Appendix J-Initial Study

Air Quality Technical Report

Air Quality Technical Report
Oakland International Airport
Runway Safety Area Improvement Project

Prepared for:

URS Corporation

Prepared by:

KB Environmental Sciences, Inc.

January 23, 2012

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1.0 Summary of Project

The Port of Oakland (Port), as owner and operator of Oakland International Airport (OAK or Airport), proposes to construct various improvements to the Runway Safety Area (RSA) of runways in both the North and South Fields to enhance safety at OAK. This effort is being undertaken by the Port in response to the requirements of *The Transportation, Treasury, Housing and Urban Development, the Judiciary, The District of Columbia, and Independent Agencies Appropriations Act, 2006* (P. L. 109-115), November 30, 2005. P. L. 109-115 requires completion of RSA improvements by airport sponsors that hold a certificate under Title 14, CFR, Part 139, to meet FAA design standards by December 31, 2015.

The proposed improvements involve a combination of runway shifts and other improvements, and are located in four geographic locations (at the end of each pair of parallel runways). The OAK RSA Improvement Project (OAK RSA Improvement Project, project, or proposed project) also includes a number of related components such as demolition and relocation of an existing electrical substation building, new underground drainage installations and pump stations, relocation of runway and taxiway lights and signage, and modifications to existing navigation aids. While not formally part of the OAK RSA Improvement Project, runway status lights would be installed on all runways concurrent with the proposed RSA improvements.

1.1 North Field

The primary components of the RSA enhancements to Runways 9R-27L and 9L-27R (additional enhancements to Runways 15-33 and 11-29) associated with the OAK RSA Improvement Project are as follows.

Runways 9R/27L and 9L/27R

- Relocate the airfield access road west of both runways westward to a location adjacent to the airport perimeter fence and Harbor Bay Parkway;
- Relocate the airfield access road east of the runways eastward to a location adjacent to the airport perimeter fence and Airport Drive;
- Reduce the Runway 9L length by implementing declared distances;
- Fill portions of small water bodies north of the west end of the Runway 9R/27L RSA;
- Fill and grade areas within the RSAs beyond the Runway 27L and 27R ends;
- Install an EMAS measuring approximately 150 feet by 170 feet, with a setback of approximately 680 feet west of the approach end of Runway 9R; and
- Correct various noncompliant conditions regarding surface grades, soil conditions, and frangibility of signs and navigation aids.

Runway 15/33

- Shift Runway 15/33 by 75 feet to the south by repainting the runway threshold markers.

1.2 South Field

Runway 11/29

- Relocate Runway 11 landing threshold and runway end by 520 feet to the northwest;
- Displace the Runway 29 landing threshold by 115 feet to the northwest;
- Relocate the northwest end of Taxiway W to the relocated Runway 11 landing threshold;
- Construct a connector taxiway between Taxiway W and Runway 11/29, approximately 450 feet northwest of the relocated Runway 29 landing threshold;
- Establish a declared distance of 10,000 feet for both arrivals and departures on Runways 11 and 29;
- Relocate the glide slope antenna and glide slope critical area for Runway 11 from the north side of the runway to the south side; and
- Correct various noncompliant conditions regarding surface grades, soil conditions, and frangibility of signs and navigation aids.

Construction activities associated the RSA Program is expected to begin in February 2013 and be completed in October 2015. **Figure 3.1-1** of the Affected Environment section shows the General and Detailed Study Area in which the construction activity for the OAK RSA improvements would occur. The OAK RSA Improvement Project would not change operational activities using OAK.

2.0 Introduction

Prepared in accordance with the California Environmental Quality Act (CEQA), this air quality impact assessment, greenhouse gas (GHG) emissions inventory, and human health risk assessment (HRA) was performed for the proposed OAK RSA Improvement Project. The Port, as owner and operator of OAK, proposes to construct various improvements to the RSAs for each of its four runways. Because the project would not change the number of aircraft operations or the aircraft fleet mix serving OAK, an operational emissions inventory was not prepared and is not required under CEQA. However, construction activities would occur as a result of the project; therefore, the air quality assessment focused on the air emissions related to these activities.

These analyses were conducted in accordance with the Bay Area Air Quality Management District (BAAQMD) *CEQA Air Quality Guidelines*, and the results were compared to the appropriate significance thresholds included within these guidelines (adopted on June 2, 2010 and updated in May of 2011).

This *Air Quality Technical Report* presents a summary of the results, the significance thresholds, mitigation measures, and technical background and information used to develop the analyses. **Attachment A** includes the assumptions and methodologies used for the construction emissions inventory for criteria pollutants and GHGs. **Attachment B** includes the assumptions and methodologies used for the HRA. **Attachment C** includes further information on the environmental setting, regulatory, and air quality management framework, and the existing air quality conditions in the project area. **Attachment D** includes further information on the regulatory setting associated with GHGs.

The criteria pollutants (and their precursors) evaluated in this assessment include reactive organic gases (ROGs), oxides of nitrogen (NO_X), carbon monoxide (CO), particulate matter with diameter equal to or less than 10 microns (PM_{10}), and particulate matter with diameter equal to or less than 2.5 microns ($PM_{2.5}$). GHGs include carbon dioxide (CO_2), nitrous oxide (N_2O), and methane (CH_4). The primary pollutant of concern in the HRA is diesel particulate matter (DPM) associated with $PM_{2.5}$ emissions from diesel-powered vehicles and equipment.

3.0 Significance Criteria

Under BAAQMD CEQA guidelines, a project would generally have a significant effect on the environment if it would:

- Conflict with or obstruct implementation of the applicable air quality plan;
- Violate any air quality standard or contribute substantially to an existing or projected air quality violation;
- Result in a cumulatively considerable net increase of any nonattainment pollutant for which the region is non-attainment under an applicable federal or state ambient air quality standard (AAQS) (including releasing emissions which exceed quantitative thresholds for ozone precursors);
- Expose sensitive receptors to substantial pollutant concentrations;
- Create objectionable odors affecting a substantial number of people;
- Generate GHG emissions, either directly or indirectly, that may have a significant impact on the environment; or
- Conflict with any applicable plan, policy, or regulation of an agency adopted for the purpose of reducing the emissions of GHG.

As noted in **Section 2.0**, the BAAQMD published an update to its *CEQA Air Quality Guidelines* in May of 2011 and adopted new significance thresholds for CEQA analysis, which are further discussed in the following sections.

3.1 Criteria Air Pollutants

The number of aircraft operations at OAK and the aircraft fleet mix serving OAK would not change as a result of the Proposed Project. Thus, operational emissions inventories were not prepared and are not required under CEQA.

For the assessment of temporary construction-dust impacts, the BAAQMD requires a qualitative approach that focuses on the dust control measures that would be implemented as part of the project. According to this approach, if appropriate mitigation measures are implemented to control fugitive dust emissions, the impact from construction dust would be less than significant.

The BAAQMD *CEQA Air Quality Guidelines* also identify the District's requirement that construction-related exhaust (non-fugitive dust) emissions be quantified and compared to significance thresholds of 54 pounds per day of ROG, NO_X, and $PM_{2.5}$, and 82 pounds per day of PM_{10} (see **Table 1**). These are in addition to the implementation of fugitive dust suppression measures from construction activities.

Table 1
Air Quality Thresholds of Significance for Criteria Air Pollutants

ROG	NO_X	PM_{10}	$PM_{2.5}$
Construction-Related Average Daily Emissions (lbs/day)			
54	54	82 (exhaust only)	54 (exhaust only)

Notes:

CO = carbon monoxide; NA = not available; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas

Past, present and future development projects contribute to the region's adverse air quality impacts on a cumulative basis. By its very nature, air pollution is largely a cumulative impact. No single project is sufficient in size to, by itself, result in nonattainment of AAQS. Instead, a project's individual emissions contribute to existing cumulatively significant adverse air quality impacts. If a project's contribution to the cumulative impact is considerable, then the project's impact on air quality would be considered significant.

According to the BAAQMD *CEQA Air Quality Guidelines*, if a project exceeds the identified significance thresholds, its emissions would be cumulatively considerable, resulting in significant adverse air quality impacts to the region's existing air quality conditions. Similarly, GHG emissions and global climate change also represent cumulative impacts. GHG emissions may contribute, on a cumulative basis, to the significant adverse environmental impacts of global climate change

3.2 Greenhouse Gases

The BAAQMD CEQA *Air Quality Guidelines* identify GHG emissions of either 1,100 metric tons of carbon dioxide equivalents (CO_2e) per year or 4.6 metric tons of CO_2e per year per service population (i.e., the number of residents plus the number of employees associated with a new development) as the project-operations-specific threshold that would result in a cumulatively considerable contribution of GHG emissions and a cumulatively significant impact on global climate change. Alternatively, project operations that are found to be consistent with a Qualified Climate Action Plan would have a less-than-significant impact on global climate change. The BAAQMD *CEQA Air Quality Guidelines* recommend quantification of construction GHG emissions and analysis to compliance with Assembly Bill (AB 32).

3.3 Odors

Generally, the BAAQMD considers any project with the potential to frequently expose members of the public to objectionable odors to cause a significant impact. Projects that would site a new odor source or a new receptor farther than the applicable BAAQMD-established screening distances from an existing receptor or odor source, respectively, would not likely result in a significant odor impact. An odor source with five confirmed complaints per year averaged over 3 years is considered to have a significant impact on receptors within the screening distances.

3.4 Toxic Air Contaminants

The significance of toxic air contaminant (TAC) emissions (see **Table 2**) from the project is dependent on the chance of getting cancer from exposure to the TACs or of having adverse health effects from exposure to non-carcinogenic TACs.

Table 2
CEQA Air Quality Thresholds of Significance for Health Risk and Hazards

Criteria	Condition	Threshold of Significance
Risk and Hazards – New Source	Individual Project	Increased cancer risk of >10.0 in a million Increased non-cancer risk of > 1.0 Hazard Index (Chronic or Acute) Ambient $PM_{2.5}$ increase: > 0.3 µg/m^3 annual average
Risk and Hazards – New Source	Cumulative Projects	Cancer: > 100 in a million (from all local sources) Non-cancer: > 10.0 Hazard Index (from all local sources) (Chronic) $PM_{2.5}$: > 0.8 µg/m^3 annual average (from all local sources)

Notes:
> =- greater than; µg/m^3 = microgram per cubic meter; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns

3.4.1 Cancer Risk

AB 2588 regulations and Proposition 65 both require public notification if the incremental cancer risk at a receptor exceeds or is equal to 10 in one million. BAAQMD *CEQA Air Quality Guidelines* also recommend that the cancer risk significance threshold be 10 in one million.

For cumulative analysis of cancer risk, BAAQMD guidelines indicate that the risks from all sources within a 1,000-foot radius of the source or new receptor should be assessed and compared to a cumulative cancer risk threshold of 100 in one million (from local sources).

3.4.2 Non-Cancer Health Hazard

The non-cancer hazard index significance threshold of 1.0 is defined in the BAAQMD *CEQA Air Quality Guidelines* and is consistent with the value requiring public notification in the AB 2588 regulations and in Proposition 65.

For cumulative analysis of non-cancer hazard index, BAAQMD guidelines indicate that the hazards from all sources within a 1,000-foot radius of the source or new receptor should be assessed and compared to a cumulative hazard index threshold of 10 (from local sources).

3.5 Ambient $PM_{2.5}$ Concentrations

Because emissions of $PM_{2.5}$ are associated with health risks, the BAAQMD has established a separate significance threshold for $PM_{2.5}$ to protect public health. For individual projects, the BAAQMD significant threshold for $PM_{2.5}$ impacts is an increase in the annual average that is greater than 0.3 microgram per cubic meter (µg/m^3).

For cumulative analysis, BAAQMD requires that the $PM_{2.5}$ concentrations from all sources within a 1,000-foot radius of the source or new receptor should be assessed and compared to a cumulative threshold in the annual average of 0.8 µg/m^3 (from local sources).

4.0 Air Quality Technical Analyses

The results of the air quality, GHG, and HRA analyses are presented in the following section and, for convenience and comparison, are arranged according to the appropriate impact statement.

4.1 Consistency with the 2010 Bay Area Clean Air Plan

On September 15, 2010, the BAAQMD adopted the *2010 Bay Area Clean Air Plan*[1]. The *2010 Clean Air Plan* updates the *Bay Area 2005 Ozone Strategy* in accordance with the requirements of the CCAA to implement all feasible measures to reduce ozone; provide a control strategy to reduce ozone, particulate matter, air toxics, and GHG in a single, integrated plan; and establish emission control measures to be adopted or implemented in the 2010 through 2012 timeframe. The primary goals of the *2010 Clean Air Plan* are to:

- Attain air quality standards;
- Reduce population exposure and protecting public health in the San Francisco Bay Area; and
- Reduce GHG emissions and protect the climate.

The BAAQMD recommended measure for determining project support of these goals is determined by considering 1) the primary goals of the *2010 Clean Air Plan*, 2) the consistency with the 55 control measures listed in the *2010 Clean Air Plan* and 3) whether the project would hinder implementation of the *2010 Clean Air Plan*.

Air quality impacts of the OAK RSA Improvement Project are related to temporary (less than three years) construction activities. As discussed above, the OAK RSA Improvement Project would have no effect on operational activities at the Airport. The proposed project would incorporate Mitigation Measures M-AQ-a as well as Improvement Measure I-AQ-a (see Section 4.2), which would reduce emissions from construction activities

The OAK RSA Improvement Project would be consistent with the *2010 Clean Air Plan* goals and would not conflict with the primary goals of the *2010 Clean Air Plan*. In addition, the proposed project would be consistent with the *2010 Clean Air Plan's* applicable specific control measures and actions. Of particular relevance to the proposed project is the Mobile Source Measures (MSM) C-1 – Construction and Farming Equipment.

- MSM C-1 will work to reduce emissions from construction by pursuing the following strategies: a) retrofit engines with diesel particulate filters or upgrade equipment with electric, Tier III or Tier IV off-road engines; b) develop more fuel-efficient off-road engines and drivetrains; and c) encourage the use of renewable electricity and renewable fuels, such as biodiesel from local crops, in applicable equipment.

[1] Bay Area Air Quality Management District (BAAQMD), Bay Area 2010 Clean Air Plan, Adopted September 15, 2010. Available Online at: http://www.baaqmd.gov//and-Research//Air-Plans.aspx. Accessed June 17, 2011.

A major component of the Airport's *Air Quality Management Program* is emission reduction measures related to construction projects. As such, the Airport has developed a construction site inspection checklist and field-monitoring follow-up to ensure contractor compliance with those measures identified in final plans and specifications. The Airport's Materials Management Program (MMP)[2] diverts from public landfills recyclable construction materials such as concrete, asphalt and rebar and converts it into reusable material for new airport construction and maintenance projects. The MMP has designated sites for material stockpiling and recycling, allowing for the reduction of disposal and material purchasing costs and reduction of truck emissions associated with landfill disposal of waste.

