Appendix K

Health Risk Assessment

HEALTH RISK ASSESSMENT
for the
Village 5 Specific Plan
Lincoln, California

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March 2016

1.0 INTRODUCTION

1.1 Purpose

This health risk assessment (HRA) evaluates the health effects of State Route 65 (SR 65) traffic emissions on future Village 5 Specific Plan sensitive receptors, including residences, schools, medical facilities, and parks.

1.2 Project Description

The Village 5 Specific Plan Area includes 8,150 residential units on 2,292 acres, 440.4 acres of commercial uses, 1,571 acres of parks and open spaces, 118 acres of public uses (primarily schools), and 365 acres of roads and rights of way. Village 5 includes a variety of residences, parks, and commercial development. Many of these land uses would be adjacent to or near SR 65.

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, also 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 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 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.

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 SR 65 adjacent 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, exposure period, child risk factors, 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 include eye irritation, respiratory irritation, throat pain, and headaches. 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 (OEHHA, 2015).

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, near intensive air 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.” In addition, 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.

PCAPCD Guidance

The PCAPCD has developed risk assessment guidance that is summarized in Appendix E of their CEQA Handbook (PCAPCD, 2012). That assessment requires the use of a health risk assessment for projects that may expose sensitive receptors to significant amounts of toxic air contaminants (TACs). The PCAPCD has established guidance showing that significant health risks occur if emissions would result a cancer risk of exceeding 10 per million-cancer risk or a hazard index exceeding 1.0.

Local Conditions

The majority of the vehicles on SR 65 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. The Village 5 traffic study estimates SR 65 traffic volumes at buildout of approximately 25,000 vehicles per day, which is one-half of the volume that CARB cites as causing potential health risks (CARB 2005).

2.0 CALCULATION OF DPM EMISSIONS

2.1 Freeway Vehicle Emissions

SR 65 traffic data for project buildout was used to analyze truck emissions. Trucks are the primary contributor to DPM emissions. SR 65 traffic volumes at buildout were used to estimate emissions. The traffic study found total average daily traffic volumes of 24,450 per day on SR 65 from Wise Road to Nelson Lane. This is the portion of SR 65 that includes Village 5 sensitive receptor locations that could be affected by traffic emissions. The number of trucks were estimated using Caltrans' 2013 estimates of total SR 65 AADT and truck percentages for 2-axle trucks (14.9%), 3-axle trucks (16.7%), 4-axle trucks (13.8 %) and 5+-axle trucks 54.6 % (see Table 1). Since trucks are the primary contributor of DPM, only the truck traffic data, and not total vehicle AADT, were used to develop mobile source emission rates.

Table 1. SR-65 Traffic Volumes (AADT)

Location	Total Vehicle Traffic	Total Truck Traffic	2-axle Trucks	3-axle Trucks	4-axle Trucks	5+-axle Trucks
SR 65 – Wise Road to Nelson Lane	24,450	3,692	550	617	509	2,016

DPM exhaust emissions were estimated using EMFAC2014 for Placer County in year 2042 and assume an average vehicle speed of 55 miles per hour. Table 2 shows those emission rates in grams per mile. Those rates were then converted to grams per second so that they could be incorporated into dispersion modeling, which was used to estimate concentrations at sensitive receptors.

To make this conversion, the length of the SR65 road segment included in the dispersion modeling was multiplied by the number of trips per day by truck type. This produced the miles per day traveled within that SR 65 road segment for each of the five truck types. For each truck type, the grams per second emission rate was estimated by multiplying miles per day by grams per mile. The resulting grams per day was divided by 84,840, which represents the number of seconds per day (24 hours per day * 3,600 seconds per hour). The resulting grams per second emission rate for each truck type were summed to obtain the resulting DPM truck emission rate to use in the dispersion modeling analysis.

