Appendix C. Air Quality Technical Information

Appendix C. Air Quality Technical Information

OZONE PRECURSORS, CARBON MONOXIDE, AND PM10 EMISSION ESTIMATES

The URBEMIS7G computer program was used to estimate ozone precursor, carbon monoxide, and PM10 emissions associated with each general plan alternative. Area source and motor vehicle emissions were estimated for each proposed land use alternative.

Area source emissions include consumer products, such as hairsprays, deodorants, and lighter fluid, and fuel combustion sources, such as space heating, water heating, and landscape maintenance activities. Emissions from area sources are based on the number and size of land uses proposed for development and the expected population that would be result. Area source emission estimates are based on emission factors developed by the California Air Resources Board and the U.S. Environmental Protection Agency.

Vehicle emissions result from trips generated by the proposed land uses associated with each general plan alternative. The trip generation rates for each land use were based on information on land use size. Those rates, along with the sizes of each proposed land use, are used by URBEMIS7G to estimate vehicle miles traveled (VMT). URBEMIS7G combines VMT and emissions from the California Air Resources Board's EMFAC7G model to calculate daily emission rates.

Carbon Monoxide Modeling

Dispersion Modeling

Predicting the ambient air quality impacts of pollutant emissions requires an assessment of the transport, dispersion, chemical transformation, and removal processes that affect pollutant emissions after their release from a source. Gaussian dispersion models are frequently used for such analyses. The term "Gaussian dispersion" refers to a general type of mathematical equation used to describe the horizontal and vertical distribution of pollutants downwind from an emission source.

Gaussian dispersion models treat pollutant emissions as being carried downwind in a defined plume, subject to horizontal and vertical mixing with the surrounding atmosphere. The plume spreads horizontally and vertically with a reduction in pollutant concentrations as it travels downwind. Mixing with the surrounding atmosphere is greatest at the edge of the plume, resulting in lower pollutant concentrations outward (horizontally and vertically) from the center of the plume.

This decrease in concentration outward from the center of the plume is treated as following a Gaussian ("normal") statistical distribution. Horizontal and vertical mixing generally occur at different rates. Because turbulent motions in the atmosphere occur on a variety of spatial and time scales, vertical and horizontal mixing also vary with distance downwind from the emission source.

The CALINE4 Model

The ambient air quality effects of traffic emissions were evaluated using the CALINE4 dispersion model (Benson 1989). CALINE4 is a Gaussian dispersion model specifically designed to evaluate air quality impacts of roadway projects. Each roadway link analyzed in the model is treated as a sequence of short segments. Each segment of a roadway link is treated as a separate emission source producing a plume of pollutants which disperses downwind. Pollutant concentrations at any specific location are calculated using the total contribution from overlapping pollution plumes originating from the sequence of roadway segments.

When winds are essentially parallel to a roadway link, pollution plumes from all roadway segments overlap. This produces high concentrations near the roadway (near the center of the overlapping pollution plumes), and low concentrations well away from the roadway (at the edges of the overlapping pollution plumes). When winds are at an angle to the roadway link, pollution plumes from distant roadway segments make essentially no contribution to the pollution concentration observed at a receptor location. Under such cross-wind situations, pollutant concentrations near the highway are lower than under parallel wind conditions (fewer overlapping plume contributions), while pollutant concentrations away from the highway may be greater than would occur with parallel winds (near the center of at least some pollution plumes).

The CALINE4 model employs a "mixing cell" approach to estimating pollutant concentrations over the roadway itself. The size of the mixing cell over each roadway segment is based on the width of the traffic lanes of the highway (generally 12 feet per lane) plus an additional turbulence zone on either side (generally 10 feet on each side). Parking lanes and roadway shoulders are not counted as traffic lanes. The height of the mixing cell is calculated by the model.

Pollutants emitted along a highway link are treated as being well mixed within the mixing cell volume due to mechanical turbulence from moving vehicles and convective mixing due to the temperature of vehicle exhaust gases. Pollutant concentrations downwind from the mixing cell are calculated using horizontal and vertical dispersion rates which are a function of various meteorological and ground surface conditions.

Modeling Procedures

Roadway and Traffic Conditions. Traffic volumes and operating conditions used in the modeling were obtained from the traffic analysis prepared for this project. Free flow traffic speeds were adjusted to reflect congested speeds using methodology from the Highway Capacity Manual

(Highway Research Board 1965). CO modeling was conducted for the following intersections: Richards Boulevard/First Street, Pole Line Road/Covell Boulevard, and the new intersections for the junior high school site.

CO modeling was performed for the following conditions:

- 2010 traffic at both intersections for Alternative 5;
- 2010 traffic at Richards Blvd. – First St. for Alternatives 2, 3, and 4.
- 2010 traffic at new intersections at the new junior high school site for Alternatives 4 and 5.

Vehicle Emission Rates. Vehicle emission rates were determined using the California Air Resources Board's EMFAC7F (version 1.1) emission rate program. A cold start percentage of 40% was assumed along with a hot start percentage of 30%.

Receptor Locations. CO concentrations were estimated for 14 receptor locations at the proposed intersections. The receptor locations are the same for all modeled conditions. Receptor heights were set at 5.9 feet.

Meteorological Conditions. Meteorological inputs to the CALINE4 model were determined using methodology recommended in Air Quality Technical Analysis Notes (California Department of Transportation 1988). The meteorological conditions used in the modeling represent a calm winter period. Thirty-six wind angles were modeled (10-360 degrees by 10 degree increments) to determine a worst-case concentration for each receptor. The meteorological inputs include: 0.5 meter per second wind speed, ground-level temperature inversion (atmospheric stability class G), wind direction standard deviation equal to five degrees, and a mixing height of 1000 meters.

Background Concentration and 8-Hour Values. Background concentration of 3 ppm was added to the modeled 1-hour values to account for sources of CO not included in the modeling. Eight-hour values were calculated from the 1-hour values using a persistence factor of 0.6. No background concentrations of 8-hour values were added (Personal Comm., Yolo-Solano AQMD which referred to John Ching, Sacramento Metropolitan Air Quality Management District).