "no significant risk level" as the level of exposure that would result in an increased cancer risk of greater than 10 in 1 million over a 70-year lifetime. The "no significant risk level" is 1/1000 of the No Observable Effect Level for reproductive toxicants.

This HRA focuses on health impacts associated with DPM from diesel trucks traveling along the portion of Capital City Freeway adjacent to the project site and the trains that emit DPM that travel along the UPRR tracks nearest to the project site. DPM is the risk-driving substance emitted from vehicles, and it has been identified by the state of California as a carcinogenic compound as indicated earlier.

1.4 Cancer Risk

Cancer risk is defined as the increase in lifetime probability (chance) of an individual developing cancer due to exposure to a carcinogenic compound, typically expressed as the increased probability in 1 million. The cancer risk from inhalation of a TAC is estimated by calculating the inhalation (and if applicable, ingestion) dose in units of milligrams/kilogram body weight per day based on a ambient concentration in units of micrograms per cubic meter ($\mu g/m^3$), breathing rate, and exposure period, and multiplying the dose by the inhalation cancer potency factor, expressed as (milligrams/kilogram body weight per day)$^{-1}$. Cancer risks for residential receptors and similar sensitive receptors are typically estimated based on a lifetime (70 years) of continuous exposure, although other time periods (e.g., 9 years, 30 years) may be evaluated in accordance with OEHHA or air district guidance.

Cancer risks are typically calculated for all carcinogenic TACs and summed to calculate the overall increase in cancer risk to an individual. The calculation procedure assumes that cancer risk is proportional to concentrations at any level of exposure and that risks due to different carcinogens are additive. This approach is generally considered a conservative assumption at low doses and is consistent with the current OEHHA regulatory approach. Exposure to carcinogenic TACs does not imply that the exposed individual would contract cancer; rather, the cancer risk is a probability of developing cancer if other factors (e.g., heredity, exposure to environmental or workplace exposures that comprise the immune system, overall health) would result in an increased susceptibility to developing cancer. The California Almanac of Emissions and Air

Quality (CARB, 2009) lists the Sacramento Valley Air Basin regional background average cancer risk for diesel particulate matter as 360 in 1 million.

1.5 Noncancer Health Effects

In addition to their carcinogenic effects, exposure to some TACs also include noncancer health effects. Other TACs may not be carcinogenic, but exposure to them results in noncancer health effects. Noncancer health effects are classified as acute (short-term) and chronic (long-term). Acute health effects are manifested over brief periods and can include eye irritation, respiratory irritation, running nose, throat pain, and headaches, among others. Typically, in health risk assessments, acute health effects are evaluated over exposure periods of 1 or 8 hours, depending on the specific TACs. Chronic health effects resulting from an exposure to a TAC can occur over exposure periods from several months to several years and can include birth defects, neurological damage, or genetic damage, among others. Typically, in health risk assessments, chronic health effects are evaluated over an exposure period of 1 year. Noncancer health effects are evaluated by the target organ or organ system they affect. The target organ or organ systems can include the respiratory system, hematopoietic system, alimentary system, endocrine system, reproductive system, kidney, nervous system, cardiovascular system, and skin.

Acute and chronic noncancer health effects are assessed relative to a Reference Exposure Level (REL). The REL is the concentration (inhalation) or daily dosage (noninhalation) at or below which no adverse health effects are anticipated. The most recent RELs, established by OEHHA and/or CARB, are found in the Consolidated Table of OEHHA/ARB Approved Risk Assessment Health Values (CARB 2013).

1.6 Land Use and Air Quality

CARB Guidance

CARB's Air Quality and Land Use Handbook: A Community Health Perspective ([CARB Handbook] CARB 2005) addresses the importance of considering health risk issues when siting sensitive land uses, including residential development, in the vicinity of intensive air pollutant emission sources including freeways or high-traffic roads, distribution centers, ports, petroleum refineries, chrome plating operations, dry cleaners, and gasoline dispensing facilities. The CARB Handbook draws upon studies evaluating the health effects of traffic traveling on major interstate highways in metropolitan California centers within the Los Angeles (Interstate (I) 405 and I-710), San Francisco Bay, and San Diego areas. The recommendations identified by CARB, including siting residential uses no closer than 500 feet from freeways or other high-traffic roadways, are consistent with those adopted by the

State of California for location of new schools. Specifically, the CARB Handbook recommends, "[a]void siting new sensitive land uses within 500 feet of a freeway, urban roads with 100,000 vehicles/day, or rural roads with 50,000 vehicles/day" (CARB 2005).

Importantly, the CARB Handbook Introduction clarifies that these guidelines as strictly advisory recognizing that: "[l]and use decisions are a local government responsibility. The Air Resources Board is advisory and these recommendations do not establish regulatory standards of any kind." Also, CARB recognizes that there may be land use objectives that need to be considered by a governmental jurisdiction relative to the general recommended setbacks, specifically stating, "[t]hese recommendations are advisory. Land use agencies have to balance other considerations, including housing and transportation needs, economic development priorities, and other quality of life issues" (CARB 2005).

The CARB Handbook provides evidence that truck traffic generating diesel particulates poses a health risk to sensitive receptors, particularly children. Studies cited in the CARB Handbook identify a health risk within 500 feet of a freeway. As stated above, these studies are based on emissions generated by traffic on major interstate commerce freeways. The study states, "[o]n a typical urban freeway (truck traffic of 10,000–20,000/day), diesel particulate matter (PM) represents 70% of the potential cancer risk from the vehicle traffic" (CARB 2005). Health impacts, however, may vary depending on vehicle traffic on a local roadway, target year for the analysis, meteorological conditions, and other factors for a specific project.

SMAQMD Guidance

SMAQMD developed the Recommended Protocol for Evaluating the Location of Sensitive Land Uses Adjacent to Major Roadways (Roadway Protocol) to provide further guidance on the CARB Handbook. This Protocol is intended to assist local land use jurisdictions in assessing the potential cancer risk of siting sensitive land uses adjacent to high-traffic roadways for DPM only (SMAQMD 2011). (The Roadway Protocol only evaluates cancer risk; noncancer acute and chronic health effects are not assessed.) With respect to the Roadway Protocol, a high-traffic roadway is defined as a "freeway, urban roadway with greater than 100,000 vehicles/day, or rural roadway with 50,000 vehicles/day." The Protocol is based on the finding in the CARB Handbook that traffic-related studies showed a 70% decrease in particulate matter concentrations at a distance of 500 feet from freeways and high-traffic roadways. The Roadway Protocol presumes that acute and chronic health effects as well as lifetime cancer risk due to DPM exposure are lowered proportionately. The Roadway Protocol includes a screening approach based on an evaluation criterion. The evaluation criterion is a cancer risk value that is based on the reasonable worst case siting situation within the boundaries of the SMAQMD. It is the level of increased individual risk corresponding to a 70 % reduction from the highest roadway risk in Sacramento County, and is calculated based on a hypothetical sensitive receptor located 50 feet from the edge of the nearest travel lane for a high-traffic roadway. Based on 2011 traffic and emissions data used in the current version of the Roadway Protocol, the reasonable worst-case siting situation is a cancer risk of 919 in 1 million. Accordingly, the evaluation criterion is 276 in 1 million.

