HEALTH RISK ASSESSMENT
FOR SEMPLE SCHOOL

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Robert Semple Elementary School

Prepared for:

City of Benicia

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November 2008

IX-B-86

HEALTH RISK ASSESSMENT
ROBERT SEMPLE ELEMENTARY SCHOOL

This report has been prepared to summarize health related impacts on the Robert Semple Elementary School related to increased traffic from the Benicia Business Park Project. LSA Associates, Inc. has completed a health risk assessment for the Robert Semple School located at 2015 East 3rd Street in the City of Benicia. This risk assessment is based on guidance and models provided by the California Air Resources Board (ARB) and Office of Environmental Health Hazard Assessment (OEHHA) and represents a typical scientific approach to identifying potential health risks associated with a project. The analysis considered specific meteorological conditions on the school site and the proximity of the school site to East 2nd Street and Interstate 780 (I-780) to determine the potential risk to both students and teachers from traffic-related emissions resulting from the project.

The health risks identified in this assessment take into account only emissions from traffic on these roadways and do not account for other emission sources (e.g., construction, factory emissions) around Robert Semple School that contribute to the overall health risk in the Bay Area. The analysis considered current conditions, as well as the future (2030) traffic volumes both with and without the Benicia Business Park. The Bay Area Air Quality Management District (BAAQMD) establishes criteria to determine if air toxics would pose an unacceptable health risk to nearby populations. Results of the assessment concluded that the health risks associated with exposure of future students and teachers at the school to roadway vehicle exhaust emissions would not exceed the significance criteria for toxic air contaminants.

Project-Related Traffic Data

This assessment used a revised project description for the Benicia Business Park, which reduced the amount of total industrial space by 46 percent from 4,443,440 square feet to 2,339,760 square feet. Commercial space (857,000 square feet) remained the same. Data provided by DMJM Harris/AECOM were used to analyze the air quality impacts for the existing (2008) and cumulative (2030) conditions in the Semple School area.

Semple School is bordered on the east by East 2nd Street and is located between Hillcrest Avenue and East S Street. East 2nd Street is an arterial roadway that extends north and east from downtown Benicia to Lake Herman Road. East 2nd Street between Industrial Way and I-780 widens to a four-lane facility with median/turn lanes and bicycle lanes. As it approaches downtown Benicia to the south, East 2nd Street has a speed limit of 35 mph. The segment of East 2nd Street near the school is approximately 770 feet or 0.15 mile, and the current daily traffic volumes are approximately 13,000 vehicles per day. Cumulative 2030 traffic volumes with the project are projected to be 30,889 vehicles per day, 13,168 of which are related to the project. Specific speed data were not available at the time of the writing of this memo, so roadway speed limits were assumed in the analysis.

Portions of the school site are located within 500 feet of Interstate 780 (I-780), which is an east-west four-lane freeway facility connecting I-680 in Benicia to I-80 in Vallejo. Annual average daily traffic on I-780 was 57,000 vehicles during Caltrans most recent monitoring counts in 2007.[1] DMJM

[1] Caltrans, 2007 Traffic Volumes on the California State Highway System. http://www.dot.ca.gov/hq/traffops/saferesr/trafdata/

Harris/ABCOM estimated the traffic volumes for 2030; the future volume on I-780 adjacent to the school is approximately 88,000 vehicles per day. DMJM Harris/AECOM showed no measurable difference in volumes with or without the project on I-780 east of East 2nd Street, as it was assumed that almost all westbound trips would access I-780 at East 2nd Street. However, in order to conservatively estimate the effects of the project, the HRA used traffic data for I-780 immediately to the west of East 2nd Street; future volumes on this segment of the freeway are projected to be approximately 97,000 vehicles per day, 13,095 of which are related to the project.

