Appendix A

Health Risk Assessment Memorandum

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M E M O

Date: July 20, 2022

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RE: Lake County Transit Center - Clearlake, CA Job#21-160

SUBJECT: Exposure of Nearby Sensitive Receptors to Diesel Particulate Matter (DPM) from the Proposed Lake County Interregional Transit Center

BACKGROUND AND INTRODUCTION

Lake Transit is considering construction of a new transit center 0.2 miles northwest of their current transit hub which is located within the parking lot of the Clearlake Shopping Center. The existing transfer hub services six Lake Transit fixed routes (three regional routes and three local routes). The new Interregional Transit Center would be located on approximately 2 acres of land on the southwest corner of S. Center Drive and Dam Road Extension (See Figure 1). Additionally, the project would include the acquisition of four (4) hydrogen buses to expand their interregional service and would make improvements to the existing Lake Transit maintenance and operations (M&O) facility to support the use of the new hydrogen buses.

Illingworth & Rodkin (I&R) assessed the community health risks associated with the construction of the project and operations of the new transit center. Specifically, this assessment looked at the impacts bus emissions (i.e., diesel particulate matter [DPM]) would have on nearby sensitive receptors located within 1,000 feet (i.e., influence area) of the proposed site for the new transit center.

The project is located in Lake County, California, which is part of the Lake County Air Quality Management District (LCAQMD). Lake County is Unclassified/Attainment for all pollutants under the National Ambient Air Quality Standards (NAAQS) and in Attainment for all of the State Air quality Standards (CAAQS). As a result, the LCAQMD does not have thresholds of significance for land development projects. However, the Bay Area Air Quality Management District (BAAQMD), which is adjacent to the LCAQMD, has established project thresholds. Therefore, BAAQMD health risk thresholds were used for comparison purposes in this analysis.

PROJECT CONSTUCTION

Construction is anticipated to begin in spring 2023, and last approximately 10 months. These activities would temporarily affect local air quality, causing a temporary increase in particulate matter (i.e., dust) and other pollutants. Site preparation, use of construction equipment, and heavy-duty vehicle trips associated with construction would result in the greatest emissions of dust and DPM from the site(s). Ground disturbance combined with windy conditions during construction could also cause substantial fugitive dust emissions if there is exposed ground or on-site vehicle travel. Pollutant emission during periods of construction would increase particulate concentrations at neighboring properties. This increase is potentially significant, but normally is mitigated using best management practices (BMPs). These include:

1. All exposed surfaces (e.g., parking areas, staging areas, soil piles, graded areas, and unpaved access roads) shall be watered two times a day.

2. All haul trucks transporting soil, sand, or other loose material off-site shall be covered.

3. All visible mud or dirt track-out onto adjacent public roads shall be removed using wet power vacuum street sweepers at least once per day. The use of dry power sweeping is prohibited.

4. All vehicle speeds on unpaved roads shall be limited to 15 mph.

5. All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible. Building pads shall be laid as soon as possible after grading unless seeding or soil binders are used.

6. Idling times shall be minimized either by shutting equipment off when not in use or reducing the maximum idling time to 5 minutes (as required by the California airborne toxics control measure Title 13, Section 2485 of California Code of Regulations [CCR]). Clear signage shall be provided for construction workers at all access points.

7. All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified mechanic and determined to be running in proper condition prior to operation.

8. Post a publicly visible sign with the telephone number and person to contact at the Lead Agency regarding dust complaints. This person shall respond and take corrective action within 48 hours. The Air District's phone number shall also be visible to ensure compliance with applicable regulations.