In summary, the Roadway Protocol includes three steps:

1. Determine if the nearest proposed sensitive receptor affected by the project is at least 500 feet from the nearest high-traffic roadway.
2. Using the screening process described in the Roadway Protocol, determine if the nearest sensitive receptor's increase in individual cancer risk is lower than the evaluation criterion. If the risk is lower than the evaluation criterion, no further roadway-related air quality evaluation is recommended under the Roadway Protocol and the projected cancer risk value and screening table used should be disclosed in the environmental documentation.
3. If the risk exceeds the evaluation criterion, complete a site-specific HRA using procedures recommended in the Protocol, and disclose this information in the environmental documentation.

Following the steps in the Roadway Protocol, sensitive receptors (residences) on the project site would be located within 500 feet from the Capital City Freeway. According to traffic data from Caltrans, existing (2012) annual average daily traffic (AADT) on the Capital City Freeway within the vicinity of the project site of up to 159,000.[2] Thus, it would be considered a high-traffic roadway under the first step. The Capital City Freeway runs roughly east to west adjacent to the proposed project site. The screening tables in the Roadway Protocol provide set distances from the nearest land of the roadway (e.g., 50 feet, 100 feet) and peak-hour traffic volumes (e.g., 4,000 trips per hour, 8,000 trips per hour). Using the screening table for a project site located south of an east-west roadway, a distance of 50 feet from the nearest lane to a residence, and peak-hour hourly trips of 12,000 (Caltrans data indicates the 2011 traffic volume is 11,700 trips per hour on the Capital City Freeway in the vicinity of the project site[3]), the predicted cancer risk is 200 in 1 million. Accordingly for the McKinley Village project, the evaluation criterion would not be exceeded.

2 http://traffic-counts.dot.ca.gov/2011all/index.html. The 2012 data indicate an AADT of 162,000.

3 2011 traffic volumes were used to be consistent with the Roadway Protocol, which relies on 2011 traffic and emissions data. Thus, the use of traffic volumes in other years would not be appropriate for using the screening tables.

As noted above, however, the SMAQMD developed the Roadway Protocol to evaluate cancer risk due to DPM emissions from vehicles traveling on a high-traffic roadway close to a proposed project site and to provide a screening approach that would not involve complex analysis for many projects. The project site is also bounded by the UPRR tracks. Locomotives traveling on those tracks are another source of DPM emissions. Accordingly, based on a request from the SMAQMD and in response to NOP comments a HRA, as described in the following sections, was conducted to more comprehensively evaluate the potential cancer risk to residents of the proposed project.

Limitations of Roadway Protocol Use for Future Scenarios

While traffic on a given roadway would increase over time, motor vehicle emissions tend to decrease over time due to increasingly stringent state and federal air quality regulations and replacement of older vehicles. Neither traffic levels nor emissions can be accurately predicted over the 70-year exposure period assumed in the Roadway Protocol. Additionally, the Roadway Protocol's evaluation criterion (currently 276 in 1 million) is dependent upon current traffic and emissions data, and without future traffic and emissions data, it is unknown what the future evaluation criterion would be. It would be inappropriate and not done for HRAs as a matter of practice to conduct an analysis of future conditions, as that analysis would include yet-to-be realized emissions reductions, speculative traffic levels, and an inaccurate evaluation criterion. For these reasons, an analysis of future conditions is not included in this HRA. This also applies to the analysis of future locomotives as well.

Local Conditions

As discussed previously, the Capital City Freeway would be considered a high-traffic urban roadway of 100,000 vehicles/day. The majority of the vehicles are 2- and 3-axle vehicles that are mostly gasoline powered, while a portion are larger 4- and 5-axle trucks that are powered by diesel engines.

On the south side of the project site, the UPRR tracks run in a roughly east–west orientation. The CARB Handbook does not include siting recommendations regarding rail lines. Instead, CARB recommends avoiding siting new sensitive land uses within 1,000 feet of a major service and maintenance rail yard and, when within 1 mile of a rail yard, CARB recommends consideration of possible siting limitations and mitigation approaches. The proposed project is not within 1 mile of a rail yard and would not be subject to CARB's advisory recommendations. While no guidance has been established by CARB or SMAQMD to determine potential impacts associated with air pollutant emissions generated during operation of a railroad, the DPM emissions from locomotives were evaluated in this HRA to provide a conservative estimate of cancer risk associated with freeway vehicles, trucks and locomotive DPM emissions near the project site.

2.0 CALCULATION OF DPM EMISSIONS

2.1 Freeway Vehicle Emissions

To be consistent with the approach in the Roadway Protocol, which uses "current" (i.e., 2011) levels of vehicles and emissions and not future levels, Caltrans traffic data for 2011 was used to analyze the emissions from trucks traveling on the Capital City Freeway. Traffic volumes were obtained to estimate emissions from truck traffic traveling on the Capital City Freeway; the freeway is designated as State Route 51 (SR-51) in records available from Caltrans. Caltrans data includes volumes for the segment between E Street and Exposition Street in Sacramento. Based on the most recent "2011 Annual Average Daily Truck Traffic on the California State Highway System" (Caltrans n.d.), it was estimated that truck traffic would account for 5,422 AADT of the 159,000 total vehicle AADT, or 3.41%, on SR-51 at Exposition Boulevard. Of these truck trips, based on Caltrans data, it is estimated that 30.6% would be 2-axle trucks, 17.1% would be 3-axle trucks, 10.4% would be 4-axle trucks and the remaining 41.9% would be 5+-axle trucks (Caltrans n.d.). It should be noted that only the truck traffic data, and not total vehicle AADT, was used to develop mobile source emission rates.

Table 1, SR-51 Traffic Volumes, presents these traffic volumes and truck distribution for 2011.

Table 1
SR-51 Traffic Volumes (AADT)

Year	Total Vehicle Traffic	Total Truck Traffic	2-axle Trucks	3-axle Trucks	4-axle Trucks	5+-axle Trucks
2011	159,000	5,422	1,660	929	564	2,269

Source: Caltrans n.d.

An inventory of hourly heavy-duty vehicle emissions was produced by CARB using the heavy-duty module of the CARB motor vehicle emission inventory model (EMFAC2011-HD) for the SMAQMD. This data set was provided to Dudek by the SMAQMD for use in this assessment (DuBose, pers. comm. 2013). The inventory contains emissions estimation by process, by model year, by EMFAC2007 vehicle class,[4] by hour for calendar year 2013, within the SMAQMD boundaries (Geographical Area Index 31) assuming an annual time frame. Emissions were estimated for four heavy-duty vehicle classes: heavy-heavy duty trucks (HHDT), medium-heavy duty trucks (MHDT), school buses (SBUS), and other buses (OBUS). Emissions from these

[4] The EMFAC2007 vehicle categories are less detailed than those in EMFAC2011 for the medium-heavy-duty truck (T6) and heavy-heavy-duty truck (T7) categories. The EMFAC2007 vehicle categories are of sufficient detail for this assessment.

vehicle classes are the only ones modeled by EMFAC2011-HD. Emissions from other vehicle classes can be modeled in EMFAC2011-LD for "light-duty" vehicle classes, but they were not used in this assessment as discussed below.