Air Toxics – Mobile Sources

Most air toxics originate from human-made sources, including on-road mobile sources, non-road mobile sources (e.g., airplanes), area sources (e.g., dry cleaners), and stationary sources (e.g., factories or refineries). Motor vehicles emit several pollutants that the Environmental Protection Agency (EPA) classifies as known or probable human carcinogens and that can cause adverse health effects. These mobile source air toxics are compounds emitted from highway vehicles and non-road equipment and are a subset of the air toxics defined by the Clean Air Act.

EPA's vehicle and fuel regulations, coupled with fleet turnover, will cause regionwide mobile source air toxic emission levels to be substantially lower over time than they are today. On a national level, these regulations are projected to reduce mobile source air toxic emissions by 57 to 87 percent from 2000 to 2020 even with an increase in vehicle miles traveled (VMT).

General Health Risks of Toxics

Determining how hazardous a substance is depends on many factors, including the amount of the substance in the air, how it enters the body, how long the exposure lasts, and what organs in the body are affected. One major way these substances enter the body is through inhalation of either gases or particulates. While many gases may be harmful, very small particles that penetrate deep into the lungs are known to contribute to a range of health problems. Particle pollution (also called particulate matter or PM) is the term for a mixture of solid particles and liquid droplets found in the air.

Serious health effects, such as increased respiratory disease, lung damage, and premature death can result from inhalation of particles smaller than 10 micrometers (PM_{10}) in diameter. Exhaust from diesel engines is a major source of these airborne particles. Diesel exhaust contains over 40 cancer-causing substances, most of which are readily attached, or adsorbed, to the particles in the exhaust.[2] The OEHHA has determined that long-term exposure to diesel exhaust particulates poses the highest cancer risk of any toxic air contaminant, accounting for more than 70 percent of the cancer risk in the state of California. Some recent studies have reported that proximity to roads is related to adverse health outcomes, particularly respiratory problems.[3] For these reasons, analyzing health impacts of diesel PM is a good indicator of the health risks associated with increased traffic volumes.

Exposure to diesel exhaust can also have short-term health effects. Diesel exhaust can irritate the eyes, nose, throat, and lungs, and it can cause coughs, headaches, lightheadedness, and nausea. In studies with human volunteers, diesel exhaust particles made people with allergies more susceptible to the materials to which they are allergic, such as dust and pollen. Exposure to diesel exhaust also

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[2] California Air Resources Board, 2005. *Summary of Adverse Impacts of Diesel Particulate Matter.*

[3] For example, South Coast Air Quality Management District, Multiple Air Toxic Exposure Study-II (2000); Highway Health Hazards, The Sierra Club (2004) summarizing 24 Studies on the relationship between health and air quality); NEPA's Uncertainty in the Federal Legal Scheme Controlling Air Pollution from Motor Vehicles, Environmental Law Institute, 35 ELR 10273 (2005) with health studies cited therein.

causes inflammation in the lungs, which may aggravate long-term chronic respiratory symptoms and increase the frequency or intensity of asthma attacks.

According to the OEHHA recommendations, children, for physiological as well as behavioral reasons, have higher air intake rates per unit of body weight and thus receive a higher dose of pollutants from contaminated air than adults. Therefore, the inhalation rate for the measured 9-year exposure duration (children) is higher than for the 30-year and 70-year (adult) exposure. For workers, including teachers, the measured exposure period for health-related impacts from toxic emissions is 40 years.

Common Air Pollutants

An Environmental Impact Report (EIR) was developed for the Benicia Business Park that described and analyzed the significant environmental effects of the proposed project. Many of the air pollutants that were analyzed for the Benicia Business Park EIR are not included in the health risk assessment, as they are regional in their impacts and/or specific hot-spot analyses were already conducted for the EIR. These pollutants include ozone, which is not emitted directly into the air, but is created by chemical reactions between oxides of nitrogen (NOx) and volatile organic compounds (VOC) in the presence of sunlight. Urban areas can have high levels of "bad" ozone, but many rural areas are also subject to high ozone levels as winds carry emissions hundreds of miles away from their original sources. Ozone is considered a regional pollutant and analyzing the direct impact of ozone at a specific site is beyond the capability of this assessment. A detailed carbon monoxide hot-spot analysis demonstrated that the proposed project would not lead to significant CO impacts, nor would the proposed project, in combination with other cumulative development, lead to CO concentrations that exceed federal or State standards.