TRANSIT CENTER OPERATION

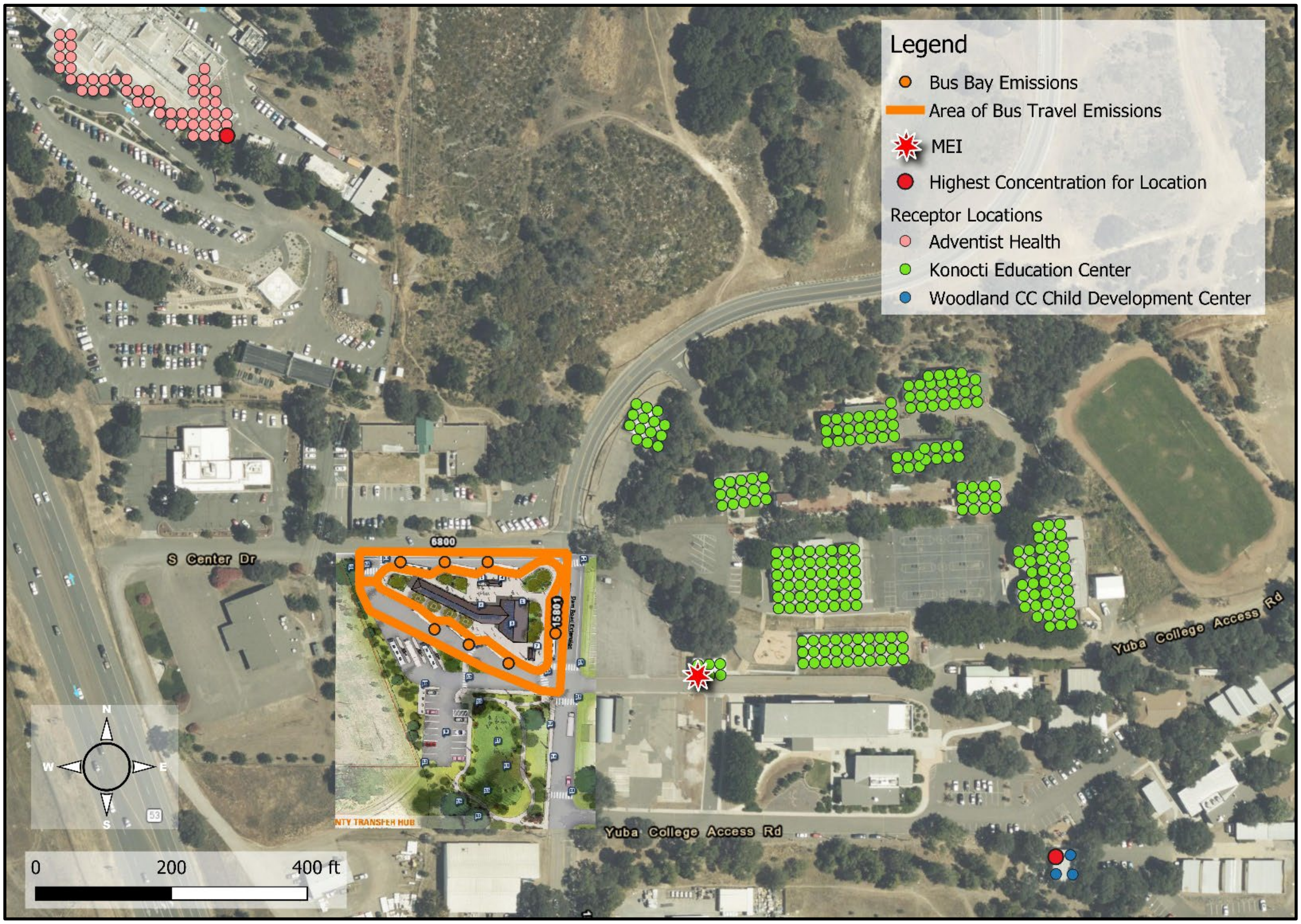
Operation of the Transit Center would generate DPM emissions from the idling and movement of diesel-fueled buses. The new center would serve six existing routes (Routes 1, 3, 4, 10, 11, and 12) with buses from their existing fleet, which are a mixture of gasoline and diesel-fueled busses. Table 1 provides the bus fleet used by Lake County Transit according to the 2017 *Lake Transit Hub Location Plan*. The health risks associated with the operation of the new transit center were estimated by using an emissions model and activity data assumptions to estimate daily emissions and a dispersion model to estimate DPM concentrations at nearby sensitive receptor locations. Figure 1 shows the location of the proposed transit center along with the modeled emissions sources and receptor locations where DPM concentrations were calculated.