Thus, the proposed project would be consistent with the type of strategies promoted by the CAP MSM C-1 for Construction Equipment. Lastly, the proposed project does not include any components that would disrupt, delay, or otherwise hinder implementation of the *2010 Clean Air Plan* (e.g., preclude the extension of a transit line or bike path). Therefore, the proposed project would not conflict with the *2010 Clean Air Plan*.

4.2 Short-Term Construction Emissions of Criteria Pollutants

Construction activities for the OAK RSA Improvement Project would include site preparation, grading, paving, placement of utilities, and other minor activities. These excavation and construction activities would require the use of heavy trucks, excavating and grading equipment, material loaders, dozers, and other mobile and stationary construction equipment. Fugitive dust emissions during construction would be generated during ground-disturbing activities, materials handling, and mobile equipment use on unimproved surfaces. Fugitive ROG emissions would be generated during paving of taxiways and runways. Equipment exhaust would be generated from construction worker vehicle trips, material truck trips, and the operation of construction equipment.

Construction emissions were estimated using the California Air Resource Board's OFFROAD2007, EMFAC2007, and URBEMIS 2007 (Version 9.2.4) emission models and other appropriate guidelines. The emission estimates combine information on construction schedule, such as hours of operation and estimated vehicle mileage with equipment emissions data specific to the Bay Area Air Basin. **Attachment A** contains the detailed assumptions and methodologies used for the construction emissions inventory.

The estimated average daily construction exhaust emissions over the entire construction period are presented in **Table 3**. As shown, these emissions are less than the applicable BAAQMD significance thresholds for all pollutants. Although the BAAQMD does not have annual emission thresholds for construction activities (exhaust and fugitive dust), **Table 4** displays, for information purposes, the annual construction-period emissions during each construction year.

[2] Oakland International Airport-Materials Management Program (MMP), Updated November 2007, http://www.flyoakland.com/pdf/OAKMMPFactSheet_12_05_2007.pdf

Table 3
Project Construction Average Daily Emissions Estimates

	Estimated Average Daily Unmitigated Emissions (pound per day)				
	ROG	**NO_X**	**CO**	**PM_{10}**	**$PM_{2.5}$**
Project	**5.12**	**44.4**	**32.6**	**1.87**	**1.69**
BAAQMD Threshold	54	54	NA	82	54
Significant?	No	No	NA	No	No

Notes:

BAAQMD = Bay Area Air Quality Management District; CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas, NA – BAAQMD CEQA Guidelines does not contain a significance threshold for CO.

Table 4
Project Construction Annual Emission Estimates

	Estimated Annual Emissions (tons/year)				
Construction Year	**ROG**	**NO_X**	**CO**	**PM_{10}**	**$PM_{2.5}$**
2013	0.66	4.21	5.82	13.6	3.01
2014	0.36	2.34	3.10	1.49	0.40
2015	0.43	2.65	3.61	2.07	0.54

Notes:

CO = carbon monoxide; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gases

To address fugitive dust and combustion emissions, the BAAQMD's *CEQA Air Quality Guidelines* recommend the implementation of *Basic Construction Mitigation Measures* for all projects, whether or not significant impacts have been identified, and implementation of *Additional Construction Mitigation Measures* for all projects that are potentially significant. Therefore, Mitigation Measures M-AQ-a shall be implemented.

Mitigation Measure M-AQ-a - Implement Basic Construction Best Management Practices

The construction contractor shall reduce construction-related air pollutant emissions by implementing BAAQMD's basic fugitive dust control measures. Therefore, the project shall include the following requirements in construction contracts:

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

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

- 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.

- All roadways, driveways, and sidewalks to be paved shall be completed as soon as possible.

- All vehicle speeds on unpaved roads shall be limited to 15 miles per hour.

- Post a publically 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 telephone number shall also be visible to ensure compliance with applicable regulations.

- 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, CCR Section 2485). Clear signage shall be provided for construction workers at all access points.

- All construction equipment shall be maintained and properly tuned in accordance with manufacturer's specifications. All equipment shall be checked by a certified visible emissions evaluator.

The project sponsor has also agreed to implement Improvement Measure I-AQ-a, which would further reduce fugitive dust emissions associated with construction activities.

Improvement Measure I-AQ-a - Implement Additional Fugitive Dust Emissions Reduction Measures

The construction contractor shall implement the following measures during construction to further reduce construction-related fugitive dust emissions:

- All excavation, grading, and/or demolition activities shall be suspended when average wind speeds exceed 20 miles per hour.

- The simultaneous occurrence of excavation, grading, and ground-disturbing construction activities in the same area at any one time shall be limited. Activities shall be phased if feasible to reduce the amount of disturbed surfaces at any one time.

- All trucks and equipment, including their tires, shall be washed off prior to leaving the site.

As the average daily construction emissions associated with the project would be less than the BAAQMD significance thresholds; construction of the OAK RSA Improvement Project would be considered less than significant.

4.3 Odors

Typically, odor sources of most concern include wastewater treatment plants, sanitary landfills, transfer stations, composting facilities, petroleum refineries, asphalt batch plants, chemical manufacturing facilities, fiberglass manufacturing facilities, auto body shops, rendering plants, and coffee roasting facilities. The OAK RSA Improvement Project would not include these odor sources.

Diesel-fueled construction equipment would generate some odors associated with diesel exhaust; however, these emissions typically dissipate quickly. This equipment would be used on existing airport property and would be unlikely to substantially affect the nearest sensitive receptors, which are located on the west side of U.S. Highway 61 (U.S. 61). Therefore, odor impacts associated with construction of the OAK RSA Improvement Project would be less than significant.

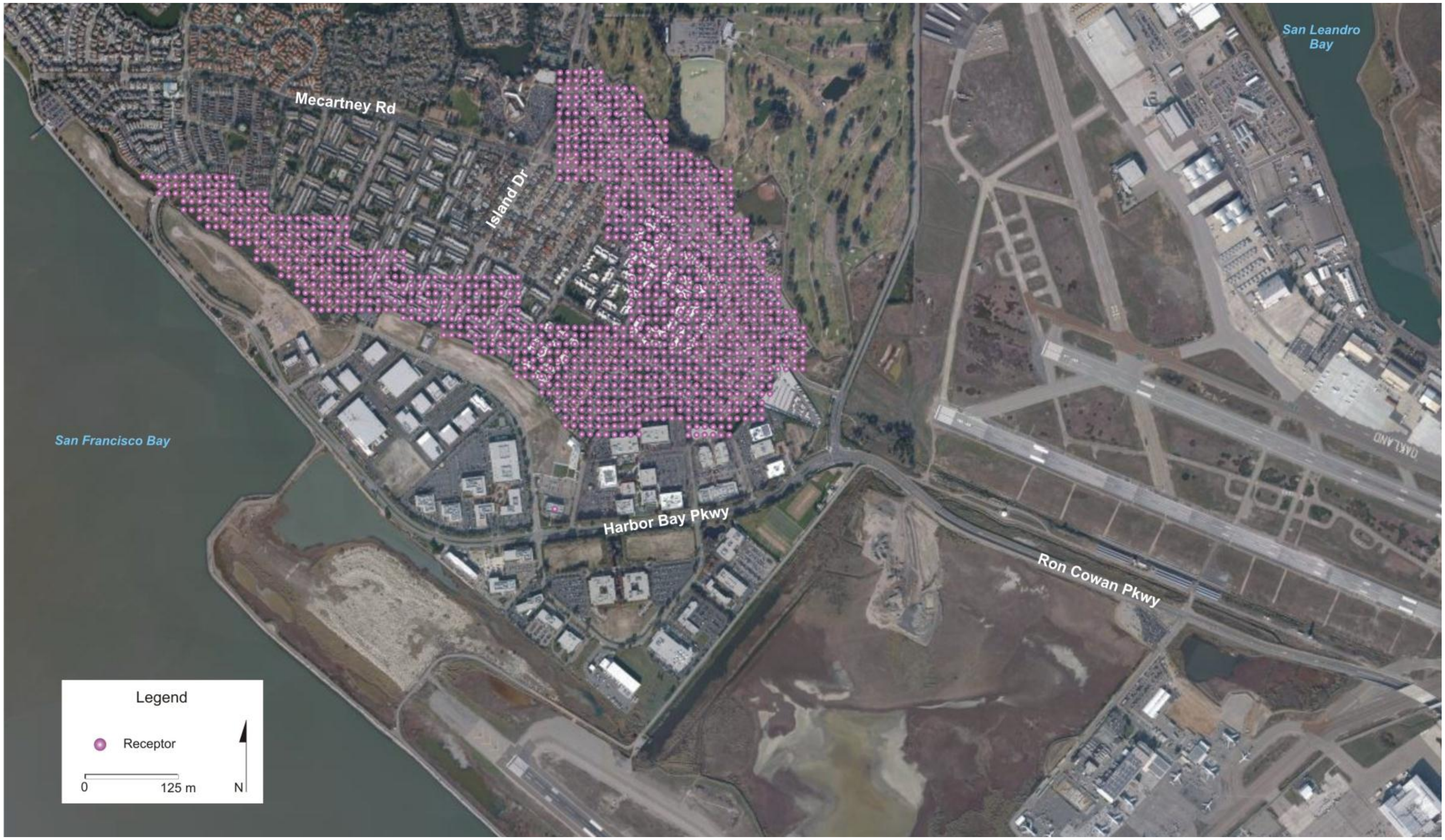
4.4 Project-Related Toxic Air Pollutants

Some receptors (i.e., segments of the human population) are considered more sensitive to air pollutants than others, because of preexisting health problems, proximity to the emissions source, or duration of exposure to air pollutants. Land uses such as primary and secondary schools, hospitals, and convalescent homes are considered to be relatively sensitive to poor air quality because the very young, the old, and the infirm are more susceptible to respiratory infections and other air quality-related health problems than the general public. Residential areas are also considered sensitive to poor air quality because people in residential areas are often at home for extended periods. Recreational land uses are moderately sensitive to air pollution, because vigorous exercise associated with recreation places a high demand on respiratory system function.

Residential and school receptors are generally located to the north of the project site are within 1,000 feet. However, residential and school receptors are located to the southeast and east are beyond 1,000 feet of the project site and thus, not included in the analysis in accordance with BAAQMD guidance.

Project-related construction activities would produce diesel particulate matter (DPM) and $PM_{2.5}$ emissions associated with construction equipment such as haul trucks, loaders, and backhoes. At elevated levels and under sufficient exposures, these emissions could lead to adverse health effects such as an increase in the risk of cancer or non-cancer health hazards. **Exhibit 1** displays the location of the receptors used in the HRA. Improvements at runway ends 11, 9R, and 9L would have a greatest impact on the sensitive receptors although all project elements were included in the analysis. **Figure 3.1-1** of the Affected Environment section shows the General and Detailed Study Area in which the construction activity for the OAK RSA improvements would occur.

EXHIBIT 1
HEALTH RISK ASSESSMENT RECEPTORS



4.4.1 Cancer Risk

Cancer risk is defined as the lifetime probability of developing cancer from exposure to carcinogenic substances. Cancer risks are expressed as the chances in one million of getting cancer; for example, ten cancer cases among one million people exposed.

Following HRA guidelines and tools established by BAAQMD's CEQA *Air Quality Guidelines* (dated May 2011), BAAQMD's *Health Risk Screening Analysis Guidelines* (dated January 2010), and in the California Office of Environmental Health Hazard Assessment (OEHHA) guidelines (dated August 2003), incremental cancer risks (i.e., the additional risk above baseline levels attributable to the project) were calculated by applying toxicity factors to modeled TAC concentrations to determine the inhalation dose (milligrams per kilogram of body weight per day [mg/kg-day]).

To determine incremental cancer risk, the estimated inhalation dose attributed to the project was multiplied by the cancer potency slope factor (cancer risk per mg/kg-day). The cancer potency slope factor is the upper bound on the increased cancer risk from a lifetime exposure to a pollutant. These slope factors are based on epidemiological studies and are different values for different pollutants. This allows the estimated inhalation dose to be equated to a cancer risk. Thus, if the inhalation dose (mg/kg-day) is estimated at 2.75 per million and the slope factor (mg/kg-day^{-1}) is 1.1; then the cancer risk is 3.0 per million persons.

The analysis used guidance from OEHHA to select other exposure parameters, including breathing rate, exposure periods, inhalation absorption factor, and age sensitivity factors, as described more fully in **Attachment B**. Different sensitive populations are associated with different exposure parameter data. For example, an adult residential receptor is assumed to have a different breathing rate than a child residential receptor. These exposure parameters define the rate of pollutants inhaled as a function of receptor type.

As a result of construction activities associated with the OAK RSA Improvement Project, the maximum cancer risk for the maximum exposed residential-adult receptor would be less than 0.01 per million. The maximum cancer risk for a residential-child would be 0.05. The maximum cancer risk for a school-child would be 0.16. The cancer risk due to construction activities is well below the BAAQMD threshold of 10 per million and would be less than significant.

According to California Environmental Protection Agency guidelines, the results of an HRA should not be interpreted as the expected rates of cancer or other potential human health effects, but rather as estimates of probability of potential risk based on current knowledge, a number of highly conservative assumptions, models, and techniques, and the best assessment tools presently available.

4.4.2 Non-Cancer Health Impacts

Both acute (short-term) and chronic (long-term) adverse health impacts unrelated to cancer are measured against a hazard index (HI), which is defined as the ratio of the predicted incremental exposure concentration from the project to a published reference exposure level (REL) that could cause adverse health effects. The RELs are published by OEHHA based on epidemiological research. The ratio (referred to as the hazard quotient) of each non-carcinogenic substance that affects a certain organ system is added to produce an overall HI for that organ system. The overall HI is calculated for each organ system. If the overall HI is greater than 1.0, then the impact is considered to be significant.

The chronic REL for DPM was established by the California OEHHA[1] as 5 $\mu g/m^3$. There is no acute REL for DPM. However, diesel exhaust does contain acrolein, which does have an acute REL. BAAQMD's DPM speciation table (based on profile 4674 within the U.S. EPA Speciate 4.2)[2] was used to assess the acute impacts of acrolein, which is approximately 1.3 percent of the total DPM emissions. The acute REL for acrolein was established by the California OEHHA[3] as 2.5 $\mu g/m^3$. The chronic impact analysis uses the annual maximum concentration while the acute impact uses the maximum 1-hour concentration over the 3-year construction period.