To illustrate that these four heavy-duty vehicle classes generate the majority of emissions of particulate matter with an aerodynamic diameter less than or equal to 10 microns (PM_{10}) within the boundaries of the SMAQMD, emission factors for all vehicles traveling within Sacramento County were determined using EMFAC2011, available online (http://www.arb.ca.gov/msei/modeling.htm). The emission inventory for calendar year 2013 was developed using EMFAC2007 vehicle classifications, aggregated model year and aggregated speed for diesel-fueled vehicles. Total vehicle-miles traveled (VMT) was estimated to be 2,092,148 miles/day, with HHDT and MHDT (T6 and T7), SBUS, and OBUS vehicle classes accounting for 1,158,878 miles/day, or 55%. These heavy-duty vehicle classes, however, produce 81% of the total PM_{10} running exhaust emissions (0.31 tons/day of the total 0.38 tons/day) and are the primary contributor to PM_{10} emissions. Note that the 2013 emission rates are being used to analyze the cancer risk associated with 70 years of exposure; however, in the next 70 years DPM emissions will be reduced due to fleet turnover and regulatory measures. Furthermore, the emission factors for the four heavy-duty vehicle classes would tend to be higher than those for lighter vehicle classes (2- and 3- axle trucks comprise about 50% of the truck traffic on the Capital City Freeway in the project area). For these reasons, use of the EMFAC2011-HD data prepared by CARB represents a conservative basis for estimating the long-term cancer risk. Therefore, the EMFAC2011-HD results for these four heavy-duty vehicle classes were used to estimate DPM emissions in this HRA.

The EMFAC2011-HD inventory provided total PM_{10} exhaust emission factors and VMT data within the SMAQMD boundaries for HHDT, MHDT, SBUS, and OBUS categories. The EMFAC database takes into consideration the vehicle category and model year distribution in the state's vehicle population for the specified calculation year. The PM_{10} emission rates (ton/hr) are the total hourly emissions for the SMAQMD mix of heavy-duty vehicles for 2013. PM_{10} emissions were used as surrogate for DPM since all DPM is considered to be less than or equal to 10 microns in diameter and most (greater than 90%) is $PM_{2.5}$ or less.

Hourly truck traffic counts were developed by first dividing each annual average hourly VMT value in the SMAQMD from EMFAC2011-HD by the annual average daily VMT count reported by EMFAC2011-HD for 2013. The result is the percent VMT for each hour. Then, the percent VMT by hour was multiplied by the total truck traffic (5,422) (Caltrans n.d.) for SR-51 at Exposition Boulevard to determine the hourly truck count (vehicles per hour) on the segment of the Capital City Freeway near the project site.

The annual average hourly PM_{10} exhaust emissions in tons per hour provided in the EMFAC2011-HD inventory were divided by the respective VMT per hour and converted to grams per VMT. To determine the grams per hour per mile, the grams per VMT for each hour were multiplied by the truck count (vehicles per hour) calculated for that hour. The grams per hour per mile were multiplied by the length of the modeled segment of the Capital City Freeway near the project site, which is 1.074 miles (1,727.7 meters), to calculate the pounds per hour to be applied in AERMOD (see discussion of variable emissions factor in Section 3.1).

Table 2, Hourly Distribution of Vehicles and PM_{10}, provides the hourly distributions of VMT and PM_{10} emissions from the EMFAC2011-HD inventory within the SMAQMD boundaries for 2013 and the converted values for use in AERMOD. In Table 2, Hour 0 is midnight to 1:00 a.m., and Hour 23 is 11:00 p.m. to midnight. Detailed calculations are provided in Attachment A.

Table 2
Hourly Distribution of Vehicles and PM_{10} Emissions

Hour	Sacramento County		Capital City Freeway	
	Heavy-Duty VMT[1]	*Heavy-Duty PM_{10} Emissions (tons/hour)*[2]	*Heavy-Duty Vehicles (per hour)*[3]	*Heavy-Duty PM_{10} Emissions (pounds/hour)*[4]
0	44,360	0.011	208	0.112
1	22,652	0.005	106	0.054
2	15,839	0.005	74	0.047
3	37,959	0.011	178	0.114
4	19,812	0.006	93	0.059
5	43,920	0.012	205	0.118
6	78,541	0.021	367	0.209
7	50,096	0.014	234	0.138
8	75,273	0.019	352	0.192
9	95,699	0.025	448	0.254
10	76,842	0.021	360	0.209
11	86,694	0.023	406	0.232
12	79,752	0.021	373	0.208
13	76,490	0.020	358	0.200
14	66,219	0.017	310	0.171
15	42,479	0.010	199	0.104
16	69,939	0.017	327	0.168
17	25,536	0.006	119	0.063
18	18,363	0.006	86	0.056
19	6,660	0.002	31	0.021
20	33,539	0.009	157	0.095

Table 2
Hourly Distribution of Vehicles and PM_{10} Emissions

Hour	Sacramento County		Capital City Freeway	
	Heavy-Duty VMT[1]	*Heavy-Duty PM_{10} Emissions (tons/hour)*[2]	*Heavy-Duty Vehicles (per hour)*[3]	*Heavy-Duty PM_{10} Emissions (pounds/hour)*[4]
21	55,349	0.015	259	0.146
22	29,723	0.008	139	0.076
23	7,141	0.002	33	0.023

Source: See Attachment A.
Notes:
1 Sacramento County VMT is total countywide vehicle-miles traveled per hour by vehicle classes in EMFAC2011-HD in 2013.
2 Sacramento County PM_{10} Emissions is total countywide tons/day of PM10 from vehicle classes in EMFAC2011-HD in 2013.
3 Heavy-Duty Vehicles is the estimated hourly distribution of heavy-duty vehicles based on the Sacramento County VMT and the Caltrans estimate of 5,422 trucks per day on SR-51 near the project site.
4 Pounds/hour is hourly PM_{10} emissions from heavy-duty diesel vehicles traveling on the freeway segment used in the dispersion modeling, which has a length of 1,727.7 meters (1.074 miles) and based on the hourly grams PM_{10} per VMT derived from the EMFAC2011-HD data for 2013.

2.2 Locomotive Emissions

Emissions for locomotives associated with UPRR freight and Amtrak passenger trains operating on the UPRR tracks adjacent to the project site would also emit DPM from the diesel engines used in the locomotives. To be consistent with the approach in the Roadway Protocol, which uses "current" levels of vehicles and emissions and not future levels,[5] the estimated locomotive emissions were based on recently observed activity levels and passenger train schedules provided by the noise consultant, Bollard Acoustical Consultants (Bollard Acoustical Consultants 2013), and 2013 locomotive emission factors.[6]

According to observations made by Bollard Acoustical Consultants during 6 consecutive days in August 2013, up to 22 freight and 8 passenger trains pass the project site per day (see Bollard Acoustical Consultants 2013 for the basis for these values [DEIR Appendix I]).[7]. A Federal Railroad Administration (FRA) website provides information on the estimated daily average of trains that pass through the 28th Street at-grade crossing. (Pursuant to pers comm. from Felix Ko, State Office of Railroad Safety, the data provided on the FRA website are

5 As with motor vehicles, train traffic on UPRR tracks could increase (see Footnote 7); however, increasing stringent federal regulations for locomotives and agreements between the railroads and CARB will reduce emissions from locomotives over time.

6 2013 locomotive emission factors were used to be consistent with the 2013 vehicle emissions data used for the evaluation of the freeway emission sources.

7 The Capitol Corridor Joint Powers Authority is evaluating the Sacramento–Roseville Third Track Project that could increase the *Capitol Corridor* passenger trains in the project area to 10 round trips (20 pass bys) per day in the future. If the project is approved it may not be completed for 15 to 30 years. This increase in trains was not assumed in this analysis because it would be a future scenario with speculative operating conditions.

considered "rough estimates." Pursuant to pers comm. from Heather Jones at UPRR, UPRR provides the information for the FRA website). Information from the FRA website accessed in August 2013 indicated an estimated daily average of 22 total trains pass through the 28th Street at-grade crossing based on information provided as of January 1, 2011. Information from the FRA website accessed in October 2013, provides updated information from July 10, 2013, which indicates an estimated daily average of 41 total trains pass through the 28th Street crossing. Because specific information regarding train schedules and frequency are not provided by UPRR or available on the FRA website, actual train counts in the project area were used for this analysis.