Table 1. Lake County Transit Bus Fleet

Lake Transit Authority Vehicle Fleet

# in Fleet	Manufacturer	Wheelchair Capacity	Seating Capacity
2	Eldorado MST II	2	30
2	Eldorado Aerotech	2	16
5	Glaval Titan	2	29
3	Eldorado Aerotech	3	17
3	Glaval Entourage	2	28
7	Glaval Universal	2	18
1	Glaval Universal	4	12
1	Glaval Legacy	2	32
1	Glaval Titan II	2	16
4	Glaval Legacy	3	27
2	Glaval Legacy	2	29

Figure 1. Project Site, DPM Sources and Modeled Receptor Locations



DPM Emissions Estimates

DPM emissions from the new transit center were estimated based on the current schedules for the six existing routes that would use the center. New intercounty routes being proposed were assumed to use one of the four new hydrogen-powered buses, thus having zero DPM emissions. It was estimated that the station could have up to 119 total daily stops at the new center, with a maximum of eight buses idling at any one time. Based on current route information, it was estimated that the center would operate 14 hours each day for 310 days per year. To conservatively (i.e., over) estimate DPM emissions, it was assumed buses would idle for 10 minutes each stop, drive the perimeter of the site (estimated to be 754.7 feet or 0.14 miles) at 5 miles per hour, and that all the buses using the center would be diesel powered.

The latest version of CARB's EMFAC emissions model (EMFAC2021) was used to develop the emissions rates needed. EMFAC2021 includes the latest data on California's car and truck fleets and travel activity. There are two diesel bus categories included in EMFAC2021 for Lake County, School Bus (SBUS) and Other Bus (OBUS). Therefore, $PM_{2.5}$ emissions rates specific to Lake County for the diesel OBUS category were used to calculate DPM emissions.

Total daily DPM emissions (in grams per day) were estimated for the transit center and then converted to grams per second. The grams per second (g/sec) emissions rate for the idling buses (i.e., bus bays) and the on-site bus travel were then input into an EPA-approved dispersion model (AERMOD) to develop annual off-site concentrations of DPM. Details on the emission calculations and information used are provided in the attachments.

Dispersion Modeling

Dispersion modeling of DPM emissions from the transit center was conducted using the U.S. EPA AERMOD dispersion model. AERMOD is the CARB-recommended model for estimating pollutant concentrations for CEQA purposes. DPM emission sources for the center were grouped into two categories: idle exhaust (bus bay) emissions and onsite bus travel emissions.

Bus bay emissions were modeled as eight separate point source while onsite travel emissions were modeled as one area source representing the perimeter around the transit center. Release heights were established to be 1.3 meters (4.25 feet) assuming each bus was equipped with an under-body street-side exhaust pipe.[1] Other bus emissions parameters, such as stack diameter and flow rate, were based on those associated with heavy-duty diesel vehicles.[2] The locations of the modeled emission sources are shown in Figure 1. Details on the dispersion modeling information for these sources are provided in the attachments.

A five-year data set (2016-2018, 2020 and 2021) of hourly meteorological data prepared for use with AERMOD by CARB from the nearest airport (i.e., Ukiah Municipal Airport, approximately 35 miles northwest in Ukiah, California) was used for the dispersion modeling analysis. Other inputs to the model included U.S. Geological Service terrain data, building downwash parameters associated with the new transit center building, and receptor locations corresponding to identified nearby sensitive receptors.

Sensitive receptors are groups of people more affected by air pollution than others. CARB has identified the following persons who are most likely to be affected by air pollution: children under 16, the elderly over 65, athletes, and people with cardiovascular and chronic respiratory diseases. These groups are classified as sensitive receptors. Locations that may contain a high concentration of these sensitive population groups include residential areas, hospitals, daycare facilities, elder care facilities, elementary schools, and parks. For cancer risk assessments, children are the most sensitive receptors, since they are more susceptible to cancer causing toxic air contaminates like DPM. The closest sensitive receptors to the site are the children attending the Konocti Education Center (4th through 12th grade school) 188 feet east of the new transit center site. The Woodland Community College Childcare Development Center (i.e., campus daycare) is located approximately 755 feet east of the new center and the Adventist Health Care Center (i.e., hospital) is located approximately 680 northwest of the new center.

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[1] Assumption is based on bus fleet information in Table 1.
[2] Source Parameters from SJVAPCD Guidance for Air Dispersion Modeling.

There were 280 receptors were included in the dispersion model to represent the nearby sensitive receptors. A receptor height of 3.3 feet (1 meter) was used to represent the breathing heights of children at the school and daycare, while a height of 4.9 feet (1.5 meters) was used for hospital receptors. Figure 1 shows the receptor locations and the location of the receptor with the highest DPM concentration at each of the three sites.