As mentioned above, particulate matter (PM) is a complex mixture of small particles that is made up of a number of compocents, including organic chemicals, metals, and soil or dust particles. A hot-spot analysis was neither required nor included in the Environmental Impact Report, but was conducted for this report. The hot-spot analysis considered the project-related increase in tailpipe, brake wear, tire wear, and road dust PM_{10} emissions separate from the health risk assessment. Existing air quality monitors along East 2nd Street in Benicia show that the maximum PM_{10} concentration in 2007 was 29 micrograms/cubic meter ($\mu g/m^3$)[4], below the national 24-hour average air quality standard of 150 $\mu g/m^3$ and the State standard of 50 $\mu g/m^3$. Table 1 shows that the project will increase particulate matter emissions related to vehicle exhaust, tire wear, brake wear, and road dust along East 2nd Street and I-780 near the school.

Particulate matter emissions are largely a function of vehicle miles traveled (VMT); as VMT increases, particulate matter emissions, especially road dust, increase. EPA's SCREEN3 model was used to predict PM_{10} concentrations in $\mu g/m^3$ using emissions in pounds/day and "worst-case" meteorological conditions by adding the emission concentrations from the project to background levels at the school. The maximum concentration at 500 feet from the freeway would be approximately 41 $\mu g/m^3$. Therefore, the project-related increase in PM_{10} emissions near the Semple School is not anticipated to cause a violation of the current ambient air quality standards in 2030.

[4] California Air Resources Board. 2008. Acrometric Data Analysis and Management (ADAM) system. Website: www.arb.ca.gov/adam/welcome.html. November.

Table 1: PM_{10} Emissions (pounds/day)

	Cumulative	Cumulative Plus Project	Project-Related Increase
PM_{10} Exhaust	1.16	1.41	0.25
PM_{10} Tire Wear	0.54	0.66	0.12
PM_{10} Brake Wear	0.72	0.88	0.16
PM_{10} Road Dust	76.19	92.98	16.79
Total PM_{10}	78.61	95.92	17.31

Source: LSA Associates, 2008

Summary of Approach

This health risk assessment examines the cancer risks from diesel exhaust particulate matter, as well as exhaust from gasoline-fueled vehicles. Gasoline exhaust includes toxic contaminants such as 1,3-butadiene, benzene, ethylbenzene, naphthalene, propylene, styrene, toluene, and m- and p-xylene. The health risk assessment also uses diesel and gasoline exhaust emission estimates to calculate the noncancer acute and chronic health risks at the school. These measures of risk are indicators of overall health risks from the East 2nd Street and I-780 vehicle-related emissions at Robert Semple School.

This health risk assessment was conducted as recommended in the OEHHA Guidelines and by the ARB.[5] The assessment consists of several steps including: (1) determining the emission factors, emission rate, and concentration of pollutants at locations of interest; (2) translating the PM concentrations into health risk values; and (3) comparing the health risk values to thresholds to determine significance.

To estimate the potential cancer risk associated with vehicle engine exhaust, a dispersion model is used to translate an emission rate from vehicles traveling on East 2nd Street and I-780 to a pollutant concentration at the Robert Semple School. This assessment was conducted using the ARB health risk model, Hotspots Analysis and Reporting Program (HARP), which includes the EPA dispersion model ISCST3. This model provides a detailed estimate of pollutant concentrations and considers details of the analysis site, source strength, distance to receptor (i.e., school buildings), and site-specific meteorological data.

Vehicle emission factors were estimated using EMFAC2007, which includes assumptions of technological and regulatory changes that will reduce emission rates over time. Emission factors from the years 2010 and 2030 were used to represent the long-term evaluation period.