Based on information provided by Amtrak schedules and actual observations, passenger trains operate each day with two westbound trains (*Capitol Corridor* and *California Zephyr*), two eastbound trains (*Capitol Corridor* and *California Zephyr*), two northbound trains (*San Joaquin*), and two southbound trains (*San Joaquin*). The freight trains were observed to have two to three locomotives in the front of the train and one locomotive in the rear. The *Capitol Corridor*, *San Joaquin* and westbound *California Zephyr* trains typically have a single locomotive, while the eastbound *California Zephyr* trains typically have two locomotives. For purposes of this analysis, 22 freight trains and 8 passenger trains were conservatively assumed to operate daily on the UPRR tracks.

In summary, the emissions were estimated based on the following assumptions:

- Freight Trains
  - Number of freight train pass bys per day: 22
  - Number of locomotives per freight train: 4
  - Rating of locomotive engine: 3,500 brake-horsepower.
- Passenger Trains
  - Number of passenger train pass bys per day: 8
  - Number of locomotives per passenger train: 1-2
  - Rating of locomotive engine: 3,500 brake-horsepower.

The EPA's Emission Factors for Locomotives (EPA 2009) was used as the source of PM_{10} emissions for the locomotives. As indicated in Table 6 of this document, the average line-haul locomotive and passenger locomotive in 2013 would emit 3.8 and 3.9 grams per gallon of diesel fuel consumed, respectively. According to Table 3, line-haul and passenger locomotives produce 20.8 brake-horsepower-hours per gallon of diesel fuel consumed. Thus, the PM_{10} emissions per gallon can be converted to 0.18 and 0.19 grams per brake-horsepower-hour. These emission factors are then multiplied by the fully rated engine rating of 3,500 brake-horsepower. The engines, however, do not operate at full load while traveling much of the time. Locomotive engines can operate in one of 8 notch settings and at idle. For this analysis, it was assumed that the engines would operate at Notches 2 or 3 because the trains appear to operate at a slow speed (estimated at approximately 20 miles per hour) on relatively flat track. The speeds of several train pass bys were monitored at the project site using a Bushnell Velocity radar gun on August 27, 2013, by Bollard Acoustical Consultants. Those measurements indicated that train speeds are fairly slow, typically ranging from 20–25 miles per hour (mph). These slow train speeds were expected given the curvature of the tracks adjacent to the project site and the proximity of the project site to the downtown Sacramento Amtrak station. During several days of observations, at no time were elevated train speeds observed above 25 mph. For the purposes of this HRA, train speeds by the site were estimated at approximately 20 mph.

The 2011 Port of Los Angeles emissions inventory (Starcrest 2012) provided load factors (percent of full load) corresponding to Notches 2 and 3 settings. The composite load factor was estimated to be 28.9%. This factor was multiplied by the full load PM_{10} emission rates to estimate the grams per hour from each locomotive, and the resultant value was multiplied by the number of locomotives that would traverse the tracks adjacent to the project site in an average hour. At a daily level of 22 freight trains per day, an average of 3.7 locomotives would travel past the project site per hour. Eight passenger trains would travel past the project site per day, each driven by one to two locomotives.

Each locomotive would travel much less than 1 hour along the tracks adjacent to the project site. For the purpose of this analysis, the modeled distance of the UPRR tracks was 1,850.7 meters (1.15 miles). At a speed of 20 miles per hour, a train would traverse this distance in 0.058 hour or about 3.5 minutes. Thus, the emission rates were adjusted by 0.058 to estimate the emissions on this segment during each hour. The resultant emissions for freight and passenger trains are shown in Table 3, Locomotive Emissions. Detailed calculations are provided in Attachment A.

Table 3
Locomotive Emissions

Train Type	PM_{10} Emissions (pounds/hour)
Freight Trains[1]	0.125
Passenger Trains[2]	0.048

Source: See Attachment A.
Notes:
1 Freight train emissions are applied to each hour of the day.
2 Passenger train emissions are applied to 6 hours of the day. Emissions shown are for the eastbound *California Zephyr*, which uses two locomotives. See Section 3.1 regarding adjustment for all other passenger trains.

3.0 MODELING METHODOLOGY

3.1 Dispersion Model

The U.S. Environmental Protection Agency (EPA)-approved dispersion model, American Meteorological Society/Environmental Protection Agency Regulatory Model (AERMOD) Version 12345 (AERMOD View, Lakes Environmental 2013) was used to model the air quality impacts of DPM emissions from trucks traveling along the Capital City Freeway and locomotives traveling on the UPRR tracks. AERMOD can estimate the air quality impacts of single or multiple sources using actual meteorological conditions. Use of AERMOD is accepted by the SMAQMD for an HRA. The AERMOD input and output files are included in Attachment B.

The model was configured with the following control parameters:

- Modeling switches: Regulatory Defaults
- Averaging periods: Period
- Choice of dispersion coefficients based upon land-use type: Urban.

AERMOD-ready meteorological data, obtained from the Yolo–Solano Air Quality Management District, are from a monitoring station at the Sacramento International Airport for 2004 to 2008 and were used in AERMOD. Urban dispersion coefficients were selected as recommended by the SMAQMD. The Sacramento International Airport meteorological monitoring site in Sacramento is approximately 10.4 miles (16.7 kilometers) northwest of the project site and the closest meteorological monitoring site to the project area with AERMOD-ready data. A wind rose illustrating prevailing wind speeds and directions for the period from 2004 to 2008 is shown in Figure 4, Wind Rose of Sacramento International Airport Station – 2004 to 2008 Meteorological Data. Terrain data for the project site and surrounding area were obtained from Lakes Environmental, available online (http://www.webgis.com/ terraindata.html). The Digital Elevation Model (DEM) data file, produced by the U.S. Geological Survey, was then processed using the AERMAP terrain preprocessor for use with AERMOD.