As a result of project-related construction, the chronic HI would be less than 0.01 and the acute HI would be 0.03 for the maximum exposed residential-adult receptor. The chronic HI would be less than 0.01 and the acute HI would be 0.03 for the maximum exposed residential-child receptor. The chronic HI would be less than 0.01 and the acute HI would be 0.04 for the maximum exposed school-child receptor. The chronic and acute HI would be below the BAAQMD threshold of 1.0, and the impact of the project would therefore be less than significant.

4.4.3 $PM_{2.5}$ Concentration

Dispersion modeling is also used to predict the exposure of sensitive receptors to project-related emissions of $PM_{2.5}$. Because emissions of $PM_{2.5}$ are associated with health risks, the BAAQMD has established a separate significance threshold to protect public health from this pollutant. Only $PM_{2.5}$ exhaust emissions (per BAAQMD guidelines) are included in this analysis. Per BAAQMD, fugitive dust (non-exhaust) emissions are addressed separately under Mitigation Measure M-AQ-a and Improvement Measure I-AQ-a.

The maximum annual $PM_{2.5}$ concentration as a result of project construction would be 0.01 $\mu g/m^3$ at the residential-adult, residential-child, and school-child receptors. The annual $PM_{2.5}$ concentration due to implementation of the project is below the BAAQMD threshold of 0.3 $\mu g/m^3$, and therefore is considered less than significant.

4.5 Long-Term Operational Emissions of Criteria Pollutants

The OAK RSA Improvement Project would not change the number of aircraft operations or the aircraft fleet mix using OAK; therefore, no operations emissions inventory is required under CEQA.

1 California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2010. http://www.oehha.ca.gov//.
2 Provides for a speciation faction of 1.3 percent of acrolein per DPM emission rate. http://www.epa.gov////.html.
3 California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2010. http://www.oehha.ca.gov//.

4.6 Carbon Monoxide Intersection Analysis

CO concentrations have declined dramatically in California due to motor vehicle emission control programs, and most areas of the state, including the San Francisco Bay Area, have no problem meeting the CO state and federal standards (i.e., current concentrations are less than 25 percent of the standards).

There is a direct relationship between traffic/congestion and CO impacts, because exhaust fumes from vehicular traffic are the primary source of CO. CO is a localized gas that dissipates very quickly under normal meteorological conditions. Therefore, CO concentrations decrease substantially as distance from the source (i.e., a traffic intersection) increases. The highest CO concentrations are typically found in areas directly adjacent to congested roadway intersections.

The OAK RSA Improvement Project would not change the number of motor vehicles and traffic pattern associated with OAK; therefore, the OAK RSA Improvement Project impact on localized CO concentrations would be less than significant. Construction activities would be temporary and onroad vehicles would be limited to employee traffic (an average of 60 per day) and periodic material deliveries. Thus, the RSA Program is expected to generate traffic volumes less than the significance thresholds and its impact on localized CO would be less than significant.

4.7 Greenhouse Gases

Gases that trap heat in the atmosphere are referred to as greenhouse gases (GHGs) because they capture heat radiated from the sun as it is reflected back into the atmosphere, much like a greenhouse does. An ever-increasing body of scientific research attributes global climate changes to GHGs, particularly those generated from the human production and use of fossil fuels.[4] The primary GHGs are CO_2, CH_4, N_2O, ozone, and water vapor.

While the presence of the primary GHGs in the atmosphere occur naturally, CO_2, CH_4, and N_2O are also emitted from human activities, accelerating the rate at which these compounds occur within earth's atmosphere. Emissions of CO_2 are largely by-products of fossil fuel combustion; methane results from off-gassing associated with agricultural practices and landfills. Other GHGs include hydrofluorocarbons, perfluorocarbons, and sulfur hexafluoride, and are generated in certain industrial processes. GHGs are typically reported in CO_2E measures.[5]

GHG emissions associated with construction activities were quantified. The construction-related GHG emissions were developed based on the CARB OFFROAD and EMFAC emissions models through estimations of fuel usage. **Attachment A** provides detailed assumptions and methodologies for the construction emissions inventory including GHG emissions.

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[4] California Climate Change Portal: http://www.climatechange.ca.gov/publications/faqs.html#ia.

[5] Because of the differential heat absorption potential of various GHG, GHG emissions are frequently measured in "carbon dioxide-equivalents," which present a weighted average based on each gas' heat absorption (or "global warming") potential.

Estimated GHG emissions that would be associated with the construction are presented in **Table 5**. As indicated, maximum annual construction-related GHG emissions would be 1,958 metric tons during 2014. There is not a significance threshold for construction GHG emissions.

The useful lifetime of the construction project would vary from between 5 and 7 years for pavement elements, approximately 20 years for EMAS, and approximately 30 years for other infrastructure elements. Thus, the useful lifetime of the construction project was estimated at 10 years. The construction GHG emissions amortized over a 10-year period would equal 461 metric tons. Of note, the BAAQMD significance threshold of 1,100 metric tons of CO_2e per year does not apply to construction activities (but instead only to operational emissions), although the 461 metric tons per year would be below this threshold. The reported GHG emissions do not include reductions due to Mitigation Measure M-AQ-a and Improvement Measure I-AQ-a, which may further reduce GHG emissions, as well as criteria pollutants, associated with the OAK RSA Improvement Project.

Table 5
Project Related Greenhouse Gas Emissions

Construction Year	GHG CO_2E Metric Tons Per Year
2013	1,958
2014	1,169
2015	1,480
Annual construction-related emissions amortized over 10 years	461

Notes:
CO_2E = carbon dioxide equivalents; GHG = greenhouse gas

The proposed project would result in GHG emissions during construction activities; however these emissions would be temporary and associated with the short-term construction period and would not continue after completion of the project. Therefore, the proposed project would not generate significant levels of GHG emissions. The proposed project would not conflict with the State's GHG reduction goals, as defined in AB 32. Therefore, the proposed project would not result in GHG emissions that would have a significant impact on the environment, nor would the proposed project conflict with any policy, plan, or regulation adopted for the purpose of reducing greenhouse gas emissions, and GHG impacts would be less than significant.

4.8 Cumulative Impacts

4.8.1 Criteria Pollutants

CEQA defines cumulative impacts as two or more individual effects which, when considered together, are either significant or "cumulatively considerable," meaning they add considerably to a significant environmental impact. Cumulative impacts can result from individually minor but collectively significant projects (CEQA Guidelines §15355).

An air quality cumulative impact analysis considers a project over time and in conjunction with other past, present, and reasonably foreseeable future projects whose air quality impacts might compound those of the project while overlapping in time and location. Projects that exceed the BAAQMD significance thresholds are considered to result in a considerable contribution to significant cumulative air quality impacts.

The project construction activities would be temporary in duration and limited to areas within OAK with minimal offsite vehicle trips. The OAK RSA Improvement Project would not change operational activities; resulting in no change in long term impacts. The OAK RSA Improvement Project's air quality impacts would result in daily average emissions of less than the CEQA significance thresholds. Thus, the OAK RSA Improvement Project would not result in a considerable contribution to cumulative criteria air pollutant impacts.

4.8.2 Toxic Air Pollutants

The BAAQMD's *CEQA Air Quality Guidelines* include standards and methods for determining the significance of cumulative health risk impacts. The method for determining cumulative health risk requires the tallying of health risk from permitted sources and major roadways in the vicinity of a project (i.e., within a 1,000-foot radius of the project), then adding the project impacts (in this case, construction activities) to determine whether the cumulative health risk thresholds are exceeded.

BAAQMD has developed a geo-referenced database of permitted TAC emissions sources throughout the San Francisco Bay Area and has developed the *Stationary Source Risk & Hazard Analysis Tool* (dated May 2011) for estimating cumulative health risks from permitted sources. Ten permitted sources are located within 1,000 feet of the project. These sources are listed in **Table 6**. Information associated with these sources was provided and/or verified by BAAQMD.[6] Information (cancer risks and hazard index) was adjusted for distance from source to receptor based on BAAQMD's *Distance Adjustment Multiplier for Diesel Internal Combustion Engine* and the *Distance Adjustment Multiplier for Gasoline Dispensing Facilities*. **Attachment B** provides information on the screening impacts (unadjusted) and distance adjustment factors for this analysis.

U.S. 61 is located adjacent (to the east of the project) and within 1,000 feet of the project and nearby sensitive receptors. Thus, the health impacts from this roadway were included in the cumulative analysis. BAAQMD has also developed a geo-referenced database of roadways throughout the San Francisco Bay Area and has developed the *Highway Screening Analysis Tool (*dated May 2011*)* for estimating cumulative health risks from roadways.

Roadway segments along U.S. 61 from Harbor Bay Parkway and 98th Avenue were reviewed within the geo-referenced database. The data associated with the southbound traffic impacts within the geo-referenced database were used, because the receptors of concern are to the west of U.S. 61 (nearest travel lanes). The data associated with the 6-foot height data within the geo-referenced database were used as

[6] Email from Andrea Gordon at BAAQMD on August 15, 2011 entitled Stationary Source Inquiry Form Request- OAK International Runway Safety Area.

most residences in the area are homes; not multi-story apartments. The maximum roadway impacts at the nearby receptors are displayed in **Table 6**.

In addition, OAK operations would be considered a non-permitted source (i.e., aircraft operations, ground support equipment, and other airport-related equipment) and also emit TACs. No other sources of TACs were identified within 1,000 feet of the project site.

Table 6 shows the cumulative cancer risk, hazard impact, and $PM_{2.5}$ concentrations (in $\mu g/m^3$) associated with the ten permitted sources, nearby roadway, and the project. As shown, the cumulative cancer risk and hazard impacts would be below the BAAQMD cumulative significance criteria. However, the cumulative $PM_{2.5}$ concentrations would be above the BAAQMD cumulative significance criteria, and thus, there is a potentially cumulative significant impact. However, given that the proposed project would not result in increased $PM_{2.5}$ concentrations exceeding the project-level thresholds (as shown in Section 4.4), the OAK RSA Improvement Project would not result in a cumulatively considerable contribution to localized health risk and hazard impacts, resulting in a less than significant cumulative air quality impact.

Table 6
Cumulative Health Impacts

Site #	Facility Type	Address/Source	Cancer Risk	Hazard Impact	$PM_{2.5}$ Concentration
17533	Federal Express	1 Sally Ride Way	1.77	<0.01	<0.01
14822	FAA	Oakland Airport	0.83	<0.01	<0.01
19325	Swissport	1 Edward White Way	2.04	<0.01	<0.01
678	Port of Oakland	#1 Airport Drive	12.3	<0.01	0.04
1201	Rolls Royce Engine Services	6711 Lockheed Street	-	-	13.5
615	Rolls Royce Engine Services	7200 Earhart Road	7.56	<0.01	0.31
G937	Oakland Airport	8500 Earhart Road	0.3	<0.01	-
8051	Airweld, Inc	8300 Earhart Road	-	<0.01	-
13734	East Bay Municipal Utility District	9301 Doolittle Drive	0.84	<0.01	<0.01
519	Chevron	N Earhart Drive	7.38	0.01	-
		Permitted Sources Total	**32.8**	**0.02**	**13.9**
		U.S. Highway 61	2.11	0.002	0.019
		Roadway Total	**2.11**	**0.002**	**0.019**
		Proposed Project	0.16	0.03	0.01
		BAAQMD Project Significance Criteria	*10*	*1*	*0.3*
		Significant Project Impact?	*No*	*No*	*No*
		Cumulative Total	**35.1**	**0.05**	**13.9**
		BAAQMD Cumulative Significance Criteria	*100*	*10*	*0.8*
		Considerably Significant Project Contribution to Cumulative Impacts?	*No*	*No*	*No*

Notes:

BAAQMD = Bay Area Air Quality Management District; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns, NA = Not available

Attachment A
Construction Emissions Inventory

Both criteria pollutant and greenhouse gas (GHG) emissions inventories of the Oakland International Airport (OAK) Runway Safety Area (RSA) Program were calculated to assess potential air quality impacts related to the project's construction. This attachment describes the input data and methodology used to prepare the emissions inventories.

A.1 Criteria Pollutant Emissions Inventory Methodology

Criteria pollutants included in this assessment comprise carbon monoxide (CO), reactive organic gases (ROG), nitrogen oxides (NO_X), sulfur oxides (SO_X), particulate matter measuring 10 micrometers or less in diameter (PM_{10}) and particulate matter measuring 2.5 micrometers or less in diameter ($PM_{2.5}$). Methodological details pertaining to the estimation of emissions from on-road construction vehicles, off-road construction equipment, fugitive dust generation, and asphalt paving are discussed.

A.2 On-Road Construction Vehicles

Activity levels and assignments for on-road construction vehicles have been developed based on a schedule of planned construction activities for the project, including vehicle miles of travel (VMT) and idling time estimates for on-road construction vehicles, by construction task and year. Additionally, emissions due to construction employee commutes to and from the work site were calculated, assuming an average commute distance of 9.5 miles (19 miles round trip) and an average of 60 employees per construction day (ranging from 50 to 75 per day).. These assumptions were based on the California Air Resources Board (CARB) URBEMIS (Version 9.2.4) emissions model.

Criteria pollutant emissions associated with on-road construction vehicles have been calculated by combining the activity information with emissions factors, in grams per mile and grams per idle hour, derived using the CARB EMFAC2007 emissions model.[1] Emissions calculations were based on **Equation 1**. The EMFAC emissions factors are summarized on **Table A-1**, per vehicle type and construction year.

Equation 1

*Emission Rate (tons/year) = EMFAC Emission Factor (gram/mile) * trips per day * miles per trip * days/year * (453.59/2000 tons/gram)*

*Emission Rate (tons/year) = EMFAC Emission Factor (gram/hour) * total idle hours * (453.59/2000 tons/gram)*

[1] CARB EMFAC2007 Emissions Model, http://www.arb.ca.gov/msei/onroad/latest_version.htm.