Thresholds of Significance

In order to evaluate whether a project has the potential to expose sensitive receptors (including schools) or the general public to substantial levels of toxic air contaminants, the BAAQMD establishes thresholds to determine if a project has a significant impact. The BAAQMD has established a threshold of significance as an increased probability of contracting cancer that is greater than 10 in 1 million. In other words, the toxic emissions from the project would need to cause an additional 10 cancers per 1 million people (above current levels) to be considered as having a significant impact.

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[5] California Air Resources Board, 2005. *HARP Model Documentation, Appendix K, Risk Assessment Procedures to Evaluate Particulate Emissions from Diesel-Fueled Engines.*

In addition to the cancer risk from a proposed project, BAAQMD establishes a hazard index of 1.0 for noncarcinogenic toxic air contaminants, which is the ratio of the modeled results to an exposure level at or below which no adverse health effects are anticipated. A hazard index value of 1.0 or less than 1.0 indicates that no adverse human health effects (noncancer) are expected to occur. The current science of health risk assessments does not distinguish between children and adult acute and chronic noncancer risks, and the risk levels reported are protective of both children and adults.

Carcinogenic and Chronic Impacts of Current and Future Conditions

The results for carcinogenic and chronic impacts for the existing conditions at the Semple School are shown in Table 2. Results of the analysis indicate that the cancer risk associated with an individual working at the school for 40 years would be an inhalation cancer risk of 0.0326 in 1 million (or 3.26 in 100 million) and the risk to a child spending 9 years at the school would be 0.0408 in 1 million (or 4.08 in 100 million), both of which are less than the threshold of 10 in 1 million. The maximum acute and chronic hazard indices would be 0.000003 and 0.000094, respectively, which are below the thresholds of 1.0.

Table 2: Health Risk Levels Based on Existing 2nd Street and I-780 Traffic Conditions

Inhalation Health Risk Levels at Robert Semple Elementary School			
Exposed Individual	**Carcinogenic Inhalation Health Risk**	**Chronic Inhalation Health Index**	**Acute Inhalation Health Index**
Student Risk Levels	0.0408 in 1 million	0.000094	0.000003
Teacher Risk Levels	0.0326 in 1 million	0.000094	0.000003
Thresholds	**10 in 1 million**	**1**	**1**

Source: LSA Associates, Inc., October 2008.

As shown in Tables 3 and 4, overall diesel-related risk levels at Semple School would be reduced in 2030, both with and without the project, compared to existing conditions due to the implementation of EPA's vehicle and fuel emissions regulations. Comparing 2030 conditions (without the project) to 2030 conditions (with the project), the project would result in an increased cancer risk of 0.0048 in 1 million for students and 0.0038 in 1 million for teachers. The increased risk from the project is equivalent to 1 additional cancer per 208 million students and 263 million teachers at the school. Exposure to toxic air emissions at the school would result in a maximum risk level that is below the BAAQMD's criteria of significance (10 in 1 million) in 2030, both with and without the project. Therefore, the impacts at the school are considered less than significant by BAAQMD.

Table 3: Health Risk Levels in 2030 Without Project

Inhalation Health Risk Levels at Robert Semple Elementary School			
Exposed Individual	**Carcinogenic Inhalation Health Risk**	**Chronic Inhalation Health Index**	**Acute Inhalation Health Index**
Student Risk Levels	0.0176 in 1 million	0.0000427	0.0000025
Teacher Risk Levels	0.0141 in 1 million	0.0000427	0.0000025
Thresholds	**10 in 1 million**	**1**	**1**

Source: LSA Associates, Inc., October 2008.

approach the BAAQMD criterion for short-term acute health risks, long-term cancer, or chronic health risks. Therefore, it is unlikely that present or future students and teachers at the school site would be exposed to any health risks above that of the average California or Bay Area resident.