Health Risks Associated with the New Transit Center

Community health risk impacts associated with operation of the new transit center were assessed by predicting increased lifetime cancer risk and computing the Hazard Index (HI) for non-cancer health risks. The most recent Office of Environmental Health Hazard Assessment (OEHHA) risk assessment guidelines were published in February of 2015 and were used for this analysis.[3] The OEHHA methodology used for computing community risks impacts, as well as the risk calculations, are provided in the attachments.

Because the LCAQMD has not developed health risk thresholds or guidance on conducting health risk assessments, the guidance and thresholds for the adjacent BAAQMD were used.[4] Unlike cancer risk, HI values are not cumulative but based on the highest (or maximum) annual DPM concentration. The maximally exposed individual (MEI) is identified as the receptor that is most impacted by the project's operation. As a result, the MEI would be located at the Konocti Education Center (see Figure 1).

Table 2 reports the community risk impacts at the three nearby sensitive receptor locations identified. Cancer risks and non-cancer HIs are compared against the BAAQMD single-source thresholds for comparison purposes. As shown, the cancer risks associated with operation of the new transit center would be less than 1 in a million and HIs would be well below 0.1. All of the impacts would be considered well below the BAAQMD single-source cancer risk and non-cancer thresholds.

Table 2. Health Risk Impacts from Operation of the Proposed Transit Center

Source	Cancer Risk (per million)	Hazard Index Maximum
Konocti Education Center (4 - 12 School)	0.36	< 0.1
Woodland CC Child Development Center (Daycare)	0.08	< 0.1
Adventist Health (Infant @ Hospital)	0.25	< 0.1
BAAQMD Single-Source Threshold	***>10.0***	***>1.0***

3 OEHHA, 2015. *Air Toxics Hot Spots Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*. Office of Environmental Health Hazard Assessment. February.

4 BAAQMD, 2016. *BAAQMD Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines*. December 2016.

Conclusions

Construction of the proposed Lake County Transit project would generate emissions, specifically particulate matter from travel on unpaved roads, earth moving activities, and wind-blown fugitive dust and DPM emissions from diesel-powered construction equipment/vehicles. These sources of emissions would be temporary in nature (less than 10 months) and would be less than significant if construction emission BMPs are implemented.

Operation of the proposed new transit center would generate DPM emissions from diesel-fueled transit buses entering, idling at, and leaving the center. DPM emissions from operations of the new transit center were estimated using the latest version of CARB's EMFAC emissions model (i.e., EMFAC2021) and offsite DPM concentrations estimated using the U.S. EPA's AERMOD model. A health risk analysis showed that increased cancer risks associated with the operation of the new transit center at nearby sensitive receptor locations would be less than one in a million. Non-cancer health risks associated with chronic DPM exposure would be less than 0.1. The LCAQMD has not established health risk thresholds. However, the adjacent BAAQMD has, and the calculated risks are well below the single source thresholds established by BAAQMD.

Attachments

Health Risk Calculation Methodology

A health risk assessment (HRA) for exposure to Toxic Air Contaminants (TACs) requires the application of a risk characterization model to the results from the air dispersion model to estimate potential health risk at each sensitive receptor location. The State of California Office of Environmental Health Hazard Assessment (OEHHA) and California Air Resources Board (CARB) develop recommended methods for conducting health risk assessments. The most recent OEHHA risk assessment guidelines were published in February of 2015.[5] These guidelines incorporate substantial changes designed to provide for enhanced protection of children, as required by State law, compared to previous published risk assessment guidelines. CARB has provided additional guidance on implementing OEHHA's recommended methods.[6] This HRA used the 2015 OEHHA risk assessment guidelines and CARB guidance. The BAAQMD has adopted recommended procedures for applying the newest OEHHA guidelines as part of Regulation 2, Rule 5: New Source Review of Toxic Air Contaminants.[7] Exposure parameters from the OEHHA guidelines and the recent BAAQMD HRA Guidelines were used in this evaluation.

Cancer Risk

Potential increased cancer risk from inhalation of TACs is calculated based on the TAC concentration over the period of exposure, inhalation dose, the TAC cancer potency factor, and an age sensitivity factor to reflect the greater sensitivity of infants and children to cancer causing TACs. The inhalation dose depends on a person's breathing rate, exposure time and frequency and duration of exposure. These parameters vary depending on the age, or age range, of the persons being exposed and whether the exposure is considered to occur at a residential location or other sensitive receptor location.