Table A-1 – Emissions Factors for On-road Vehicles, by Construction Year

Vehicle Type	Pollutant	Idle Emissions Factor (grams/hour)			Running Emissions Factor (grams/mile)		
		2013	2014	2015	2013	2014	2015
Light Truck	ROG	--	--	--	0.06	0.05	0.04
	CO	--	--	--	2.39	2.24	2.09
	NO_X	--	--	--	0.30	0.28	0.25
	SO2	--	--	--	0.004	0.004	0.004
	PM_{10}	--	--	--	0.04	0.04	0.04
	$PM_{2.5}$	--	--	--	0.03	0.03	0.03
Medium Heavy Truck	ROG	6.30	6.31	6.32	0.19	0.17	0.16
	CO	44.24	44.28	44.32	2.13	1.95	1.79
	NO_X	63.23	63.11	62.99	4.58	4.10	3.66
	SO2	0.041	0.041	0.041	0.013	0.013	0.013
	PM_{10}	0.77	0.76	0.74	0.19	0.18	0.17
	$PM_{2.5}$	0.71	0.70	0.69	0.16	0.15	0.14
Employee Vehicle	ROG	--	--	--	0.04	0.04	0.03
	CO	--	--	--	1.69	1.52	1.37
	NO_X	--	--	--	0.15	0.14	0.12
	SO2	--	--	--	0.003	0.001	0.003
	PM_{10}	--	--	--	0.03	0.03	0.03
	$PM_{2.5}$	--	--	--	0.02	0.02	0.02

Notes:
CO = carbon monoxide; NA = not available; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; SO_2 = sulfur dioxide

A.3 Off-Road Construction Equipment

Parameters for off-road construction equipment required for each OAK RSA Improvement Project construction task, including equipment and fuel type, estimated horsepower and estimated annual hours of operation, were also developed. Annual hours of off-road equipment operation were based on materials quantities and production rates required to complete each construction subtask, generally as a result of a ten-hour by seven day work week. This information was applied to criteria pollutant emissions factors, in grams per horsepower-hour, primarily derived using the CARB OFFROAD2007 emissions model.

Because CARB is revisiting some information contained within the OFFROAD model, and has issued a draft database of data updates for select diesel equipment (i.e., the Offroad Emissions Inventory [OEI] Database), the OFFROAD emissions information was appended with the OEI Database information, where necessary and applicable. Equation 2 outlines how off-road construction equipment emissions were computed, and the emissions factors used in this assessment are summarized, by equipment type and construction year, on **Tables A-2** through **A-4**.

Equation 2

*Emission Rate (tons/year) = OFFROAD Emission Factor (gram/hp-hour) * size (hp) * hours of operation * Load Factor * (453.59/2000 tons/gram)*

Table A-2 – 2013 Emissions Factors for Off-Road Equipment (g/hp-hour)

SCC	Description	hp	LF	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$
2270002063	Rubber Tired Dozers	200	0.40	0.75	2.12	6.45	0.01	0.27	0.26
2270002051	Off-Highway Trucks	1200	0.38	0.50	1.52	5.43	0.01	0.16	0.16
2270002036	Excavators	700	0.38	0.42	1.28	3.70	0.01	0.13	0.12
2270002066	Tractors/Loaders/Backhoes	800	0.37	0.38	1.23	3.50	0.01	0.12	0.11
2270003020	Forklifts	350	0.20	0.39	1.12	3.26	0.01	0.11	0.11
2270002048	Graders	180	0.41	0.49	1.43	4.68	0.01	0.16	0.16
2270002015	Rollers	165	0.38	0.65	3.26	5.31	0.01	0.29	0.28
2270002015	Rollers	83	0.38	0.95	3.91	6.02	0.01	0.51	0.50
2270002021	Paving Equipment	121	0.36	1.13	4.13	6.84	0.01	0.60	0.58
2270005035	Sprayers	350	0.50	0.26	1.13	3.84	0.01	0.10	0.10
2270002021	Paving Equipment	600	0.36	0.59	1.75	5.67	0.01	0.22	0.21
2270002024	Surfacing Equipment	500	0.30	0.40	1.65	4.36	0.01	0.15	0.14

Notes:
*Represents equipment which did not change from OFFROAD2007 as a result of applying information contained within the Offroad Emissions Inventory (OEI) Database.
CO = carbon monoxide; g/hp-hour = gallons per horsepower per hour; hp = horsepower; LF = load factor; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; SCC = Source Classification Code; SO_2 = sulfur dioxide

Table A-3 – 2014 Emissions Factors for Off-Road Equipment (g/hp-hour)

SCC	Description	hp	LF	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$
2270002063	Rubber Tired Dozers	200	0.40	0.72	2.03	6.04	0.01	0.25	0.25
2270002051	Off-Highway Trucks	1200	0.38	0.47	1.43	5.07	0.01	0.15	0.15
2270002036	Excavators	700	0.38	0.40	1.24	3.29	0.01	0.11	0.11
2270002066	Tractors/Loaders/Backhoes	800	0.37	0.36	1.19	3.10	0.01	0.10	0.10
2270003020	Forklifts	350	0.20	0.37	1.11	2.87	0.01	0.10	0.10
2270002048	Graders	180	0.41	0.46	1.38	4.24	0.01	0.15	0.14
2270002015	Rollers	165	0.38	0.62	3.25	5.01	0.01	0.27	0.26
2270002015	Rollers	83	0.38	0.89	3.88	5.69	0.01	0.48	0.46
2270002021	Paving Equipment	121	0.36	1.07	4.09	6.51	0.01	0.56	0.54
2270005035	Sprayers	350	0.50	0.23	1.09	3.47	0.01	0.09	0.09
2270002021	Paving Equipment	600	0.36	0.56	1.67	5.26	0.01	0.20	0.19
2270002024	Surfacing Equipment	500	0.30	0.37	1.56	3.98	0.01	0.13	0.13

Notes:
*Represents equipment which did not change from OFFROAD2007 as a result of applying information contained within the Offroad Emissions Inventory (OEI) Database.
CO = carbon monoxide; g/hp-hour = gallons per horsepower per hour; hp = horsepower; LF = load factor; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; SCC = Source Classification Code; SO_2 = sulfur dioxide

Table A-4 – 2015 Emissions Factors for Off-Road Equipment (g/hp-hour)

SCC	Description	hp	LF	ROG	CO	NO_X	SO_2	PM_{10}	$PM_{2.5}$
2270002063	Rubber Tired Dozers	200	0.40	0.68	1.95	5.66	0.01	0.24	0.23
2270002051	Off-Highway Trucks	1200	0.38	0.44	1.35	4.74	0.01	0.14	0.13
2270002036	Excavators	700	0.38	0.39	1.21	2.91	0.01	0.10	0.10
2270002066	Tractors/Loaders/Backhoes	800	0.37	0.35	1.17	2.72	0.01	0.09	0.09
2270003020	Forklifts	350	0.20	0.36	1.10	2.53	0.01	0.09	0.09
2270002048	Graders	180	0.41	0.44	1.34	3.83	0.01	0.13	0.13
2270002015	Rollers	165	0.38	0.58	3.24	4.59	0.01	0.25	0.24
2270002015	Rollers	83	0.38	0.82	3.85	5.29	0.01	0.44	0.42
2270002021	Paving Equipment	121	0.36	1.01	4.06	6.12	0.01	0.52	0.51
2270005035	Sprayers	350	0.50	0.21	1.06	3.15	0.01	0.08	0.08
2270002021	Paving Equipment	600	0.36	0.53	1.60	4.88	0.01	0.18	0.18
2270002024	Surfacing Equipment	500	0.30	0.35	1.48	3.63	0.01	0.12	0.12

Notes:
*Represents equipment which did not change from OFFROAD2007 as a result of applying information contained within the Offroad Emissions Inventory (OEI) Database.
CO = carbon monoxide; g/hp-hour = gallons per horsepower per hour; hp = horsepower; LF = load factor; NO_X = oxides of nitrogen; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ROG = reactive organic gas; SCC = Source Classification Code; SO_2 = sulfur dioxide

A.4 Fugitive Dust

Fugitive dust emissions that may occur due to construction of the OAK RSA Improvement Project were also estimated. Although the URBEMIS model was not used directly in this analysis, it provides emissions factors and parameter assumptions that are representative of activities in the San Francisco Bay Area Air Basin. Specifically, the URBEMIS model provides a worst-case, uncontrolled PM_{10} emissions rate of 38.2 pounds per acre-day for fugitive dust emissions occurring due to travel on unpaved roads, site preparation, grading activities, wind erosion, and other land disturbance activities. The model also indicates that a maximum of 25 percent of the project acreage would likely be disturbed on any given construction day, and that 20 percent of the PM_{10} emissions occur as $PM_{2.5}$. The project acreage was based on the amount of excavation and the amount of asphalt pavement; generally a conservative estimate of the disturbance area. Lastly, URBEMIS includes 61 percent emissions control efficiency for fugitive dust estimates, which reflect Bay Area Air Quality Management District (BAAQMD) basic mitigation measures.

A.5 Asphalt Paving

From the URBEMIS model, an emission factor of 2.62 pounds of ROG per acre of asphalt material was used to estimate emissions from asphalt placement and curing. The construction schedule provided requisite quantities of bituminous surface material, in tons. Equivalent acreage was calculated using a weight of asphalt of 2,111 tons per acre, assuming an eight inch pavement depth, based on data available from the National Asphalt Pavement Association and Federal Aviation Administration Advisory Circular AC 150/5320-6E.

A.6 Construction Schedule

The construction schedule is shown on **Table A-5** and shows construction from 2013 through 2015. Estimated hours of operations and mileage for offroad equipment and onroad vehicles are shown on **Exhibit A-1**

Table A-5 – RSA Program Construction Schedule

Construction Project	Start	End
PROJECT 1 - RWY 11/29 RSA	February 2013	December 2013
PROJECT 2 - RWY 9R/27L RSA	March 2014	October 2014
PROJECT 3 - RWY 9L/27R RSA	March 2015	October 2015

A.7 Construction Emissions Inventory

The annual construction emissions of ROG, CO, NO_X, PM_{10}, and $PM_{2.5}$ are presented, by RSA project and year, in **Table A-6 through A-10**, respectively.

Table A-6 – Construction Reactive Organic Gas Emissions (tons) by Year and RSA

Construction Phase	2013	2014	2015
PROJECT 1 - RWY 11/29 RSA	0.66		
PROJECT 2 - RWY 9R/27L RSA		0.36	0.08
PROJECT 3 - RWY 9L/27R RSA			0.35
Totals	**0.68**	**0.36**	**0.43**

Table A-7 – Construction Carbon Monoxide Emissions (tons) by Year and RSA

Construction Phase	2013	2014	2015
PROJECT 1 - RWY 11/29 RSA	4.21		
PROJECT 2 - RWY 9R/27L RSA		2.34	0.54
PROJECT 3 - RWY 9L/27R RSA			2.10
Totals	**4.21**	**2.34**	**2.65**

Table A-8 – Construction Oxides of Nitrogen Emissions (tons) by Year and RSA

Construction Phase	2013	2014	2015
PROJECT 1 - RWY 11/29 RSA	5.82		
PROJECT 2 - RWY 9R/27L RSA		3.10	0.70
PROJECT 3 - RWY 9L/27R RSA			2.91
Totals	**6.37**	**3.44**	**3.61**

Table A-9 – Construction PM_{10} Emissions (tons) by Year and RSA

Construction Phase	2013	2014	2015
PROJECT 1 - RWY 11/29 RSA	13.6		
PROJECT 2 - RWY 9R/27L RSA		1.49	0.33
PROJECT 3 - RWY 9L/27R RSA			1.74
Totals	**13.6**	**1.49**	**2.07**

Table A-10 – Construction $PM_{2.5}$ Emissions (tons) by Year and RSA

Construction Phase	2013	2014	2015
PROJECT 1 - RWY 11/29 RSA	3.01		
PROJECT 2 - RWY 9R/27L RSA		0.40	0.09
PROJECT 3 - RWY 9L/27R RSA			0.45
Totals	**3.01**	**0.40**	**0.54**

A.8 Greenhouse Gas Emissions Inventory Methodology

GHG emissions of carbon dioxide (CO_2), methane (CH_4) and nitrous oxide (N_2O) expected to occur as a result of construction of the OAK RSA Improvement Project have also been calculated, and converted to carbon dioxide equivalent (CO_2E) emissions. Methodological details relevant to emissions factor selection, emissions calculation for on-road construction vehicles and off-road construction equipment, and conversion of GHG emissions to CO_2E are discussed below.

Emission Factors

The BAAQMD GHG Model (BGM) incorporates fuel-based emissions factors for gasoline and diesel fuel adapted from the California Climate Registry *General Reporting Protocol.* Although BGM was not used to calculate GHG emissions for this assessment, the emission factors contained within the model were used and are summarized on **Table A-10**.

Table A-10 – Greenhouse Gas Emissions Factors (kilogram/gallon of fuel)

	CO_2	CH_4	N_2O
Gasoline	8.81	0.0005	0.00022
Diesel	10.15	0.00058	0.00026

Notes:
CH_4 = methane; CO_2 = carbon dioxide; N_2O = nitrous oxide

On-road Construction Vehicles

To estimate on-road vehicle fuel consumption, VMT information provided within or derived from the anticipated construction schedule were coupled with fuel economies, in miles per gallon, obtained from the EMFAC2007 model. GHG emissions factors represented on **Table A-10** were applied to the fuel consumption calculations according to **Equation 3**. **Table A-11** lists the fuel economies used in the analysis, per vehicle type, fuel type, and construction year.

Equation 3

CO_2 *Emissions = Fuel Usage (gallons) ** CO_2 *Emissions Factor (kilograms/gallon) * 0.001 metric tons per kilogram*

CH_4 *Emissions = Fuel Usage (gallons) ** CH_4 *Emissions Factor (kilograms/gallon) * 0.001 metric tons per kilogram*

N_2O *Emissions = Fuel Usage (gallons) ** N_2O *Emissions Factor (kilograms/gallon) * 0.001 metric tons per kilogram*

Table A-11 – On-road Vehicle Fuel Economies (miles/gallon)

Vehicle Type	2013	2014	2015
Light Truck	28.8	28.8	28.9
Heavy Truck	6.70	6.70	6.70
Employee Vehicle	28.5	28.6	28.7

Off-Road Construction Equipment

Brake-specific fuel consumption (BSFC) values, in pounds (of fuel) per horsepower-hour (lbs/hp-hr), are available within the OFFROAD2007 model and are appended for select diesel equipment in the OEI database recently released by CARB. BSFC varies by equipment type, fuel type and horsepower. These values were converted to a fuel flow rate, in gallons per horsepower-hour, according to **Equations 4 and 5**.

Equation 4

Gasoline Fuel Flow (gallons/hp-hr) = BSFC (lbs/hp-hr)/6.17/Load Factor
where:
6.17 = assumed density of gasoline fuel in lbs/gallon

Equation 5

Diesel Fuel Flow (gallons/hp-hr) = BSFC (lbs/hp-hr)/7.0/LF
where:
7.0 = assumed density of diesel fuel in lbs/gallon

Parameters for off-road construction equipment required for each OAK RSA Improvement Project construction subtask, including equipment and fuel type, estimated horsepower and estimated annual hours of operation, were developed in the construction schedule. Annual hours of off-road equipment operation were based on materials quantities and production rates required to complete each subtask, generally as a result of a ten-hour by seven day work week. Fuel flow rates described previously were coupled with equipment horsepower and hours of operation documented in the construction schedule to determine the equivalent fuel usage, by equipment and fuel type. These values were then applied to fuel based emissions factors recommended by the California Climate Registry as reported on **Table B-10**. The calculation steps for this process are outlined in **Equations 6 and 7**. Fuel flows used for off-road equipment are summarized on **Table A-12**.