3.2 Source Characteristics

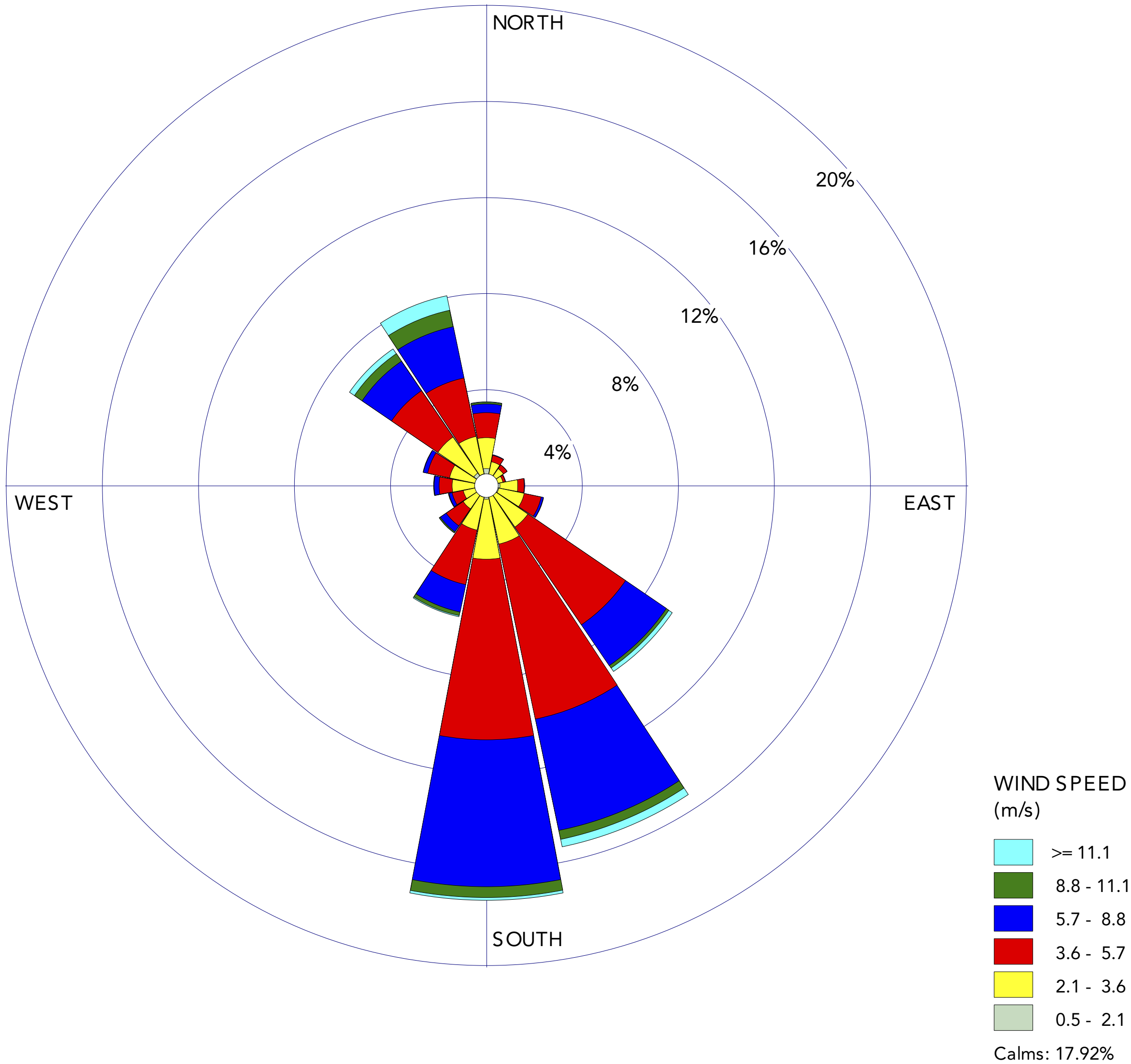
The emissions from trucks traveling on the freeway, as described in Section 2.1, were modeled as a series of 6 line sources (one for each freeway lane) consisting of adjacent volume sources along a 1.07-mile long segment of the Capital City Freeway. The length of the line sources representing the freeway is approximately 1,000 feet beyond the end of the project site in each direction. Each volume source has 12-foot by 12-foot lateral dimensions, representing the width of each lane and a release height of 4.15 meters (per nominal height of exhaust stack above ground level per CARB risk assessment scenarios). Emission rates for freeway trucks were previously shown in Table 2; these emission rates were divided by 6 (because there are 6 freeway lanes and emission rates are obtained for each line source) and converted to grams/second for each line source in AERMOD. The emission rates shown in Table 2 are for the entire freeway.

The emissions from the trains, as described in Section 2.2, were modeled as a series of two line sources consisting of adjacent volume sources along a 1.15-mile long segment of the UPRR tracks. As noted in the Noise Assessment prepared for the project (see Appendix I of the Draft EIR - Bollard Acoustical Consultants 2013), there are additional tracks to the east of the project site. These tracks run from the south and one leg turns westward and another leg continues to the north. Insufficient data was available in the noise assessment to distinguish the trains running on the tracks adjacent to the project site from trains running on these other tracks. Furthermore, it appears that a limited number of trains use these tracks on a typical day. Thus, to simplify the analysis, all trains were modeled as if they were running on the tracks adjacent to the site. This approach would also be more conservative because the emissions from trains on the other tracks would contribute somewhat less to the exposure to the project's residents because they are farther away. The length of the line sources representing the tracks is approximately 1,000 feet beyond the end of the project site in each direction. Each volume source has 12-foot by 12-foot lateral dimensions, representing one-half the approximate width of each tracks and a release height of 5.6 meter (per daytime plume height above ground level per CARB risk assessment scenarios for rail yards[8]). Emission rates for the trains were previously shown in Table 3; these emission rates were divided by 2 (to reflect two line sources) and converted to grams/second for each line source in AERMOD.

8 http://www.arb.ca.gov/railyard/hra/hra.htm

WIND ROSE PLOT:
Station #93225 Sacramento International Airport

DISPLAY:
Wind Speed
Direction (blowing from)



DATA PERIOD: Start Date: 1/1/2004 - 00:00 End Date: 12/31/2008 - 23:00	
CALM WINDS: 17.92%	TOTAL COUNT: 43842 hrs.
AVG. WIND SPEED: 3.76 m/s	DATE: 12/19/2012

DUDEK

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FIGURE 4
Wind Rose of Sacramento International Airport Station
2004 to 2008 Meteorological Data

HEALTH RISK ASSESSMENT FOR THE MCKINLEY VILLAGE PROJECT

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The AERMOD source characteristics are summarized in Table 4, Source Characteristics for DPM Sources.

Table 4
Source Characteristics for DPM Sources

Trucks on Capital City Freeway	
Number of Line-Volume Sources:	6
Type/Number of Volume Sources:	Adjacent/473 sources
Length of Sides of Volume Sources:	12 feet (3.66 meters)
Initial Lateral Dimension:	1.70 meters
Height of Volume Sources:	4.15 meters (nominal height of exhaust stack above ground level per CARB risk assessment scenarios)
Initial Vertical Dimension:	1.93 meters
Locomotives on UPRR Tracks	
Number of Line-Volume Sources:	2
Type/Number of Volume Sources:	Adjacent/506 sources
Length of Sides of Volume Sources:	12 feet (3.66 meters)
Initial Lateral Dimension:	1.70 meters
Height of Volume Sources:	5.6 meters (nominal height of exhaust stack above ground level per railyard risk assessment scenarios)
Initial Vertical Dimension:	1.30 meters

Source: See Attachment B.

The DPM emissions from trucks traveling on the Capital City Freeway were input in AERMOD by using the maximum hourly emission rate of 0.042 pounds/hour per line source and a variable emissions factor, using the HROFDAY code, to reflect lower emission rates during the other hours. The variable emissions factor was based on the values in the Capital City Freeway/ Heavy-Duty PM_{10} Emissions column of Table 2, in which Hour 9 has the maximum hourly emissions and a variable emissions factor of 1.00.

Freight trains do not appear to operate on a specific schedule and can run during the day or night according to UPRR. Thus, the freight train emissions were assumed to occur hourly during 24 hours of each day. According to current Amtrak schedules, the passenger trains would pass the project site during the hours of 6:00 a.m. to 7:00 a.m., 7:00 a.m. to 8:00 a.m., 11:00 a.m. to noon, noon to 1:00 p.m., 2:00 p.m. to 3:00 p.m., 5:00 p.m. to 6:00 p.m., and 11:00 p.m. to midnight. Thus, the HROFDY code in AERMOD was applied so that the passenger locomotive emissions would occur only during the hours these trains pass the project site (i.e., a factor of 1.0 represents an hour where a passenger train would be present, and a factor of 0.0 represents an hour where a passenger train would be absent). To account for two locomotives on the eastbound *California Zephyr* trains, a factor of 2.0 was applied to double the emissions for this train. A factor of 2.0 was also applied to hours in which multiple passenger trains may pass the site in the same hour, although not simultaneously.