The current OEHHA guidance recommends that cancer risk be calculated by age groups to account for different breathing rates and sensitivity to TACs. Specifically, they recommend evaluating risks for the third trimester of pregnancy to age zero, ages zero to less than two (infant exposure), ages two to less than 16 (child exposure), and ages 16 to 70 (adult exposure). Age sensitivity factors (ASFs) associated with the different types of exposure are an ASF of 10 for the third trimester and infant exposures, an ASF of 3 for a child exposure, and an ASF of 1 for an adult exposure. Also associated with each exposure type are different breathing rates, expressed as liters per kilogram of body weight per day (L/kg-day) or liters per kilogram of body weight per 8-hour period for the case of worker or school child exposures. As recommended by the BAAQMD for residential exposures, 95th percentile breathing rates are used for the third trimester and infant exposures, and 80th percentile breathing rates for child and adult exposures. For children at schools and daycare facilities, BAAQMD recommends using the 95th percentile 8-hour breathing rates. Additionally, CARB and the BAAQMD recommend the use of a residential exposure duration of 30 years for sources with long-term emissions (e.g., roadways). For workers, assumed to be adults,

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5 OEHHA, 2015. *Air Toxics Hot Spots Program Risk Assessment Guidelines, The Air Toxics Hot Spots Program Guidance Manual for Preparation of Health Risk Assessments*. Office of Environmental Health Hazard Assessment. February.
6 CARB, 2015. *Risk Management Guidance for Stationary Sources of Air Toxics*. July 23.
7 BAAQMD, 2016. *BAAQMD Air Toxics NSR Program Health Risk Assessment (HRA) Guidelines*. December 2016.

a 25-year exposure period is recommended by the BAAQMD. For school children a 9-year exposure period is recommended by the BAAQMD.

Under previous OEHHA and BAAQMD HRA guidance, residential receptors are assumed to be at their home 24 hours a day, or 100 percent of the time. In the 2015 Risk Assessment Guidance, OEHHA includes adjustments to exposure duration to account for the fraction of time at home (FAH), which can be less than 100 percent of the time, based on updated population and activity statistics. The FAH factors are age-specific and are: 0.85 for third trimester of pregnancy to less than 2 years old, 0.72 for ages 2 to less than 16 years, and 0.73 for ages 16 to 70 years. Use of the FAH factors are allowed by the BAAQMD if there are no schools in the project vicinity have a cancer risk of one in a million or greater assuming 100 percent exposure (FAH = 1.0).

Functionally, cancer risk is calculated using the following parameters and formulas:

Cancer Risk (per million) = $CPF \times Inhalation\ Dose \times ASF \times ED/AT \times FAH \times 10^6$

Where:

CPF = Cancer potency factor $(mg/kg\text{-}day)^{-1}$
ASF = Age sensitivity factor for specified age group
ED = Exposure duration (years)
AT = Averaging time for lifetime cancer risk (years)
FAH = Fraction of time spent at home (unitless)

Inhalation Dose = $C_{air} \times DBR^* \times A \times (EF/365) \times 10^{-6}$

Where:

C_{air} = concentration in air ($\mu g/m^3$)
DBR = daily breathing rate (L/kg body weight-day)
8HrBR = 8-hour breathing rate (L/kg body weight-8 hours)
A = Inhalation absorption factor
EF = Exposure frequency (days/year)
10^{-6} = Conversion factor

* An 8-hour breathing rate (8HrBR) is used for worker and school child exposures.

The health risk parameters used in this evaluation are summarized as follows:

Parameter	Exposure Type →	Infant		Child	Adult
	Age Range →	3rd Trimester	0<2	2 < 16	16 - 30
DPM Cancer Potency Factor $(mg/kg\text{-}day)^{-1}$		1.10E+00	1.10E+00	1.10E+00	1.10E+00
Daily Breathing Rate (L/kg-day) 80th Percentile Rate		273	758	572	261
Daily Breathing Rate (L/kg-day) 95th Percentile Rate		361	1,090	745	335
8-hour Breathing Rate (L/kg-8 hours) 95th Percentile Rate		-	1,200	520	240
Inhalation Absorption Factor		1	1	1	1
Averaging Time (years)		70	70	70	70
Exposure Duration (years)		0.25	2	14	14*
Exposure Frequency (days/year)		350	350	350	350*
Age Sensitivity Factor		10	10	3	1
Fraction of Time at Home (FAH)		0.85-1.0	0.85-1.0	0.72-1.0	0.73*