Equation 6

*Fuel Usage (gallons) = Fuel Flow (gallons/hp-hr) * Operating Hours * Equipment Horsepower * Load Factor*

Equation 7

*CO_2 Emissions = Fuel Usage (gallons) * CO_2 Emissions Factor (kilograms/gallon) * 0.001 metric tons per kilogram*

*CH_4 Emissions = Fuel Usage (gallons) * CH_4 Emissions Factor (kilograms/gallon) * 0.001 metric tons per kilogram*

*N_2O Emissions = Fuel Usage (gallons) * N_2O Emissions Factor (kilograms/gallon) * 0.001 metric tons per kilogram*

Table A-12 – Fuel Flow Rates for Off-Road Equipment (g/hp-hr)[1]

SCC	Description	hp	LF	Fuel Flow
2270002063	Rubber Tired Dozers	200	0.40	0.1308
2270002051	Off-Highway Trucks	1200	0.38	0.1353
2270002036	Excavators	700	0.38	0.1353
2270002066	Tractors/Loaders/Backhoes	800	0.37	0.1403
2270003020	Forklifts	350	0.20	0.2572
2270002048	Graders	180	0.41	0.1265
2270002015	Rollers	165	0.38	0.1378
2270002015	Rollers	83	0.38	0.1378
2270002021	Paving Equipment	121	0.36	0.1456
2270005035	Sprayers	350	0.50	0.1155
2270002021	Paving Equipment	600	0.36	0.1456
2270002024	Surfacing Equipment	500	0.30	0.1714

Notes:
*Represents equipment which did not change from OFFROAD2007 as a result of applying information contained within the Offroad Emissions Inventory (OEI) Database.
g/hp-hour = gallon per horsepower per hour; hp = horsepower; LF = Load Factor; SCC = Source Classification Code

Conversion to Carbon Dioxide Equivalents

Individual GHG emissions of CO_2, CH_4 and N_2O were converted to CO_2E following the formula below (**Equation 8**), using global warming potentials contained within the Intergovernmental Panel on Climate Change's Fourth Assessment Report. GWP define how potent a GHG is as a climate warming agent relative to the potency of CO_2, and for this analysis correspond to 1 for CO_2, 25 for CH_4 and 298 for N_2O.

Equation 8

*CO_2E (metric tons) = [CO_2 emissions (metric tons) * 1] + [CH_4 emissions (metric tons) * 25] + [N_2O emissions (metric tons) *298]*

Exhibit A-1 – RSA Program Construction Usage

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES					TOTAL ACTIVE HOURS	TOTAL IDLE HOURS	NOTES
Resource		Horsepower (OFF ROAD)	Vehicle Miles (ON-ROAD)	Mileage Notes			
Bull Dozer		200			980	N/A	OFF ROAD
Ready-Mix Concrete Truck			33,100	Assumed 35mph during active hours	946	89	Assumed 45 min idle time per 8 hr day
Concrete Paving Machine		600			111	N/A	OFF ROAD
Dump Truck - Off-Road - 22 CY		1,200			920	N/A	OFF ROAD
Dump Truck 5 Ton - Street Legal		N/A	33,526	Assumed 35mph during active hours	958	90	Assumed 45 min idle time per 8 hr day
Dump Truck 28 CY - Street Legal		N/A	0	Assumed 35mph during active hours	0	0	Assumed 45 min idle time per 8 hr day
Excavator - Track-Mounted - 10 CY Bucket		700			4,095	N/A	OFF ROAD
Front End Loader - 11 CY Bucket		800			1,773	N/A	OFF ROAD
Fork Lift		350			224	N/A	OFF ROAD
Motor Grader		180			789	N/A	OFF ROAD
Roller - Sheepsfoot		165			1,207	N/A	OFF ROAD
Roller - Steel Wheel		83			1,177	N/A	OFF ROAD
Roller - Vibratory		165			1,177	N/A	OFF ROAD
Rubber Tire Asphalt Paving Machine		121			666	N/A	OFF ROAD
Hydro-Seed Sprayer		N/A	19,915	Assumed 45mph during active hours	443	41	Assumed 45 min idle time per 8 hr day
Soil Mixer		350			470	N/A	OFF ROAD
Milling Machine		500			524	N/A	OFF ROAD
Tractor-Trailer - Low Boy		N/A	12,299	Assumed 45mph during active hours	273	26	Assumed 45 min idle time per 8 hr day
Work Truck (F350)		N/A	918,612	Assumed 30mph during active hours	30,620	15,310	Assumed 240 min idle time per 8 hr day
Water Truck - 5,000 Gal		N/A	35,299	Assumed 30mph during active hours	1,177	110	Assumed 45 min idle time per 8 hr day
					48,529	15,666	

PROJECT 1 - RWY 11/29 (with associated RSA, Rwy Extension, and New Taxiways)

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES					TOTAL ACTIVE HOURS	TOTAL IDLE HOURS	NOTES
Resource		Horsepower (OFF ROAD)	Vehicle Miles (ON-ROAD)	Mileage Notes			
Bull Dozer	Hours of Op	200			319	N/A	OFF ROAD
Ready-Mix Concrete Truck	Hours of Op		31,000	Assumed 35mph during active hours	886	83	Assumed 45 min idle time per 8 hr day
Concrete Paving Machine		600			111	N/A	OFF ROAD
Dump Truck - Off-Road - 22 CY	Hours of Op	1,200			319	N/A	OFF ROAD
Dump Truck 5 Ton - Street Legal	Hours of Op	N/A	27,632	Assumed 35mph during active hours	789	74	Assumed 45 min idle time per 8 hr day
Dump Truck 28 CY - Street Legal	Hours of Op	N/A	0	Assumed 35mph during active hours	0	0	Assumed 45 min idle time per 8 hr day
Excavator - Track-Mounted - 10 CY Bucket	Hours of Op	700			1,385	N/A	OFF ROAD
Front End Loader - 11 CY Bucket	Hours of Op	800			945	N/A	OFF ROAD
Fork Lift	Hours of Op	350			0	N/A	OFF ROAD
Motor Grader	Hours of Op	180			280	N/A	OFF ROAD
Roller - Sheepsfoot	Hours of Op	165			646	N/A	OFF ROAD
Roller - Steel Wheel	Hours of Op	83			646	N/A	OFF ROAD
Roller - Vibratory	Hours of Op	165			646	N/A	OFF ROAD
Rubber Tire Asphalt Paving Machine	Hours of Op	121			450	N/A	OFF ROAD
Hydro-Seed Sprayer	Hours of Op	N/A	7,650	Assumed 45mph during active hours	170	16	Assumed 45 min idle time per 8 hr day
Soil Mixer	Hours of Op	350			102	N/A	OFF ROAD
Milling Machine		500			376	N/A	OFF ROAD
Tractor-Trailer - Low Boy	Hours of Op	N/A	4,413	Assumed 45mph during active hours	98	9	Assumed 45 min idle time per 8 hr day
Work Truck (F350)	Hours of Op	N/A	610,470	Assumed 45mph during active hours	13,566	6,783	Assumed 240 min idle time per 8 hr day
Water Truck - 5,000 Gal	Hours of Op	N/A	19,385	Assumed 30mph during active hours	646	61	Assumed 45 min idle time per 8 hr day

PROJECT 2 - RWY 9R/27L (with associated RSA and EMAS)

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES					TOTAL ACTIVE HOURS	TOTAL IDLE HOURS	NOTES
Resource		Horsepower (OFF ROAD)	Vehicle Miles (ON-ROAD)	Mileage Notes			
Bull Dozer	Hours of Op	200			386	N/A	OFF ROAD
Ready-Mix Concrete Truck	Hours of Op		2,100	Assumed 35mph during active hours	60	6	Assumed 45 min idle time per 8 hr day
Concrete Paving Machine		600			0	N/A	OFF ROAD
Dump Truck - Off-Road - 22 CY	Hours of Op	1,200			326	N/A	OFF ROAD
Dump Truck 5 Ton - Street Legal	Hours of Op	N/A	2,947	Assumed 35mph during active hours	84	8	Assumed 45 min idle time per 8 hr day
Dump Truck 28 CY - Street Legal	Hours of Op	N/A	0	Assumed 35mph during active hours	0	0	Assumed 45 min idle time per 8 hr day
Excavator - Track-Mounted - 10 CY Bucket	Hours of Op	700			1,475	N/A	OFF ROAD
Front End Loader - 11 CY Bucket	Hours of Op	800			440	N/A	OFF ROAD
Fork Lift	Hours of Op	350			131	N/A	OFF ROAD
Motor Grader	Hours of Op	180			304	N/A	OFF ROAD
Roller - Sheepsfoot	Hours of Op	165			297	N/A	OFF ROAD
Roller - Steel Wheel	Hours of Op	83			267	N/A	OFF ROAD
Roller - Vibratory	Hours of Op	165			267	N/A	OFF ROAD
Rubber Tire Asphalt Paving Machine	Hours of Op	121			96	N/A	OFF ROAD
Hydro-Seed Sprayer	Hours of Op	N/A	6,660	Assumed 45mph during active hours	148	14	Assumed 45 min idle time per 8 hr day
Soil Mixer	Hours of Op	350			200	N/A	OFF ROAD
Milling Machine		500			80	N/A	OFF ROAD
Tractor-Trailer - Low Boy	Hours of Op	N/A	4,652	Assumed 45mph during active hours	103	10	Assumed 45 min idle time per 8 hr day
Work Truck (F350)	Hours of Op	N/A	460,044	Assumed 45mph during active hours	10,223	5,112	Assumed 240 min idle time per 8 hr day
Water Truck - 5,000 Gal	Hours of Op	N/A	8,003	Assumed 30mph during active hours	267	25	Assumed 45 min idle time per 8 hr day

PROJECT 3 - RWY 9L/27R (with associated RSA)

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES					TOTAL ACTIVE HOURS	TOTAL IDLE HOURS	NOTES
Resource		Horsepower (OFF ROAD)	Vehicle Miles (ON-ROAD)	Mileage Notes			
Bull Dozer	Hours of Op	200			275	N/A	OFF ROAD
Ready-Mix Concrete Truck	Hours of Op		0	Assumed 35mph during active hours	0	0	Assumed 45 min idle time per 8 hr day
Concrete Paving Machine		600			0	N/A	OFF ROAD
Dump Truck - Off-Road - 22 CY	Hours of Op	1,200			275	N/A	OFF ROAD
Dump Truck 5 Ton - Street Legal	Hours of Op	N/A	2,947	Assumed 35mph during active hours	84	8	Assumed 45 min idle time per 8 hr day
Dump Truck 28 CY - Street Legal	Hours of Op	N/A	0	Assumed 35mph during active hours	0	0	Assumed 45 min idle time per 8 hr day
Excavator - Track-Mounted - 10 CY Bucket	Hours of Op	700			1,234	N/A	OFF ROAD
Front End Loader - 11 CY Bucket	Hours of Op	800			388	N/A	OFF ROAD
Fork Lift	Hours of Op	350			93	N/A	OFF ROAD
Motor Grader	Hours of Op	180			205	N/A	OFF ROAD
Roller - Sheepsfoot	Hours of Op	165			264	N/A	OFF ROAD
Roller - Steel Wheel	Hours of Op	83			264	N/A	OFF ROAD
Roller - Vibratory	Hours of Op	165			264	N/A	OFF ROAD
Rubber Tire Asphalt Paving Machine	Hours of Op	121			120	N/A	OFF ROAD
Hydro-Seed Sprayer	Hours of Op	N/A	5,605	Assumed 45mph during active hours	125	12	Assumed 45 min idle time per 8 hr day
Soil Mixer	Hours of Op	350			168	N/A	OFF ROAD
Milling Machine		500			68	N/A	OFF ROAD
Tractor-Trailer - Low Boy	Hours of Op	N/A	3,234	Assumed 45mph during active hours	72	7	Assumed 45 min idle time per 8 hr day
Work Truck (F350)	Hours of Op	N/A	307,404	Assumed 45mph during active hours	6,831	3,416	Assumed 240 min idle time per 8 hr day
Water Truck - 5,000 Gal	Hours of Op	N/A	7,912	Assumed 30mph during active hours	264	25	Assumed 45 min idle time per 8 hr day

SOUTH FIELD

PROJECT 1 - RWY 11/29 (with associated RSA, Rwy Extension, and New Taxiways)		
Demolition	SY	94,000
Soil Improvement		
Excavation	SY	255,000
Stockpile	SY	255,000
Backfill/Compact	SY	255,000
Paving-Asphalt	TON	45,000
Paving-Concrete	SY	38,750
Painting	DAYS	5
Electrical/NAVAIDS	DAYS	65
Supervision	DAYS	258

NORTH FIELD

PROJECT 2 - RWY 9R/27L (with associated RSA and EMAS)		
Demolition	SY	17,000
Soil Improvement		
Excavation	SY	222,000
Stockpile	SY	222,000
Backfill/Compact	SY	222,000
Paving-Asphalt	TON	4,800
Paving-Concrete	SY	-
Painting	DAYS	5
Electrical/NAVAIDS	DAYS	49
Supervision	DAYS	194
EMAS Excavation	SY	3,000
EMAS Bed Prep	SY	3,000
Deliver EMAS Blocks	SY	3,000
Install EMAS	SY	3,000

PROJECT 3 - RWY 9L/27R (with associated RSA)		
Demolition	SY	17,000
Soil Improvement		
Excavation	SY	186,835
Stockpile	SY	186,835
Backfill/Compact	SY	186,835
Paving-Asphalt	TON	4,800
Paving-Concrete	SY	-
Painting	DAYS	5
Electrical/NAVAIDS	DAYS	32
Supervision	DAYS	129