3.3 Receptor Grid

A uniform Cartesian grid of receptors was set up across and in the vicinity of the project site. The grid covered the project site, approximately 600 feet north of the Capital City Freeway, approximately 600 feet south of the UPRR tracks, and approximately 1,200 feet east and west of the ends of the project site. A fine receptor grid with 50-meter interval spacing was used, and a total of 1,200 receptors were modeled within this receptor grid. The flagpole receptor height was set to 1.5 meters for all receptors. The cancer risks to residents of the project site are captured by this receptor grid, and no discrete sensitive receptors were defined in the model. The receptor grid covered enough of the surrounding area for AERMOD View to generate isopleths of cancer risk (i.e., lines of equal level of cancer risk).

4.0 EVALUATION OF HEALTH IMPACTS

4.1 Cancer Risk

As discussed previously, the evaluation criterion is a cancer risk value that is based on the reasonable worst-case siting situation within the boundaries of the SMAQMD. It is the level of increased individual risk corresponding to a 70% reduction from the highest roadway risk in Sacramento County. It is calculated based on a hypothetical sensitive receptor located 50 feet from the edge of the nearest travel lane for the highest peak traffic volume reported by Caltrans for Sacramento County (24,000 vehicles per hour) east (downwind) of a north–south roadway. For 2011 and later evaluations, the evaluation criterion is a cancer risk of 276 in 1 million. It is calculated by reducing the cancer risk at 50 feet from the worst-case roadway by 70%: (100% - 70%) × 919 in 1 million = 276 in 1 million.

The cancer risk calculations for the project site were performed by multiplying the AERMOD-predicted DPM concentrations in $\mu g/m^3$ due to DPM emissions from trucks and locomotives by the appropriate risk values. The exposure and risk equations that were used to calculate the cancer risk at residential receptors are taken from the OEHHA manual for health risk assessments prepared under the Air Toxics "Hot Spots" program (OEHHA 2003).

The potential exposure pathway for DPM includes inhalation only. The potential exposure through other pathways (e.g., ingestion) requires substance and site-specific data, and the specific parameters for DPM are not known for these pathways (CARB 1998). Cancer risks were evaluated using the inhalation cancer potency factor published by the OEHHA and CARB (CARB 2013). The cancer potency factor for DPM is 1.1 per milligram per kilogram of body weight per day (mg/kg-day).

The following equations were used to calculate the cancer risk due to inhalation using the modeled DPM concentrations:

*Risk = Inhalation potency factor * Dose Inhalation* (1)

where:

Inhalation potency factor = 1.1 (mg/kg-day) for diesel particulate matter,

and:

$$Dose\ Inhalation = C_{air} * DBR * A * EF * ED * 10^{-6} / AT \quad (2)$$

where:

C_{air} = *concentration of DPM in microgram per cubic meter* ($\mu g/m^3$)

DBR = breathing rate in liter per kilogram of body weight per day
A = inhalation absorption factor (1 for DPM)
EF = exposure frequency in days per year
ED = exposure duration in years
AT = averaging time period over which exposure is averaged in days (25,550 days for 70 years)

In accordance with CARB policy (CARB/OEHHA 2003), the breathing rate equal to the 80th percentile, or 302 liters per kilogram of body weight per day, was used for the cancer risk calculations.

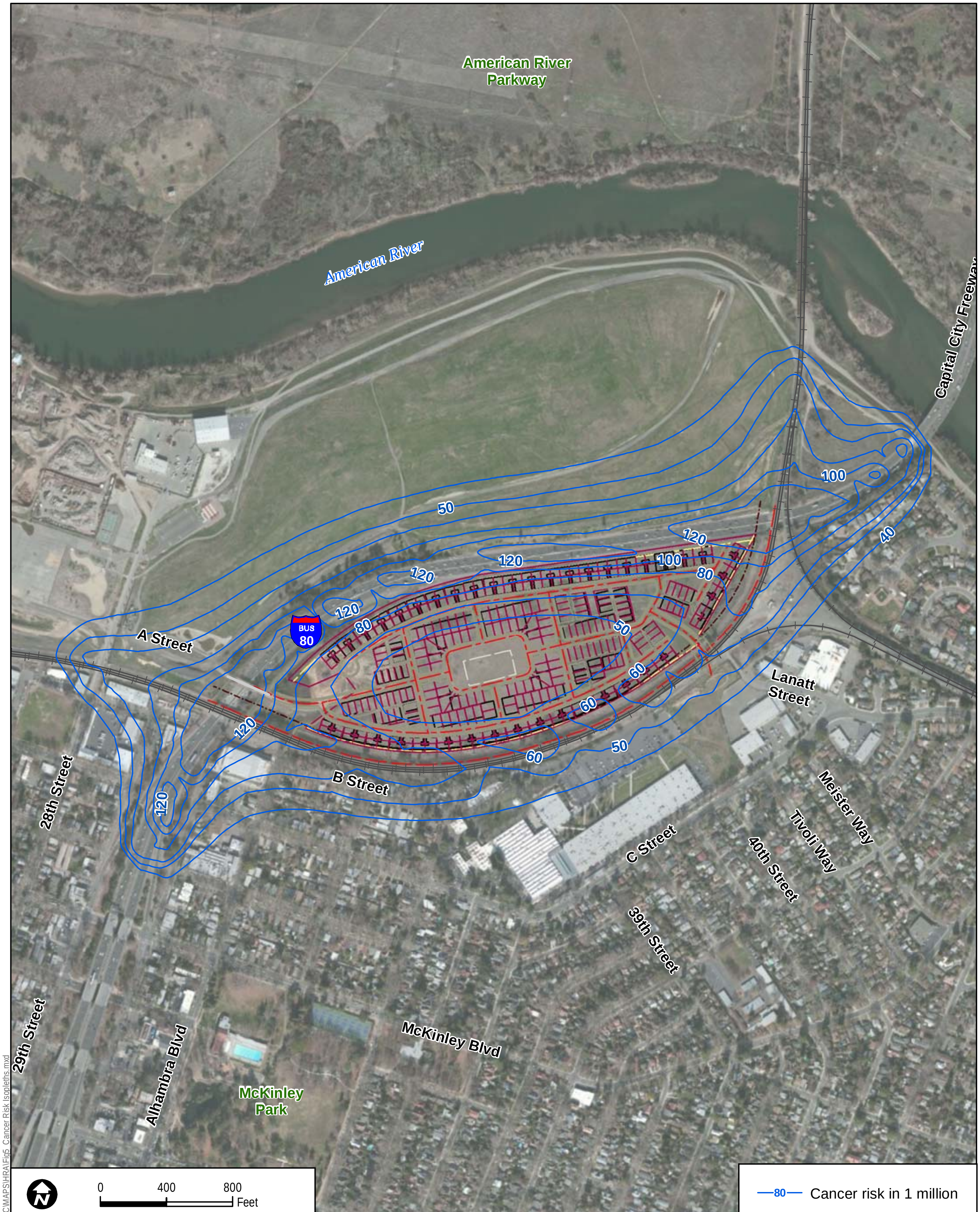
To calculate risk directly from the modeled concentrations, a concentration multiplier was derived based on the information discussed above. This factor, when multiplied by the concentration that the dispersion model calculates, results in an estimated cancer risk in 1 million at a particular receptor. The concentration multiplier was applied to the modeled DPM concentrations using a post-processing tool in AERMOD View (Lakes Environmental 2013). The concentration multiplier was calculated as follows:

$$= CPF*(DBR*A*EF*ED*10^{-6}/AT)*10^{6}$$

$$= 1.1\ (mg/kg\text{-}day)^{-1} * (302\ L/kg\ body\ weight\text{–}day * 1 * 350\ day/yr * 70\ yr * 10^{-6} / 25{,}550\ days) * 10^{6}$$

$$= 318.55\ (\mu g/m^{3})^{-1}.$$

The resultant cancer risk isopleths as depicted in Figure 5, Modeled Cancer Risk due to DPM Emissions, represent the 70-year cancer risks. Under this exposure scenario, and as shown in Figure 5, nearly all of the project site would be exposed to a cancer risk of approximately 80 in 1 million or less. Based on this analysis, the maximum cancer risk would occur at the eastern end of the project site of the proposed project, closest to the freeway and the UPRR tracks, at a level of approximately 120 in 1 million.