Table 2. Highway 65 Truck Emission Rates

Vehicle Truck Type	Miles per Trip	Trips per Day	Miles per Day	Emission Rate (grams/mile)	Emission Rate (grams/second)
Medium Duty	0.68	550	375.0	7.29E-4	3.16E-6
Light Heavy Duty 1	0.68	308.5	210.3	6.53E-3	1.59E-5
Light Heavy Duty 2	0.68	308.5	210.3	5.54E-3	1.35E-5
Public Heavy Heavy Duty T6	0.68	509	347.1	2.23E-3	8.96E-6
Public Heavy Heavy Duty T7	0.68	2,016	1374.55	7.18755E-3	1.14E-4
Total Emission Rate					1.56E-4

3.0 MODELING METHODOLOGY

3.1 Dispersion Model

The U.S. Environmental Protection Agency (EPA) ISCST model was used to model the air quality impacts of DPM emissions from trucks traveling along SR 65. ISCST can estimate the air quality impacts of single or multiple sources using actual meteorological conditions. Use of ISCST is accepted by the PCAPCD for an HRA. The ISCST input and output files are included in Appendix B of the Draft EIR.

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.

ISCST-ready meteorological data are available for Roseville and were obtained from the California Air Resources Board (2015).

3.2 Source Characteristics

The emissions from trucks traveling on the freeway, as described in Section 2.1, were modeled as a series of line sources (one for each freeway lane) consisting of adjacent volume sources along a 0.68-mile long segment of the SR 65. Emission rates for freeway trucks were modeled using a unitary emission rate of 1 gram per second. The resulting concentrations were then modeled by actual emission rates previously shown in Table 2.

3.3 Receptor Grid

Maximum concentrations were estimated at uniform distances from both sides of SR 65. The receptor grid covered the area surrounding SR 65 so that ISCST could generate DPM concentrations as a function of distance from the edge of SR 65.

4.0 EVALUATION OF HEALTH IMPACTS

4.1 Cancer Risk

As discussed previously, the PCAPCD uses a cancer risk of one in one million and a non-cancer health index of 1.0 to determine significant impacts.

The ISCST modeling was originally modeled using a truck emission rate of 1 gram per second. The resulting concentrations were then converted to actual concentrations by multiplying by the actual DPM emission rate of 1.55837E-4 grams per second. Table 3 shows the ISCST modeling results using the 1 gram per second truck emission rate and the actual truck emission rate.

Table 3. Dispersion Modeling Results as a Function of Distance from SR65 Road Edge

Distance in Feet from Edge of SR65	Concentration (at 1 grams/second emission rate)	Adjusted Concentration (at 1.55837E-4 grams/second emission rate)
0	82.4	1.28E-2
100	74.7	1.16E-2
200	60.4	9.41E-3
300	47.4	7.38E-3
400	38.2	5.96E-3
500	32.1	5.00E-3
600	27.9	4.35E-3
700	24.8	3.86E-3
800	22.2	3.46E-3
900	20.1	3.12E-3
1,000	18.3	2.85E-3

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 2015).

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 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 (OEHHA, 2015):

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

where:

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

and:

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

where:

C_{air} = *concentration of DPM in microgram per cubic meter* ($\mu g/m^3$)
DBR = breathing rate in liters per kilogram of body weight per day; 361 for the third trimester; 1090 for ages 0 to 2, 745 for ages 2 to 16, and 290 for ages 16 to 70.
A = inhalation absorption factor (1 for DPM)

EF = exposure frequency in days per year
ED = exposure duration in years
ASF = age sensitivity factor for a specific age group (unitless); 10 for ages from 3rd trimester to age 2, 3 for ages 2 to 16, and 1 for ages 16 to 70.

AT = averaging time period over which exposure is averaged in days (25,550 days for 70 years)
FAH = fraction of time at home (unitless); 85% or 0.85 for ages from 3rd trimester to age 2, 72% or 0.72 for ages 2 through 16 and 73% or 0.73 for ages 16 through 70.

Emissions estimated in this health risk assessment represent 70-year cancer risks. Table 4 shows the cancer risk inputs by age category. These are the cancer risk inputs as recommended by OEHHA (2015).

Table 4. Cancer Risk Inputs by Age Category

Age Category	Daily Breathing Rate	Inhalation Absorption Rate	Days/year	Years	Days in 70 Years	Child Risk Factor	Fraction of Time at Home
3rd Trimester to Birth	361	1	365	0.3	25,550	10	0.85
0 to 2	1090	1	365	2	25,550	10	0.85
2 to 16	745	1	365	14	25,550	3	0.72
16 to 70	290	1	365	54	25,550	1	0.73

Table 5 shows the cancer risk results as a function of distance from the edge of SR 65. The estimates in Table 5 are shown in 100-foot increments for distances between 0 and 1,000 feet from the edge of SR 65. For each increment, total cancer risks are the sum of the four age groups – 3rd trimester to birth, birth to age 2, age 2 to 16, and age 16 to 70. Cancer risks would exceed the PCAPCD's threshold of 10 per million at the edge of SR65. However, at 100 feet from SR 65, cancer risk would equal 9.77 per million, which is below the significance threshold of 10 per million.