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES		PROJECT 1 - RWY 11/29 (with associated RSA)																											TOTAL PROJECT 1 HOURS
Resource		Demolition			Excavation			Stockpile			Backfill/Compact			Paving Asphalt			Paving Concrete			Painting			Electrical/NAVAIDS			Supervision			
	QUANTITY	24,000	RATE		200,000	RATE		200,000	RATE		200,000	RATE		40,000	RATE		38,750	RATE		5	RATE		63	RATE		258	RATE		
	UNITS	SY			SY			SY			SY			TON			SY			DAYS			DAYS			DAYS			
Bull Dozer	Hours of Op										319	800	SY/HR																319
Ready Mix Concrete Truck	Hours of Op																880	44	SY/HR										880
Concrete Paving Machine	Hours of Op																111	350	SY/HR										111
Dump Truck - Off Road - 22 CY	Hours of Op										319	800	SY/HR																319
Dump Truck 5 Ton - Street Legal	Hours of Op													702	57	TON/HR													702
Dump Truck 20 CY - Street Legal	Hours of Op																												0
Excavator - Track Mounted - 10 CY Bucket	Hours of Op	607	150	SY/HR	319	800	SY/HR	440	560	SY/HR																			1,366
Front End Loader - 11 CY Bucket	Hours of Op	607	150	SY/HR							319	800	SY/HR																926
Fork Lift	Hours of Op																												0
Motor Grader	Hours of Op										390	810	SY/HR																390
Roller - Sheepsfoot	Hours of Op										198	1,300	SY/HR	450	100	TON/HR													648
Roller - Steel Wheel	Hours of Op										198	1,300	SY/HR	450	100	TON/HR													648
Roller - Vibratory	Hours of Op										198	1,300	SY/HR	450	100	TON/HR													648
Rubber Tire Asphalt Paving Machine	Hours of Op													450	100	TON/HR													450
Hydro Seed Sprayer	Hours of Op										170	1,200	SY/HR																170
Soil Mixer	Hours of Op										100	2,000	SY/HR																100
Milling Machine	Hours of Op	276	350	SY/HR																									276
Tractor Trailer - Low Boy	Hours of Op										96	2,000	SY/HR																96
Work Truck (F250)	Hours of Op													20	1,800	TON/HR				120	24	Veh HR/DAY	3,024	48	Veh HR/DAY	10,320	40	Veh HR/DAY	13,484
Water Truck - 5,000 Gal	Hours of Op										198	1,300	SY/HR	450	100	TON/HR													648
																													22,397

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES		PROJECT 2 - RWY 9R/27L (with associated RSA and EMAS)																																					TOTAL PROJECT 2 HOURS
Resource		Demolition			Excavation			Stockpile			Backfill/Compact			Paving Asphalt			Paving Concrete			Painting			Electrical/NAVAIDS			Supervision			EMAS Excavation			EMAS Bed Prep			Deliver EMAS Blocks			Install EMAS			
	QUANTITY	17,000	RATE		222,000	RATE		222,000	RATE		222,000	RATE		4,800	RATE		0	RATE		5	RATE		48	RATE		184	RATE		3,000	RATE		3,000	RATE		3,000	RATE		3,000	RATE		
	UNITS	SY			SY			SY			SY			TON			SY			DAYS			DAYS			DAYS			SY			SY			SY			SY			
Bull Dozer	Hours of Op										326	680	SY/HR																60	50	SY/HR										386
Ready Mix Concrete Truck	Hours of Op																																		60	50	SY/HR				60
Ready Mix Concrete Truck	Hours of Op																																								0
Dump Truck - Off Road - 22 CY	Hours of Op										326	680	SY/HR																												326
Dump Truck 5 Ton - Street Legal	Hours of Op													84	57	TON/HR																									84
Dump Truck 20 CY - Street Legal	Hours of Op																																								0
Excavator - Track Mounted - 10 CY Bucket	Hours of Op	113	150	SY/HR	888	250	SY/HR	444	500	SY/HR																			30	100	SY/HR										1,475
Front End Loader - 11 CY Bucket	Hours of Op	113	150	SY/HR							326	680	SY/HR																												440
Fork Lift	Hours of Op				111	2,000	SY/HR																												20	150	SY/HR				131
Motor Grader	Hours of Op										244	910	SY/HR																			60	50	SY/HR							304
Roller - Sheepsfoot	Hours of Op										171	1,300	SY/HR	96	50	TON/HR																30	100	SY/HR							297
Roller - Steel Wheel	Hours of Op										171	1,300	SY/HR	96	50	TON/HR																									267
Roller - Vibratory	Hours of Op										171	1,300	SY/HR	96	50	TON/HR																									267
Rubber Tire Asphalt Paving Machine	Hours of Op													96	50	TON/HR																									96
Hydro Seed Sprayer	Hours of Op										148	1,500	SY/HR																												148
Soil Mixer	Hours of Op				111	2,000	SY/HR				89	2,500	SY/HR																												200
Milling Machine	Hours of Op	68	250	SY/HR																															12	250	SY/HR				80
Tractor Trailer - Low Boy	Hours of Op										85	2,600	SY/HR																						12	250	SY/HR	6	500	SY/HR	103
Work Truck (F250)	Hours of Op													3	1,800	TON/HR				120	24	Veh HR/DAY	2,304	48	Veh HR/DAY	7,360	40	Veh HR/DAY										12	250	SY/HR	10,335
Water Truck - 5,000 Gal	Hours of Op										171	1,300	SY/HR	96	50	TON/HR																									267
																																							18,190

OAKLAND INTERNATIONAL AIRPORT RSA UPGRADES		PROJECT 3 - RWY 9L/27R (with associated RSA)																											TOTAL PROJECT 3 HOURS
Resource		Demolition			Excavation			Stockpile			Backfill/Compact			Paving Asphalt			Paving Concrete			Painting			Electrical/NAVAIDS			Supervision			
	QUANTITY	17,000	RATE		186,635	RATE		186,635	RATE		186,635	RATE		4,800	RATE		0	RATE		5	RATE		32	RATE		129	RATE		
	UNITS	SY			SY			SY			SY			TON			SY			DAYS			DAYS			DAYS			
Bull Dozer	Hours of Op										275	680	SY/HR																275
Ready Mix Concrete Truck	Hours of Op																												0
Ready Mix Concrete Truck	Hours of Op																												0
Dump Truck - Off Road - 22 CY	Hours of Op										275	680	SY/HR																275
Dump Truck 5 Ton - Street Legal	Hours of Op													84	57	TON/HR													84
Dump Truck 20 CY - Street Legal	Hours of Op																												0
Excavator - Track Mounted - 10 CY Bucket	Hours of Op	113	150	SY/HR	747	250	SY/HR	374	500	SY/HR																			1,234
Front End Loader - 11 CY Bucket	Hours of Op	113	150	SY/HR							275	680	SY/HR																388
Fork Lift	Hours of Op				93	2,000	SY/HR																						93
Motor Grader	Hours of Op										205	910	SY/HR																205
Roller - Sheepsfoot	Hours of Op										144	1,300	SY/HR	120	40	TON/HR													264
Roller - Steel Wheel	Hours of Op										144	1,300	SY/HR	120	40	TON/HR													264
Roller - Vibratory	Hours of Op										144	1,300	SY/HR	120	40	TON/HR													264
Rubber Tire Asphalt Paving Machine	Hours of Op													120	40	TON/HR													120
Hydro Seed Sprayer	Hours of Op										124	1,500	SY/HR																124
Soil Mixer	Hours of Op				93	2,000	SY/HR				75	2,500	SY/HR																168
Milling Machine	Hours of Op	68	250	SY/HR																									68
Tractor Trailer - Low Boy	Hours of Op										72	2,600	SY/HR																72
Work Truck (F250)	Hours of Op													3	1,800	TON/HR				120	24	Veh HR/DAY	1,536	48	Veh HR/DAY	5,160	40	Veh HR/DAY	6,819
Water Truck - 5,000 Gal	Hours of Op										144	1,300	SY/HR	120	40	TON/HR													264
																													10,864

Attachment B
Health Risk Assessment

A health risk assessment (HRA) is accomplished in four steps: hazards identification, exposure assessment, toxicity assessment, and risk characterization. This attachment describes the methodologies and assumptions used to execute each step of the HRA for the Oakland International Airport (OAK) Runway Safety Area (RSA) Program.

B.1 Terms and Definitions

As the practice of conducting a HRA is particularly complex and involves concepts that are not altogether familiar to most people, several terms and definitions are included that are considered essential to the understanding of the approach, methodology and results.

Acute effect – a health effect (non-cancer) produced within a short period of time (a few minutes to several days) following an exposure to toxic air contaminants (TAC).

Cancer risk – the probability of an individual getting cancer from a lifetime (i.e., 70-year lifetime) exposure to TACs in the ambient air.

Chronic effect – a health effect (non-cancer) produced from a continuous exposure occurring over an extended period of time (weeks, months, years).

Hazard Index (HI) – the unitless ratio of an exposure level in excess of the acceptable reference concentration (RfC). The HI can be applied to multiple compounds in an additive manner.

Hazard Quotient (HQ) – the unitless ratio of an exposure level in excess of the acceptable RfC. The HQ is applied to individual compounds.

Toxic air contaminants – any air pollutant that is capable of causing short-term (acute) and/or long-term (chronic or carcinogenic, i.e., cancer causing) adverse human health effects (i.e., injury or illness). The current California list of TACs lists approximately 200 compounds, including particulate emissions from diesel-fueled engines.

Human Health Effects – comprise disorders such as eye watering, respiratory or heart ailments, and other (i.e., non-cancer) related diseases.

Health Risk Assessment – an analysis designed to predict the generation and dispersion of TACs in the outdoor environment, evaluate the potential for exposure of human populations, and to assess and quantify both the individual and population-wide health risks associated with those levels of exposure.

Incremental – under CEQA, the net difference (or change) in conditions or impacts when comparing the baseline to future year project conditions.

Maximum exposed individual – an individual assumed to be located at the point where the highest concentrations of TACs, and therefore, health risks are predicted to occur.

Non-cancer risks – health risks such as eye watering, respiratory or heart ailments, and other non-cancer related diseases.

Receptors – the locations where potential health impacts or risks are predicted (schools, residences).

B.2 Hazards Identification

TAC emissions associated with the OAK RSA Improvement Project would occur from off-road equipment and haul trucks during construction activities. Diesel exhaust is a complex mixture of numerous individual gaseous and particulate compounds emitted from diesel-fueled combustion engines. Diesel particulate matter (DPM) is formed primarily through the incomplete combustion of diesel fuel. DPM is removed from the atmosphere through physical processes including atmospheric fall-out and washout by rain. Humans can be exposed to airborne DPM by deposition on water, soil, and vegetation; although the main pathway of exposure is inhalation.

In August 1998, the California Air Resource Board (CARB) identified DPM as a TAC. CARB developed the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel- Fueled Engines and Vehicles and Risk Management Guidance for the Permitting of New Stationary Diesel-Fueled Engines* and approved these documents on September 28, 2000. The documents represent proposals to reduce DPM emissions, with the goal of reducing emissions and the associated health risk by 75 percent in 2010 and by 85 percent in 2020. The program aimed to require the use of state-of-the-art catalyzed DPM filters and ultra-low-sulfur diesel fuel.

B.3 Exposure Assessment

Dispersion is the process by which atmospheric pollutants disseminate due to wind and the vertical instability of the atmosphere. The results of a dispersion analysis are used to assess pollutant concentrations at or near an emission source. The results of this analysis allow predicted concentrations of pollutants to be compared directly to air quality standards and other criteria such as health risks.

Dispersion Modeling Approach

This section presents the methodology used for the dispersion modeling analysis. This section addresses all of the fundamental components of an air dispersion modeling analysis including:

- Model selection and options
- Receptor locations
- Meteorological data
- Source release characteristics

Model Selection and Options

The AERMOD dispersion model (Version 11103) was used for the modeling analysis. AERMOD is the U.S. Environmental Protection Agency (U.S. EPA) preferred dispersion model for general industrial sources. The model can simulate point, area, volume, and line sources. The AERMOD model is the appropriate model for this analysis based on the coverage of simple, intermediate, and complex terrain. It also predicts both short-term and long-term (annual) average concentrations. The model was executed using the regulatory default options (stack-tip downwash, buoyancy-induced dispersion, and final plume rise), default wind speed profile categories, default potential temperature gradients, and no pollutant decay.

The selection of the appropriate dispersion coefficients depends on land use within three kilometers (km) of the project site. The land use type was based on the classification method defined by Auer (1978); using U.S. Geological Survey (USGS) 1:24,000 scale (7.5 minute) topographic maps of the area. If the Auer land use types of heavy industrial, light-to-moderate industrial, commercial, and compact residential account for 50 percent or more of the total area, the U.S. EPA *Guideline on Air Quality Models* recommends using urban dispersion coefficients; otherwise, the appropriate rural coefficients are to be used. Based on observation of the area surrounding the project site, rural dispersion coefficients were applied in the analysis (urban is only designated within dense city centers such as downtown Oakland and rural coefficients tend to estimate higher concentrations than urban coefficients).

Receptor Locations

Sensitive receptors such as residences near the project were chosen as the receptors to be analyzed. Receptors were placed at a height of 1.8 meters (typical breathing height) for adult receptors and at a height of 1.3 meters for children receptors. Residential[1] and school receptors are located to the north and east of the project; both within 1,000 feet of the project.

Terrain elevations for receptor locations were used (i.e., complex terrain) based on available USGS Digital Elevation Model (DEM) for the area. AERMAP (Version 11103) was used to develop the terrain elevations.

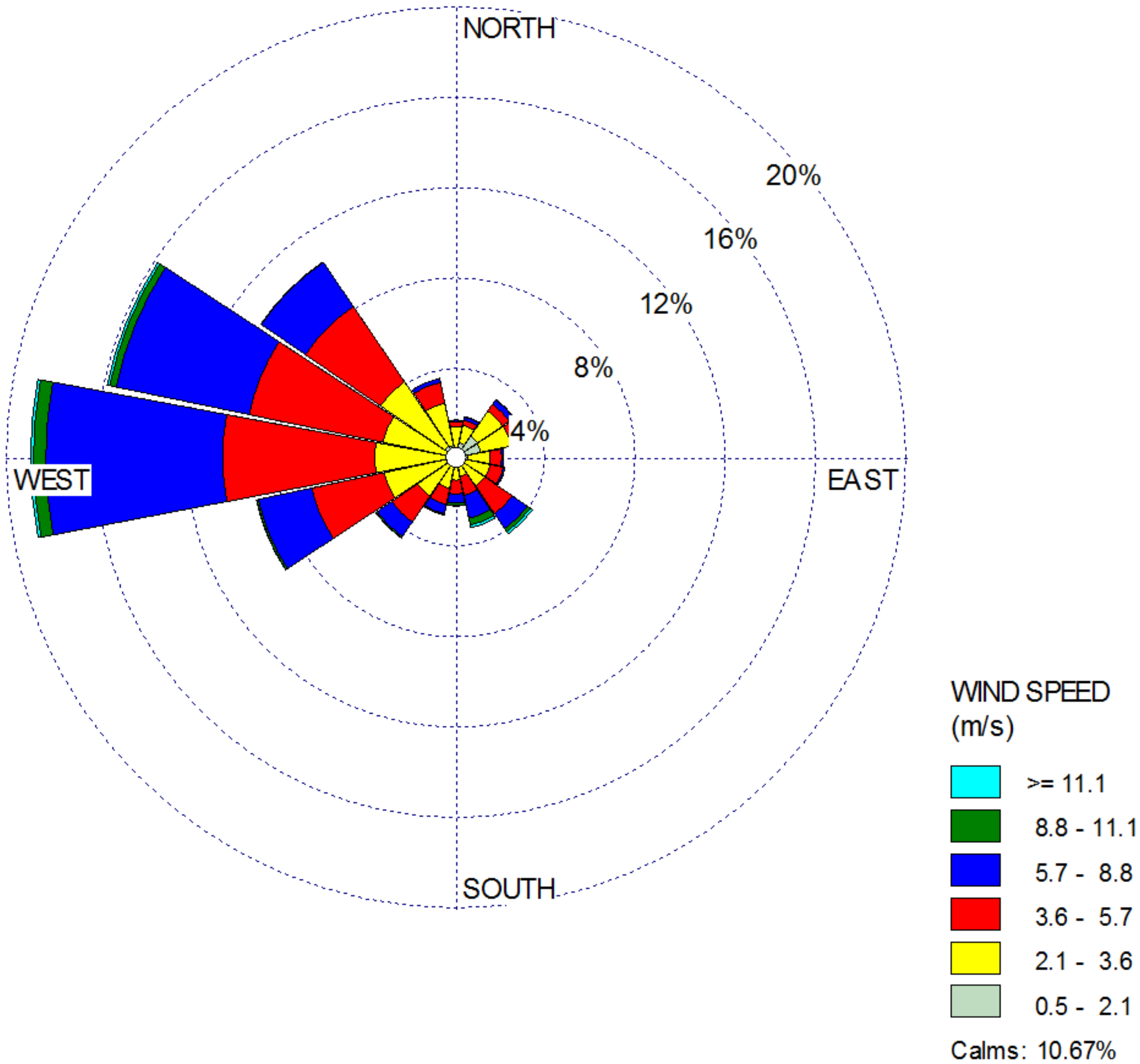
Meteorological Data

Air quality is a function of both the rate and location of pollutant emissions under the influence of meteorological conditions and topographic features affecting pollutant movement and dispersal. Atmospheric conditions such as wind speed, wind direction, atmospheric stability, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants, and consequently affect air quality.