Non-Cancer Hazards

Non-cancer health risk is usually determined by comparing the predicted level of exposure to a chemical to the level of exposure that is not expected to cause any adverse effects (reference exposure level), even to the most susceptible people. Potential non-cancer health hazards from TAC exposure are expressed in terms of a hazard index (HI), which is the ratio of the TAC concentration to a reference exposure level (REL). OEHHA has defined acceptable concentration levels for contaminants that pose non-cancer health hazards. TAC concentrations below the REL are not expected to cause adverse health impacts, even for sensitive individuals. The total HI is calculated as the sum of the HIs for each TAC evaluated and the total HI is compared to the BAAQMD significance thresholds to determine whether a significant non-cancer health impact from a project would occur.

Typically, for residential projects located near roadways with substantial TAC emissions, the primary TAC of concern with non-cancer health effects is diesel particulate matter (DPM). For DPM, the chronic inhalation REL is 5 micrograms per cubic meter ($\mu g/m^3$).

Annual $PM_{2.5}$ Concentrations

While not a TAC, fine particulate matter ($PM_{2.5}$) has been identified by the BAAQMD as a pollutant with potential non-cancer health effects that should be included when evaluating potential community health impacts under the California Environmental Quality Act (CEQA). The thresholds of significance for $PM_{2.5}$ (project level and cumulative) are in terms of an increase in the annual average concentration. When considering $PM_{2.5}$ impacts, the contribution from all sources of $PM_{2.5}$ emissions should be included. For projects with potential impacts from nearby local roadways, the $PM_{2.5}$ impacts should include those from vehicle exhaust emissions, $PM_{2.5}$ generated from vehicle tire and brake wear, and fugitive emissions from re-suspended dust on the roads.

Vehicle Category	VMT Fraction Across Category	Diesel VMT Fraction Within Category	Gas VMT Fraction Within Category
OBUS	1	1	0

	<= 5 mph	10 mph	15 mph	20 mph	25 mph	30 mph	35 mph	40 mph	45 mph	50 mph	55 mph	60 mph	65 mph	70 mph	75 mph
PM2_5 Ex Dsl															
OBUS	0.104205888	0.088426606	0.063267418	0.045796946	0.03860857	0.03507973	0.033494636	0.033851	0.036147	0.040382	0.046555	0.052528	0.05733	0.05733	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

OBUS Onsite Travel Emissions - DPM

Area Source	RD Seg ID	Modeled Perimiter (ft)	Modeled Perimiter (m)	Plume Vertical (ft)	Plume Vertical (m)	Initial Vertical Dispersion	Release Height (ft)	Release Height (m)	Fraction that are OBUS	No. of Daily Buses	Travel Speed (mph)	DPM EF[b] (g/veh-mi)	Bus Travel DPM Emissions Daily (g/day)	Hourly (g/s)	Annual (lbs/yr)
On-site:		754.7	230.0	9.38	2.86	1.33	4.27	1.30	1	119.00	5	0.104206	1.772473	2.051E-05	1.211
		0.143													

[a]Source Parameters from SJVAPCD *Guidance for Air Dispersion Modeling*

[b]Emissions Factor from CT_EMFAC2017

OBUS Idle Emissions - DPM

On-Site	Stack Height (ft)	Stack Height (m)	Stack Diameter[a] (ft)	Stack Diameter[a] (m)	Stack Velocity[a] (m/s)	Temp[a] (K)	Fraction of OBUS	No. of:	Idle Emissions (g/veh-hr)	Idle Emissions Daily (g/day)	Hourly (g/s)	Annual (g/yr)	(lb/yr)	
Buses (total)	4.27	1.30	0.33	0.1	51.71	366	1	119	0.52102944	10.33375	0.000119604	3203.463	7.062426	Total All Buses
Bus Bay	4.27	1.30	0.33	0.1	51.71	366	1	8	0.52102944	1.291719	1.49504E-05	400.433	0.88280	per Bus Bay

[a]Source Parameters from SJVAPCD *Guidance for Air Dispersion Modeling*

[b]Emissions Factor from CT_EMFAC2017

Bus Info

Total Bus Trips per day	=	238
Total Buses per day	=	119
Operation Days	=	310
Daily Operation Hours	=	14