Path: Z:\Projects\j782801\MAPDOC\MAPS\HRA\Fig5_Cancer Risk Isopleths.mxd

SOURCE: ESRI; County of Sacramento 2012

FIGURE 5

Modeled Cancer Risk Due to DPM Emissions

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HEALTH RISK ASSESSMENT FOR THE MCKINLEY VILLAGE PROJECT

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4.2 Cancer Burden

As discussed previously, the Roadway Protocol recommends an assessment of the cancer risk associated with DPM emissions from vehicles traveling on a nearby roadway, which is compared to the evaluation criterion, although it does not represent an acceptable cancer risk or a threshold of significance. Another measure of potential effects from carcinogens is cancer burden. While it is not recommended in the SMAQMD's *Guide to Air Quality Assessment in Sacramento County* (SMAQMD 2013) as a health-based threshold of significance, cancer burden is often used to assess a population's exposure in HRAs prepared in accordance with the Air Toxics "Hot Spots" Information and Assessment Act of 1987 (OEHHA 2003). In some cases in other air districts (e.g., South Coast Air Quality Management District), cancer burden is recommended as a metric for CEQA analysis and/or permitting of stationary sources emitting TACs. Unlike cancer risk, which is the lifetime *probability* (chances) of an individual developing cancer due to exposure to a carcinogenic compound, cancer burden uses the cancer risk estimates to compute the estimated number of theoretical cancer *cases* in a defined population resulting from a lifetime exposure to carcinogenic TACs. Population exposure can be assessed by determining the number of people at a particular cancer risk level such as 1 or 10 in 1 million. The traditional way of estimating population exposure for cancer has been the cancer burden or the theoretical number of excess cancer cases in the exposed population (OEHHA 2003). The cancer burden is often calculated by multiplying the number of people exposed by the cancer risk at either the maximum estimated cancer risk or the population centroid of each census block. The result of this calculation is an estimate of the number of cancer cases in the exposed population expected from a 70-year exposure. For this project, the maximum estimated cancer risk was multiplied by the anticipated population of the project. As indicated in Section 1.2, the project is anticipated to generate a total population of 656 new residents at buildout, based on the City's rate of 2.0 persons per household. Using the maximum cancer risk of approximately 120 in 1 million, and multiplying this value by the project population gives a cancer burden of 0.08. Accordingly, the cancer burden indicates that less than one person could contract cancer assuming a 70-year exposure under the modeled scenario of DPM emissions and provided that other factors related to an individual's susceptibility to contracting cancer would occur.

4.3 Noncancer Health Effects

As noted in Section 1.6, the Roadway Protocol only evaluates cancer risk; noncancer acute and chronic health effects are not assessed. The CARB Air Quality and Land Use Handbook (CARB 2005) refers to several studies that identify noncancer health effects associated living near heavily traveled roadways. Such effects include a variety of respiratory symptoms, asthma exacerbations (hospital visits, symptoms), and decreases in lung function. A more recent CARB report (CARB 2012) reviews more recent studies that associate proximity to busy roadways with asthma onset in children, impaired lung function, and increased heart disease.

In addition to the potential cancer risk, DPM has chronic (i.e., long term) noncancer health effects. The chronic hazard index was evaluated using the OEHHA/CARB inhalation reference exposure level (REL) (CARB 2013). The REL is the concentration (inhalation) or daily dosage (noninhalation) at or below which no adverse health effects are anticipated. No acute REL has been established for DPM. The chronic noncancer inhalation hazard index is calculated by dividing the maximum modeled annual average concentrations of DPM by its REL, which is 5 micrograms per cubic meter ($\mu g/m^3$). (This calculation is based on an annual exposure at a given concentration and not a 70-year exposure as was used for the cancer risk calculations.) The modeled annual average concentration corresponding to the maximum cancer risk of 120 in 1 million is 0.38 $\mu g/m^3$ for a chronic hazard index of 0.076. Similarly, as noted in Section 4.1, most of the project site would be exposed to a cancer risk of less than 80 in 1 million. This level corresponds to an annual average concentration of 0.25 $\mu g/m^3$ for a chronic hazard index of 0.050.

The SMAQMD has not established a significance threshold for hazard indices where the project's residents would be exposed to TACs from mobile sources. However, if the hazard index is less than 1.0 (i.e., TAC concentrations are less than the REL), then no adverse health effects are anticipated. Accordingly, no adverse noncancer health effects from DPM would be expected.

DPM, however, consists primarily of fine particulate matter, generally less than 2.5 microns in aerodynamic diameter, which is referred to as $PM_{2.5}$. In June 2010, the Bay Area Air Quality Management District (BAAQMD) adopted revised significance thresholds as part of an update to its CEQA Air Quality Guidelines (BAAQMD 2010). While the adoption of these thresholds has been litigated, the underlying basis for the thresholds was not generally in question in the litigation. As part of its recommended evaluation of "risks and hazards," the BAAQMD adopted a $PM_{2.5}$ "cumulative" threshold of 0.8 $\mu g/m^3$ (annual average). To evaluate this threshold, sources of $PM_{2.5}$, including roadways and stationary sources, within 1,000 feet of a development project with new sensitive receptors would be assessed to determine if the $PM_{2.5}$ emissions from such sources would expose sensitive receptors to an annual average concentration greater than 0.8 $\mu g/m^3$. In the absence of other applicable thresholds, if this threshold were applied to the McKinley Village project, the cumulative annual average $PM_{2.5}$ concentrations resulting from DPM emitted from trucks on the Capital City Freeway and locomotives on the UPRR tracks would generally be less than 0.25 $\mu g/m^3$ and no greater than 0.38 $\mu g/m^3$. Based on the BAAQMD $PM_{2.5}$ threshold, the residents of the proposed project would not be exposed to significant levels of $PM_{2.5}$.

5.0 CONCLUSIONS

Based on this analysis, the majority of the residents of the proposed project would be exposed to a cancer risk of 80 in 1 million or less, with a maximum cancer risk of 120 in 1 million. Most residents would not live at the same location for 70 years. People tend to live at a given location for approximately 9 years (average) to 30 years (95th percentile). Thus, the estimated cancer risk would be lower for more typical residency periods. In addition, while it is not suggested as a criterion in the Roadway Protocol, the estimated cancer burden (theoretical cancer cases) based on the maximum exposure of 120 in 1 million over the project site was determined to be 0.08 such that less than 1.0 additional cancer case would be likely to occur in the exposed population of the proposed project. In addition, the residents of the proposed project are not anticipated to be exposed to significant noncancer health effects from DPM or $PM_{2.5}$.