Hourly meteorological data (both surface and upper air) from OAK were used in the dispersion modeling analysis. The data from 2002 through 2006 were used. Wind directions are predominately from the west and there is a high frequency of calm and low wind conditions. **Exhibit B-1** shows the windrose for OAK. Of note, a majority of the wind flow is from the west to the east.

[1] Existing off-site residence(s) (e.g., house or apartment).

EXHIBIT B-1
WINDROSE FOR OAKLAND INTERNATIONAL AIRPORT



Source Release Characteristics

Construction equipment was treated as separate area sources located within the North and South Fields. The release height of the off-road equipment exhaust was 3.05 meters. Haul trucks were treated as a line source (i.e., volume sources placed at regular intervals) located along U.S. Highway 61 (U.S. 61). The haul trucks were assigned a release height of 3.05 meters and an initial vertical dimension of 4.15 meters, which accounts for dispersion from the movement of vehicles.

Terrain elevations for emission source locations were used (i.e., complex terrain) based on available USGS DEM for the area. AERMAP was used to develop the terrain elevations, although the project site is generally flat.

Emission Estimates

Attachment A provides detailed assumptions and methodologies for the construction emissions inventory. To accurately access the annual concentration of DPM emissions from the project, a series of operational profiles were developed. Operational (or temporal) factors are used to describe the relationship of one period of time to another period of time (i.e., the relationship of the activity during 1 hour to the activity during a 24-hour period). In AERMOD, temporal factors (unitless) are applied to represent varying levels of activity as a fraction of a peak hour, peak daily, and peak monthly. The use of temporal factors gives the model the ability to more accurately reflect changes in activity through the year.

Construction activity would typically occur for 10 hours per day, 7 days per week for all construction activity areas. The construction activity was segregated by construction year (2013, 2014, and 2015) as the monthly activity pattern is different. **Table B-1** presents the project tasks by month and year.

Table B-1
Monthly Profile by Year – Offroad Equipment

	2013	2014	2015
January	-	-	-
February	RW 11/29	-	-
March	RW 11/29	RW 9R/27L	RW 9L/27R
April	RW 11/29	RW 9R/27L	RW 9L/27R
May	RW 11/29	RW 9R/27L	RW 9L/27R
June	RW 11/29	RW 9R/27L	RW 9L/27R
July	RW 11/29	RW 9R/27L	RW 9L/27R
August	RW 11/29	RW 9R/27L	RW 9L/27R
September	RW 11/29	RW 9R/27L	RW 9L/27R
October	RW 11/29	RW 9R/27L	RW 9L/27R
November	RW 11/29	-	-
December	RW 11/29	-	-

B.4 Toxicity Assessment

The HRA was conducted following methodologies in the BAAQMD *CEQA Air Quality Guidelines*, *Health Risk Screening Analysis Guidelines* (dated June 2005), and in the California Office of Environmental Health Hazard Assessment (OEHHA) guidelines (dated August 2003). This assessment was accomplished by applying the highest estimated concentrations at the receptors analyzed to the established cancer risk estimates and acceptable RfCs for non-cancer health effects.

The toxicity values used in this analysis were based on OEHHA guidance. These toxicity values are for carcinogenic effects and chronic health impacts. The primary pathway for exposures was assumed to be inhalation and carcinogenic and non-carcinogenic effects were evaluated separately. The incremental risks were determined for these sources of TACs as described above and summed to obtain an estimated total incremental carcinogenic health risk.

The 80th percentile adult breathing rate of 302 liters per kilogram of body weight per day (L/kg-day) was used to determine cancer risks to adult residents from exposure to TACs. The residential exposure frequency was assumed to be 350 days per year.

For children, OEHHA recommends assuming a breathing rate of 581 L/kg-day to assess potential risk via the inhalation exposure pathway. This value represents the upper 95th percentile of daily breathing rates for children. The modeled TAC concentrations were used to represent the exposure concentrations in the air. The inhalation absorption factor was assumed to be 1. For children at school sites, exposure is assumed to occur 10 hours per day for 180 days (or 36 weeks) per year.

Cancer risk estimates also incorporate age sensitivity factors (ASFs). This approach provides updated calculation procedures that factor in the increased susceptibility of infants and children to carcinogens as compared to adults. OEHHA recommends that cancer risks be weighted by a factor of 10 for exposures that occur from the third trimester of pregnancy to 2 years of age, and by a factor of 3 for exposures from 2 years through 15 years of age. For estimating cancer risks for residential receptors over a 70-year lifetime, the incorporation of the ASFs results in a cancer risk adjustment factor (CRAF) of 1.7. The exposure duration would be 3 years, given the duration of the construction period.

Table B-3 provides a summary of the risk assessment parameters used in the analysis.

Table B-3
Risk Assessment Parameters

Receptor	Breathing Rate (DBR)	Absorption Factor	Cancer Risk Adjustment Factor (CRAF)	Exposure Frequency (EF)	Exposure Duration (ED)
Adult-Residence	302	1	1.7	350 days	3 years
Child-Residence	581	1	10	350 days	3 years
Child-School	581	1	3	180 days	3 years

B.5 Risk Characterization

For the cancer risk assessment, emission rates were determined based on the average emission rate over the 70-year lifetime (i.e., the project emission rate divided by 70 years). However, for the chronic and acute health impacts, the maximum annual and 1-hour emission rates, respectively, were used. These rates were based on the total emissions for each year of construction and the number of days/hours of construction (i.e., evenly spread through the construction period).

Cancer risk is defined as the lifetime probability of developing cancer from exposure to carcinogenic substances. Cancer risks are expressed as the chance in one million of getting cancer (i.e., number of cancer cases among one million people exposed). The cancer risk is the probability of an individual developing cancer as a result of exposure to air toxics. The cancer risks are assumed to occur exclusively through the inhalation pathway. The cancer risk based on a one-year exposure can be estimated by using the cancer potency factor (milligrams per kilogram of body weight per day [mg/kg-day]), the 70-year annual average concentration (microgram per cubic meter [µg/m^3]), and the lifetime exposure adjustment.

Following guidelines established by OEHHA, the incremental cancer risks attributable to the project were calculated by applying exposure parameters to modeled TAC concentrations in order to determine the inhalation dose (mg/kg-day) or the amount of pollutants inhaled per body weight mass per day. Different sensitive populations are associated with different exposure parameter data. For example, an adult receptor is assumed to have a different breathing rate than a child receptor. These exposure parameters define the amount of pollutants inhaled as a function of on receptor type.

The cancer risks occur exclusively through the inhalation pathway; therefore, the cancer risks can be estimated from the following equation:

$$\text{Dose-inh} = \frac{C_{air} * \{DBR\} * A * CRAF * EF * ED * 10\text{-}^{6}}{AT}$$

Where:

Dose-inh	= Dose of the toxic substance through inhalation in mg/kg-day
10-^6	= Micrograms to milligrams conversion, Liters to cubic meters conversion
C_{air}	= Concentration in air (microgram (µg)/cubic meter (m$^{3)}$)
{DBR}	= Daily breathing rate (liter (L)/kg body weight – day)
A	= Inhalation absorption factor
CRAF	= Cancer Risk Adjustment Factor, Age Sensitivity Factor
EF	= Exposure frequency (days/year)
ED	= Exposure duration (years)
AT	= Averaging time period over which exposure is averaged in days (25,550 days for a 70 year cancer risk)

To determine incremental cancer risk, the estimated inhalation dose attributed to the project was multiplied by the cancer potency slope factor (cancer risk per mg/kg-day). The cancer potency slope factor is the upper bound on the increased cancer risk from a lifetime exposure to a pollutant. These slope factors are based on epidemiological studies and are different values for different pollutants. This allows the estimated inhalation dose to be equated to a cancer risk. Thus, if the inhalation dose (mg/kg-day) is estimated at 2.75 per million and the slope factor (mg/kg-day^{-1}) is 1.1; then the cancer risk is 3.0 per million persons.

Non-cancer adverse health impacts, acute (short-term) and chronic (long-term), are measured against a hazard index (HI), which is defined as the ratio of the predicted incremental exposure concentration from the project to a published reference exposure level (REL) that could cause adverse health effects as established by OEHHA. The ratio (referred to as the Hazard Quotient [HQ]) of each non-carcinogenic substance that affects a certain organ system is added to produce an overall HI for that organ system. The overall HI is calculated for each organ system. If the overall HI for the highest-impacted organ system is greater than one, then the impact is considered to be significant.

The HI is an expression used for the potential for non-cancer health effects. The relationship for the non-cancer health effects is given by the annual concentration (μg/m^3) and the REL (μg/m^3). The acute hazard index was determined using the "simple" concurrent maximum approach, which tends to be conservative (i.e., overpredicts).

The relationship for the non-cancer health effects is given by the following equation:

$$HI = C/REL$$

where,

HI	Hazard index; an expression of the potential for non-cancer health effects.
C	Annual average concentration (μg/m^3) during the 70 year exposure period
REL	Reference exposure level (REL); the concentration at which no adverse health effects are anticipated.

The chronic REL for DPM was established by the California OEHHA[2] as 5 μg/m^3. There is no acute REL for DPM. However, diesel exhaust does contain acrolein and other compounds, which do have an acute REL. BAAQMD's DPM speciation table (based on profile 4674 within the U.S. EPA Speciate 4.2)[3] was used to assess the acute impacts. Acrolein emissions are approximately 1.3 percent of the total emissions. The acute REL for acrolein was established by the California OEHHA[4] as 2.5 μg/m^3.

B.6 Cumulative Analysis

The BAAQMD's *CEQA Air Quality Guidelines* include standards and methods for determining the significance of cumulative health risk impacts. The method for determining cumulative health risk requires the tallying of health risk from permitted sources and major roadways in the vicinity of a project (i.e., within a 1,000-foot radius of the project), then adding the project impacts (in this case, construction activities) to determine whether the cumulative health risk thresholds are exceeded.

BAAQMD has developed a geo-referenced database of permitted emissions sources throughout the San Francisco Bay Area, and has developed the *Stationary Source Risk & Hazard Analysis Tool* (dated May 2011) for estimating cumulative health risks from permitted sources. Ten permitted sources are located within 1,000 feet of the project. These sources are listed in **Table B-4**.

Information associated with these sources was provided and/or verified by BAAQMD.[5] Information (cancer risks and hazard index) was adjusted for distance from source to receptor, based on BAAQMD's *Distance Adjustment Multiplier for Diesel Internal Combustion Engine* and the *Distance Adjustment Multiplier for Gasoline Dispensing Facilities*. **Table B-4** provides the distance adjustment factors and the screening (unadjusted) cancer risk, hazard impacts, and the $PM_{2.5}$ concentrations. **Table B-5** provides the adjusted cancer risk, hazard impacts, and the $PM_{2.5}$ concentrations.

2 California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2010. http://www.oehha.ca.gov//.

3 Provides for a speciation faction of 1.3 percent of acrolein per DPM emission rate. http://www.epa.gov////.html.

4 California Office of Environmental Health Hazards Assessment Toxicity Criteria Database, 2010. http://www.oehha.ca.gov//.

5 Email from Andrea Gordon at BAAQMD on August 16, 2011 Stationary Source Inquiry Form Request- OAK International Runway Safety Area.

U.S. 61 is located adjacent (to the east of the project) and within 1,000 feet of the project. Thus, the health impacts from this roadway were included in the cumulative analysis. BAAQMD has also developed a geo-referenced database of roadways throughout the San Francisco Bay Area and has developed the *Highway Screening Analysis Tool (*dated May 2011*)* for estimating cumulative health risks from roadways. Roadway segments along U.S. 61 from Harbor Bay Parkway and 98th Avenue were reviewed. The data associated with the southbound traffic impacts (nearest travel lanes) within the geo-referenced database were used, as the receptors of concern are to the west of U.S. 61. The data associated with the six feet height within the geo-referenced database were used as most residences in the area are single or two story homes.

In addition, OAK operations would be considered a non-permitted source (i.e., aircraft operations, ground support equipment, and other airport-related equipment) and also emit TACs. There are no known additional construction activities within 1,000 feet of the project site.

Table B-4
Cumulative Permitted BAAQMD Sources – Distance Adjustment Factors and Screening Data

Site #	Facility Type	Address	Distance Adjustment Factor	Screening Cancer Risk	Screening Hazard Impact	$PM_{2.5}$ Concentration
17533	Federal Express	1 Sally Ride Way	0.04	44.32	0.016	0.079
14822	FAA	Oakland Airport	0.04	20.80	0.007	0.037
19325	Swissport	1 Edward White Way	0.04	50.99	0.018	0.012
678	Port of Oakland	#1 Airport Drive	0.04	307.53	0.112	1.050
1201	Rolls Royce Engine	6711 Lockheed Street	1	0.00	0.00	13.5
615	Rolls Royce Engine	7200 Earhart Road	1	7.56	0.004	0.312
G937	Oakland Airport	8500 Earhart Road	0.015	1.683	0.002	0.00
8051	Airweld, Inc	8300 Earhart Road	1	0.00	0.001	0.00
13734	East Bay Muni Utility District	9301 Doolittle Drive	0.04	21.10	0.007	0.005
519	Chevron	N Earhart Drive	1	7.38	0.005	0.00

Source: BAAQMD Stationary Source Inquiry Forms, 2011.