Bus Idle DPM Emission Information

Emissions Factor @ 5 mph (g/mi)	=	0.104205888
Bus Idle Emissions Rate (g/hr)	=	0.52102944
Idle Time per Bus (min)	=	10

Assume street-side under-bus exhaust

Lake County Transit Center - DPM Cancer Risks
AERMOD Risk Modeling Parameters and Maximum Concentrations
Child Exposures (1.0 meter receptor heights)

Emissions Years	2024
Receptor Information	
Number of Receptors	280
Receptor Height =	1.0 meters
Receptor distances =	5 meter spacing
Meteorological Conditions	
CARB Ukiah Muni Airport Met Data	2016-2018, 2020, 2021
Land Use Classification	urban
Wind speed =	variable
Wind direction =	variable
Terrain	
USGS NED 1/3 (USA ~10m)	Source and receptor base elevations

MEI at Konocti Education Center (4 - 12 School)

Emission Year	DPM Concentration (μg/m^3)	Hazard Index
2024	0.00358	0.00072

MEI at Woodland CC Child Development Center (Daycare)

Emission Year	DPM Concentration (μg/m^3)	Hazard Index
2024	0.00090	0.00018

MEI at Adventist Health (Hospital, 1.5m heights)

Emission Year	DPM Concentration (μg/m^3)	Hazard Index
2024	0.00140	0.00028

Lake County Transit Center - DPM Cancer Risks for Konocti Education Center MEI
Maximum Child Cancer Risk
1.0 meter receptor heights
School - 4th Grade through 12th Grade Exposure (Ages 8 - 18 years)

Cancer Risk Calculation Method

Student Cancer Risk (per million) = CPF x Inhalation Dose x ASF x ED/AT x 1.0E6

Where: CPF = Cancer potency factor $(mg/kg\text{-}day)^{-1}$
ASF = Age sensitivity factor for specified age group
ED = Exposure duration (years)
AT = Averaging time for lifetime cancer risk (years)

Inhalation Dose = C_{air} x DAF x 8hr BR x A x (EF/365) x 10^{-6}

Where: C_{air} = concentration in air ($\mu g/m^3$)
AF = Adjustment Factor (unitless) for School operation and exposures different than 8 hours/day
= (24/SHR) x (EHR/8 hrs)
SHR = Hours of emission source operation
EHR = Activity exposure hours while emission source in operation
8-Hr BR = Eight-hour breathing rate (L/kg body weight-per 8 hrs)
HR = Operation hours
A = Inhalation absorption factor
EF = Days per Year
10^{-6} = Conversion factor

Values

Cancer Potency Factors $(mg/kg\text{-}day)^{-1}$

TAC	CPF
DPM	1.10E+00

	Infant	Child	Adult
Age -->	0 - <2	2 - < 16	16 - 30
Parameter			
ASF	10	3	1
8-Hr BR* =	1200	520	240
EHR** =	8.00	8.00	8.00
HR =	8	8	8
SHR =	14	14	14
A =	1	1	1
EF =	180	180	180
AT =	70	70	70
AF =	1.00	1.00	1.00

* 95th percentile 8-hr breathing rates for moderate intensity activities
** EHR based on 8 hours

Transit Cancer Risk by Year - Maximum Impact Receptor Location

				Maximum - Exposure Information		
Exposure Year	Year	Exposure Duration (years)	Age	Age Sensitivity Factor	Annual DPM Conc	Cancer Risk (per million)
1	2024	1	8 - 9	3	0.0036	0.043
2	2025	1	9 - 10	3	0.0036	0.043
3	2026	1	10 - 11	3	0.0036	0.043
4	2027	1	11 - 12	3	0.0036	0.043
5	2028	1	12 - 13	3	0.0036	0.043
6	2029	1	13 - 14	3	0.0036	0.043
7	2030	1	14 - 15	3	0.0036	0.043
8	2031	1	15 - 16	3	0.0036	0.043
9	2032	1	16 - 17	1	0.0036	0.007
10	2033	1	17 - 18	1	0.0036	0.007
Total Increased Cancer Risk						**0.360**

Woodland CC Child Development Center
Maximum Child Cancer Risk
Child Exposures (1.0 meter receptor heights)
4-Year Exposure (Ages 2 - 5 years)