The results determined in this analysis reflect reasonable estimates of source emissions and exhaust characteristics, available meteorological data near the project site, and the use of currently approved air quality models. Given the limits associated with health risk assessments (e.g., assumptions regarding emission sources, air quality dispersion model options, health effects calculations), the actual impacts may vary from the estimates in this assessment. However, the combined use of the AERMOD dispersion model and the health impact calculations required by the OEHHA and the SMAQMD tend to over-predict impacts, such that they produce conservative (i.e., health-protective) results. Accordingly, the health impacts are not expected to be higher than those estimated in this assessment.

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ATTACHMENT A

Emission Calculations

McKinley Village
Truck ADT on Capital City Freeway

Hour	EMFAC2011 VMT	Percent of VMT	Truck ADT
0	44,360	3.8%	208
1	22,652	2.0%	106
2	15,839	1.4%	74
3	37,959	3.3%	178
4	19,812	1.7%	93
5	43,920	3.8%	205
6	78,541	6.8%	367
7	50,096	4.3%	234
8	75,273	6.5%	352
9	95,699	8.3%	448
10	76,842	6.6%	360
11	86,694	7.5%	406
12	79,752	6.9%	373
13	76,490	6.6%	358
14	66,219	5.7%	310
15	42,479	3.7%	199
16	69,939	6.0%	327
17	25,536	2.2%	119
18	18,363	1.6%	86
19	6,660	0.6%	31
20	33,539	2.9%	157
21	55,349	4.8%	259
22	29,723	2.6%	139
23	7,141	0.6%	33
Totals	1,158,878	100.0%	5,422

Notes:
Truck VMT is based on percent of VMT and
Caltrans reported ADT for Capital City Freeway
at Exposition Blvd. = 5,422 ADT

McKinley Village
Hourly PM10 Emissions on Capital City Freeway

Hour	EMFAC2011 Sac. Co. VMT	EMFAC2011 Sac. Co. PM10 ton/hr	PM10 g/VMT	Vehicles per hr	g/hr/mi	lb/hr	AERMOD Inputs		
							lb/hr/source	HROFDY Scalar	Model Hour
0	44,360	0.011	0.2277	208	47.356	0.112	0.019	0.44	1
1	22,652	0.005	0.2147	106	22.758	0.054	0.009	0.21	2
2	15,839	0.005	0.2697	74	19.956	0.047	0.008	0.19	3
3	37,959	0.011	0.2697	178	48.002	0.114	0.019	0.45	4
4	19,812	0.006	0.2697	93	25.080	0.059	0.010	0.23	5
5	43,920	0.012	0.2438	205	49.978	0.118	0.020	0.47	6
6	78,541	0.021	0.2407	367	88.345	0.209	0.035	0.82	7
7	50,096	0.014	0.2498	234	58.451	0.138	0.023	0.54	8
8	75,273	0.019	0.2306	352	81.161	0.192	0.032	0.76	9
9	95,699	0.025	0.2399	448	107.475	0.254	0.042	1.00	10
10	76,842	0.021	0.2449	360	88.179	0.209	0.035	0.82	11
11	86,694	0.023	0.2418	406	98.167	0.232	0.039	0.91	12
12	79,752	0.021	0.2352	373	87.735	0.208	0.035	0.82	13
13	76,490	0.020	0.2365	358	84.681	0.200	0.033	0.79	14
14	66,219	0.017	0.2335	310	72.378	0.171	0.029	0.67	15
15	42,479	0.010	0.2208	199	43.939	0.104	0.017	0.41	16
16	69,939	0.017	0.2174	327	71.102	0.168	0.028	0.66	17
17	25,536	0.006	0.2239	119	26.639	0.063	0.011	0.25	18
18	18,363	0.006	0.2754	86	23.681	0.056	0.009	0.22	19
19	6,660	0.002	0.2876	31	8.916	0.021	0.004	0.08	20
20	33,539	0.009	0.2565	157	40.272	0.095	0.016	0.37	21
21	55,349	0.015	0.2384	259	61.747	0.146	0.024	0.57	22
22	29,723	0.008	0.2321	139	32.265	0.076	0.013	0.30	23
23	7,141	0.002	0.2934	33	9.681	0.023	0.004	0.09	24

Notes:
1. gm/hr/mi based on gm/VMT times trucks/hr.
2. lb/hr based on gm/hr/mile times 1.074 miles (1727.7 meters) of line sources.
3. lb/hr/source = lb/hr / 6 line sources (lanes)
4. HROFDY scalar based on Hour 9 at 0.254 lb/hr = 1.00
5. Model hour is AERMOD hour (e.g., Hour 1 is midnight to 1 AM).

McKinley Village
Locomotive Emission Factors

Emission Factors for Line Haul Locomotives, g/hp-hr		
	PM10	
EF, g/gal	3.8	From Table 6
BFSC, bhp-hr/gal	20.8	From Table 3
EF, g/bhp-hr	0.18	

Source: EPA. 2009. Emission Factors for Locomotives.

Emission Factors for Passenger Locomotives, g/hp-hr		
	PM10	
EF, g/gal	3.9	From Table 6
BFSC, bhp-hr/gal	20.8	From Table 3
EF, g/bhp-hr	0.19	

Modified from Table 6.6: Estimated Average Load Factor

Notch	% of Full Power in Notch	% of Operating Time in Notch	% Full Power x % Time
3	23.5%	50%	11.8%
4	34.3%	50%	17.2%
	Average line haul locomotive load factor:		**28.9%**

Source: Starcrest Consulting Group, LLC. 2012. Port of Los Angeles Inventory of Air Emissions for Calendar Year 2011.
% of Operating Time in Notch is assumed.

McKinley Village
Locomotive Emission Rates

Risk Contribution from Line Haul Rail Line		
Locomotive Parameters		Notes:
Link Length (miles)	1.15	Given
Locomotives per train	4	Assumption: 3-4 locomotives (conservative assumption)
Trains per hour	0.92	Given: 22 trains/day
Locomotives per hour	3.7	Assumption: 4 locomotives/train
Speed (mph)	20	Observed
Travel Time (hour)	0.058	Calculated
Diesel PM Emission Factor (grams/horsepower-hour)	0.18	From Tables 3 and 6 "Emission Factors for Locomotives"
Load Factor	28.9%	Calculated on previous sheet, based on assumptions
Average Locomotive Horsepower	3,500	Assumption: 3,500 hp engine
Emissions Rate		
Emission Rate (gr/hr while passing project site)	**38.96**	
Emission Rate (lb/hr while passing project site)	**0.086**	

Risk Contribution from Passenger Train Rail Line		
Locomotive Parameters		Notes:
Link Length (miles)	1.15	Given
Locomotives per train	1	Assumption: 1 locomotive for most trains
Trains per hour	1	Given: 1 train/hour
Locomotives per hour	1.0	Assumption: 1 locomotive/train
Speed (mph)	20	Observed
Travel Time (hour)	0.058	Calculated
Diesel PM Emission Factor (grams/horsepower-hour)	0.19	From Tables 3 and 6 "Emission Factors for Locomotives"
Load Factor	28.9%	Calculated on previous sheet, based on assumptions
Average Locomotive Horsepower	3,500	Assumption: 3,500 hp engine
Emissions Rate		
Emission Rate (gr/hr while passing project site)	**10.91**	
Emission Rate (lb/hr while passing project site)	**0.024**	

Note: Emission rate for single locomotive trains will be adjusted
in AERMOD using HROFDY (see report).

ATTACHMENT B

AERMOD Modeling Results

(Model output files are provided on the enclosed CD and are only able to be accessed using the AERMOD program)