The cancer risks shown in Table 5 assume an individual would be at the same location for 70 years, from the 3rd trimester through age 70, with only a limited time away from that location. This is an extremely conservative assumption. Even with this assumption, at distances of 100 feet or more from the edge of SR 65, cancer risks would be less than PCAPCD's 10 in a million risk threshold. Table 5 also shows that cancer risks decrease with increasing distance from the edge of SR 65. These results indicate that individuals living, working, attending schools, or participating in athletic events at 100 feet or more from the edge of SR 65 would not be exposed to significant cancer risks from trucks traveling on SR 65. Even with these conservative results, however, it is always prudent to maximize buffer space between major roads such as SR 65 and locations where individuals will be living, working, or recreating.

Table 5. Cancer Risk Results

Distance in Feet from Edge of SR65	Adjusted Concentration	Cancer Potency Factor	3rd Tri to Birth	0 to 2	2 to 16	16 to 70	Total Cancer Risk	Cancer Risk per Million
0	1.28E-2	1.1	1.86E-7	3.74E-6	4.54E-6	2.31E-6	1.08E-5	10.8
100	1.16E-2	1.1	1.68E-7	3.39E-6	4.12E-6	2.09E-6	9.77E-6	9.8
200	9.41E-3	1.1	1.36E-7	2.74E-6	3.33E-6	1.69E-6	7.90E-6	7.9
300	7.38E-3	1.1	1.07E-7	2.15E-6	2.61E-6	1.33E-6	6.19E-6	6.2
400	5.96E-3	1.1	8.62E-8	1.73E-6	2.11E-6	1.07E-6	5.00E-6	5.0
500	5.00E-3	1.1	7.24E-8	1.46E-6	1.77E-6	8.99E-7	4.20E-6	4.2
600	4.35E-3	1.1	6.30E-8	1.27E-6	1.54E-6	7.82E-7	3.65E-6	3.7
700	3.86E-3	1.1	5.59E-8	1.12E-6	1.37E-6	6.94E-7	3.24E-6	3.2
800	3.46E-3	1.1	5.00E-8	1.01E-6	1.22E-6	6.21E-7	2.90E-6	2.9
900	3.12E-3	1.1	4.52E-8	9.10E-7	1.11E-6	5.61E-7	2.62E-6	2.6
1,000	2.85E-3	1.1	4.12E-8	8.29E-7	1.01E-6	5.11E-7	2.39E-6	2.4

4.3 Noncancer Health Effects

The CARB Air Quality and Land Use Handbook (CARB 2005) refers to several studies that identify noncancer health effects associated with living near heavily traveled roadways. Such effects include a variety of respiratory symptoms, asthma exacerbations (hospital visits, symptoms), and decreases in lung function. A recent CARB report (CARB 2012) reviews additional 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 chronic hazard index of 0.0003 for sensitive receptors located at the edge of SR 65. This is the highest chronic hazard index, and this value decreases with distance from the edge of SR 65.

PCAPCD has identified a hazard index exceeding 1.0 (i.e., TAC concentrations are greater than the REL) as a significant health effect. Accordingly, no adverse noncancer health effects from DPM inhalation would be expected from the project.

5.0 CONCLUSIONS

Based on this analysis, residents and other sensitive land uses of the Village 5 Specific Plan would be exposed to a cancer risk of less than 10 in 1 million, with a maximum cancer risk of 9.8 at 100 feet from the edge of SR 65. 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). In addition, the residents of the proposed project would not be exposed to significant noncancer health effects from DPM inhalation.

The results determined in this analysis reflect reasonable estimates of source emissions and exhaust characteristics, and available meteorological data near the project site. 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 ISCST dispersion model and the health impact calculations required by the OEHHA and the PCAPCD 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.

6.0 REFERENCES

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