Cancer Risk Calculation Method

Student Cancer Risk (per million) = CPF x Inhalation Dose x ASF x ED/AT x 1.0E6

Where: CPF = Cancer potency factor $(mg/kg\text{-}day)^{-1}$
ASF = Age sensitivity factor for specified age group
ED = Exposure duration (years)
AT = Averaging time for lifetime cancer risk (years)

Inhalation Dose = C_{air} x DAF x 8hr BR x A x (EF/365) x 10^{-6}

Where: C_{air} = concentration in air ($\mu g/m^3$)
DAF = Daycare Adjustment Factor (unitless) for source operation and exposures different than 8 hours/day
= (24/SHR) x (DEHR/8 hrs)
SHR = Hours of emission source operation
DEHR = Daycare activity exposure hours while emission source in operation
8-Hr BR = Eight-hour breathing rate (L/kg body weight-per 8 hrs)
DHR = Daycare operation hours
EF = Days per Year
A = Inhalation absorption factor
10^{-6} = Conversion factor

Values

Cancer Potency Factors $(mg/kg\text{-}day)^{-1}$

TAC	CPF
DPM	1.10E+00

	Infant	Child
Age -->	0 - < 2	2 - < 5
Parameter		
ASF	10	3
8-Hr BR* =	1200	520
DEHR =	10.00	10.00
DHR =	10	10
SHR =	14	14
A =	1	1
EF =	260	260
AT =	70	70
DAF =	1.25	1.25

* 95th percentile 8-hr breathing rates for moderate intensity activities

Transit Cancer Risk by Year - Maximum Impact Receptor Location

Exposure Year	Year	Exposure Duration (years)	Age	Maximum - Exposure Information: Age Sensitivity Factor	Maximum - Exposure Information: Annual DPM Conc (ug/m3)	DPM Cancer Risk (per million)
1	2024	1	2	3	0.0009	0.0196
2	2025	1	3	3	0.0009	0.0196
3	2026	1	4	3	0.0009	0.020
4	2027	1	5	3	0.0009	0.020
Total Increased Cancer Risk						0.079

Adventist Health (Hospital, 1.5m heights)
Maximum DPM Cancer Risk From Transit Center Operations
Impacts at Hospital Receptors - 1.5 meter receptor height

Cancer Risk (per million) = CPF x Inhalation Dose x ASF x ED/AT x FAH x 1.0E6

Where: CPF = Cancer potency factor $(mg/kg\text{-}day)^{-1}$
ASF = Age sensitivity factor for specified age group
ED = Exposure duration (years)
AT = Averaging time for lifetime cancer risk (years)
FAH = Fraction of time spent at home (unitless)

Inhalation Dose = C_{air} x DBR x A x (EF/365) x 10^{-6}

Where: C_{air} = concentration in air ($\mu g/m^3$)
DBR = daily breathing rate (L/kg body weight-day)
A = Inhalation absorption factor
EF = Exposure frequency (days/year)
10^{-6} = Conversion factor

Values

	Infant/Child			**Adult**
Age -->	**3rd Trimester**	**0 - 2**	**2 - 16**	**16 - 30**
Parameter				
ASF =	10	10	3	1
CPF =	1.10E+00	1.10E+00	1.10E+00	1.10E+00
DBR* =	361	1090	572	261
A =	1	1	1	1
EF =	350	350	350	350
AT =	70	70	70	70
FAH =	1.00	1.00	1.00	0.73

* 95th percentile breathing rates for infants and 80th percentile for children and adults

Construction Cancer Risk by Year - Maximum Impact Receptor Location

Exposure Year	**Exposure Duration (years)**	**Age**	**Exposure Information: DPM Conc (ug/m3) Year**	**DPM Conc (ug/m3) Annual**	**Age Sensitivity Factor**	**Infant/Child Cancer Risk (per million)**	**Adult: Modeled DPM Conc (ug/m3) Year**	**Adult: Modeled DPM Conc (ug/m3) Annual**	**Adult: Age Sensitivity Factor**	**Adult Cancer Risk (per million)**
0	0.25	-0.25 - 0*	2024	0.0014	10	0.02				
1	1	0 - 1	2024	0.0014	10	0.23	2024	0.0014	1	0.004
Total Increased Cancer Risk						**0.25**				**0.004**

* Third trimester of pregnancy