Table B-5
Cumulative Permitted BAAQMD Sources – Adjusted for Source Distance

Site #	Facility Type	Address	Cancer Risk	Hazard Impact	$PM_{2.5}$ Concentration
17533	Federal Express	1 Sally Ride Way	1.77	<0.01	<0.01
14822	FAA	Oakland Airport	0.83	<0.01	<0.01
19325	Swissport	1 Edward White Way	2.04	<0.01	<0.01
678	Port of Oakland	#1 Airport Drive	12.3	<0.01	0.04
1201	Rolls Royce Engine	6711 Lockheed Street	-	-	13.5
615	Rolls Royce Engine	7200 Earhart Road	7.56	<0.01	0.31
G937	Oakland Airport	8500 Earhart Road	0.03	<0.01	-
8051	Airweld, Inc	8300 Earhart Road	-	<0.01	-
13734	East Bay Municipal Utility District	9301 Doolittle Drive	0.84	<0.01	<0.01
519	Chevron	N Earhart Drive	7.36	0.01	-

Attachment C
Air Quality Setting

The Oakland International Airport (OAK) is located within the San Francisco Bay Area Air Basin (Air Basin), which encompasses Alameda, Contra Costa, Santa Clara, San Francisco, San Mateo, Marin, and Napa Counties, and the southern portions of Solano and Sonoma Counties. The Air Basin is characterized by complex terrain which distorts normal wind flow patterns, consisting of coastal mountain ranges, inland valleys, and bays.

The primary factors that determine air quality in the Air Basin are the locations of air pollutant sources and the amounts of pollutants emitted. Meteorological and topographical conditions are also important factors. Atmospheric conditions such as wind speed, wind direction, and air temperature gradients interact with the physical features of the landscape to determine the movement and dispersal of air pollutants.

C.1 Geography and Meteorology

The climate of the greater San Francisco Bay Area is a Mediterranean-type climate characterized by warm, dry summers and mild, wet winters. The climate is determined largely by a high-pressure system that is often present over the eastern Pacific Ocean off the West Coast of North America. In winter, the Pacific high-pressure system shifts southward, allowing storms to pass through the region. During summer and fall, air emissions generated within the Bay Area can combine with abundant sunshine under the restraining influences of topography and subsidence inversions to create conditions that are conducive to the formation of photochemical pollutants, such as ozone and secondary particulates, such as sulfates and nitrates.

Low wind speed contributes to the buildup of air pollution because it allows more pollutants to be accumulated in the air mass per unit of time. Light winds occur most frequently during periods of low sun (fall and winter, and early morning) and at night.

OAK is located within the Bay Area Air Quality Management District's (BAAQMD) climatological subregion known as Alameda. Within the Alameda area, the bay-breeze effect along the immediate shoreline, augmented by a low profile in the hills to the east, gives rise to a prevailing wind from the west. Almost 50 percent of the wind is from the northwest-southwest sector. The average wind speed for this northwest through southwest sector is 9 miles per hour (mph) and ranges from 6 to 11 mph. Observations of less than 7 mph occurs 50 percent of the time. A secondary frequency maximum from a southeasterly direction reflects drainage of air through the nearby Hayward Gap, particularly in winter, but with lower speeds than for the westerly direction. Maximum summer temperatures average near 70 ºF and minima average in the low 50 ºF. In winter maximums are in the middle 50 ºF and minimums are in the upper 30 ºF. Precipitation totals near 18 inches annually, on the average. Sunshine is slightly more plentiful than at the more coastward locations, but invasions of stratus in summer keep the amount somewhat lower than at the more inland locations.

C.2 Air Pollutants of Concern

The U.S. Environmental Protection Agency (U.S. EPA) has identified criteria air pollutants that are a hazard to public health and welfare. These pollutants are called criteria air pollutants because standards (known as National Ambient Air Quality Standards or NAAQS) have been established for each of them to meet specific public health and welfare criteria. California has adopted state standards or CAAQS. The following are descriptions of these criteria pollutants.

Ozone

Ozone is a respiratory irritant and an oxidant that increases susceptibility to respiratory infections, and can cause substantial damage to vegetation and other materials. Ozone is not emitted directly into the atmosphere, but is a secondary air pollutant produced through a complex series of photochemical atmospheric reactions involving reactive organic gases (ROGs) and oxides of nitrogen (NO_X). Hence, ROG and NO_X are known as precursor compounds for ozone. Significant production generally requires ozone precursors to be present in a stable atmosphere with strong sunlight for approximately 3 hours.

Ozone is a regional air pollutant because it is not emitted directly by sources, but is formed downwind of sources of ROG and NO_X under the influence of wind and sunlight. Ozone concentrations tend to be highest in the late spring, summer, and fall, when the long sunny days combine with regional subsidence inversions to create conditions conducive to the formation and accumulation of secondary photochemical compounds.

Nitrogen Dioxide

Nitrogen dioxide (NO_2) is an air quality pollutant of concern because it acts as a respiratory irritant. NO_2 is a major component of the group of gaseous nitrogen compounds commonly referred to as NO_X. A precursor to ozone formation, NO_X is produced by fuel combustion in motor vehicles, stationary sources used in industrial activities, ships, aircraft, and rail transit. Typically, NO_X emitted from fuel combustion is in the form of nitric oxide (NO) and NO_2. NO is often converted to NO_2 when it reacts with ozone or undergoes photochemical reactions in the atmosphere.

Current scientific evidence links short-term NO_2 exposures, ranging from 30 minutes to 24 hours, with adverse respiratory effects including airway inflammation in healthy people and increased respiratory symptoms in people with asthma. Also, studies show a connection between breathing elevated short-term NO_2 concentrations, and increased visits to emergency departments and hospital admissions for respiratory issues, especially asthma.

On January 22, 2010 the U.S. EPA established a new 1-hour NO_2 NAAQS to help protect sensitive members of the human population from exposure to elevated short-term concentrations of NO_2. Set at 100 parts per billion (ppb), the new standard is evaluated based on the 3-year average of the 98^{th} percentile of the maximum 1-hour average concentrations. The new standard became effective on April 12, 2010. The U.S. EPA is currently assessing the attainment status for the new 1-hour NO_2 NAAQS, however, the region is in attainment for the 1-hour NO_2 CAAQS.

Carbon Monoxide

Carbon monoxide (CO) is a product of incomplete combustion, is relatively non-reactive, and is mostly associated with motor vehicle traffic. High CO concentrations develop primarily during winter when periods of light winds interact with ground level temperature inversions (typically from the evening through early morning) and reduce the dispersal of vehicle emissions. Motor vehicles also exhibit increased CO emission rates at low air temperatures. When inhaled at high concentrations, CO combines with hemoglobin in the blood and reduces its oxygen-carrying capacity, resulting in reduced oxygen reaching the brain, heart, and other body tissues. This condition is especially critical for people with cardiovascular diseases, chronic lung disease, or anemia.

Particulate Matter

Particulate matter equal to or less than 10 microns in diameter (PM_{10}) and particulate matter equal to or less than 2.5 microns in diameter ($PM_{2.5}$) represent fractions of particulate matter that can penetrate deeply into the respiratory system and cause adverse health effects. Particulate matter in the atmosphere results from many kinds of dust- and fume-producing industrial and agricultural operations, fuel combustion, and atmospheric photochemical reactions. Some sources of particulate matter, such as demolition and construction activities, are more local in nature, while others such as vehicular traffic have a more regional effect. Very small constituents of particulate matter (e.g., sulfates and nitrates) can cause lung damage directly, or can contain adsorbed gases (e.g., chlorides or ammonium) that may be injurious to health. According to the California Air Resources Board (CARB), exposure to ambient $PM_{2.5}$ can be associated with approximately 14,000 to 24,000 premature annual deaths statewide.[1] Particulates can also damage materials and reduce visibility.

Other Criteria Pollutants

Sulfur dioxide (SO_2) is a combustion product of sulfur or sulfur-containing fuels such as coal. SO_2 is also a precursor to the formation of atmospheric sulfate and particulate matter (both PM_{10} and $PM_{2.5}$) and contributes to potential atmospheric sulfuric acid formation that could precipitate downwind as acid rain.

Lead has a range of adverse neurotoxic health effects, and has historically been released into the atmosphere via the combustion of leaded gasoline. The phase-out of leaded gasoline in California resulted in decreasing levels of atmospheric lead.

C.3 Existing Air Quality in the Project Vicinity

Criteria Air Pollutants

The BAAQMD monitors air quality at more than 30 locations throughout the Bay Area. The closest monitoring station to OAK is located at 9925 International Boulevard in Oakland, approximately two miles east of the Airport and seven miles southeast of downtown Oakland. Criteria pollutants monitored at this location include O_3, CO, NO_2, and $PM_{2.5}$.

A summary of the monitoring data from this station is shown in **Table C-1** for the period 2007 through 2009. The data shows a trend of generally improving air quality and lower monitored concentrations.

[1] California Air Resources Board (ARB), "Methodology for Estimating Premature Deaths Associated with Long-term Exposures to Fine Airborne Particulate Matter in California" http://www.arb.ca.gov/research/health/pm-mort/pm-mortdraft.pdf, December 7, 2009.

Notably, measured concentrations of CO, SO_2, NO_2, and ozone did not exceed the NAAQS or CAAQS for any of the monitoring years.

The 24-hour state PM_{10} standard was exceeded twice in 2007 but decreased in 2008 and 2009, and there were no exceedances of the federal 24-hour PM_{10} standard recorded during the 3 years of collected data. The annual average PM_{10} concentrations exceed the state standard during 2008. Violations of the federal $PM_{2.5}$ annual average standard were reduced from five times in 2007 to once in 2009.

C.4 Laws, Regulations, and Plans

Federal

The 1977 federal Clean Air Act (CAA) required the U.S. EPA to identify NAAQS to protect public health and welfare. National standards have been established for the seven criteria air pollutants, so-called because the U.S. EPA publishes criteria documents to justify the choice of standards. The seven criteria air pollutants for which federal and state ambient standards have been established are: ozone, CO, NO_2, SO_2, PM_{10}, $PM_{2.5}$, and lead. Criteria pollutant standards are listed in **Table C-2**.

Areas that do not violate an ambient air quality standard are considered to be in attainment of the standard. Violations of ambient air quality standards are based on air pollutant monitoring data with respect to each air pollutant. The San Francisco Bay Area as a whole does not meet state or federal ambient air quality standards for ground level ozone and state standards for particulate matter (both PM_{10} and $PM_{2.5}$).

Under the CAA, the U.S. EPA has classified the Bay Area as marginally nonattainment for the 1997 8-hour ozone standard. In May 2008, the U.S. EPA lowered the 8-hour ozone standard from 0.080 part per million (ppm) to 0.075 ppm. The new attainment/nonattainment designation for the Bay Area is expected to be issued within 1 year from final adoption of the revised standards, which are currently under review. In December 2008, the U.S. EPA designated the entire Bay Area as nonattainment for the 24-hour $PM_{2.5}$ NAAQS.

Table C-1
Air Quality Data Summary (2007–2009) for the Project Area

Pollutant	Monitoring Data by Year		
	2007	**2008**	**2009**
Ozone			
Highest 1-Hour Average (ppm)	0.060	0.086	0.092
Days Over State Standard (0.09 ppm)	0	0	0
Highest 8-Hour Average (ppm)	0.053	0.064	0.062
Days Over State Standard (0.07 ppm)	0	0	0
Days Over Federal Standard (0.075 ppm)	0	0	0
Nitrogen Dioxide			
Highest 1-Hour Average (ppm)	0.069	0.070	0.062
Days Over State Standard (0.18 ppm)	0	0	0
Annual Average (ppm)	0.016	0.015	0.014
Exceed State Standard? (0.030 ppm)	No	No	No
Carbon Monoxide			
Highest 1-Hour Average (ppm)	2.5	3.0	4.6
Days Over State Standard (20.0 ppm)	0	0	0
Highest 8-Hour Average (ppm)	1.6	1.6	2.0
Days Over State Standard (9.0 ppm)	0	0	0
Particulate Matter (PM_{10})			
Highest 24-Hour Average (µg/m^3)	70	41	36
Days Over State Standard (50 µg/m^3)	2	0	0
Days Over Federal Standard (150 µg/m^3)	0	0	0
Annual Average (µg/m^3)	21.9	22.0	18.7
Exceed State Standard? (20 µg/m^3)	No	Yes	No
Particulate Matter ($PM_{2.5}$)			
Highest 24-Hour Average (µg/m^3)	45.2	30.1	36.3
Days Over Federal Standard (35 µg/m^3)	5	0	1
Annual Average (µg/m^3)	8.7	9.5	9.3
Exceed State Standard? (12 µg/m^3)	No	No	No

Notes:
µg/m^3 = micrograms per cubic meter
PM_{10} = particulate matter equal to less than 10 microns in diameter
$PM_{2.5}$ = particulate matter equal to less than 2.5 microns in diameter
ppm = parts per million
Source: BAAQMD, 2010c.

Table C-2
Ambient Air Quality Standards and Bay Area Air Basin Attainment Status

Pollutant	Averaging Time	State Standard Concentration	State Standard Attainment Status	National Standard Concentration	National Standard Attainment Status
Ozone	1-Hour 8-Hour	0.09 ppm 0.07 ppm	Non-attainment Non-attainment	– 0.075 ppm	 Non-attainment
Carbon Monoxide	1-Hour 8-Hour	20 ppm 9.0 ppm	Attainment Attainment	35 ppm 9 ppm	Attainment Attainment
Nitrogen Dioxide	1-Hour Annual	0.18 ppm 0.030 ppm	Attainment Attainment	0.100 ppm 0.053 ppm	Unclassified Attainment
Sulfur Dioxide	1-Hour 3-Hour 24-Hour Annual	0.25 ppm – 0.04 ppm –	Attainment Attainment 	0.75 ppm 0.5 ppm 0.14 ppm 0.03 ppm	Attainment Attainment Attainment Attainment
Respirable Particulate Matter (PM_{10})	24-Hour Annual	50 $\mu g/m^3$ 20 $\mu g/m^3$	Non-attainment Non-attainment	150 $\mu g/m^3$ –	Unclassified
Fine Particulate Matter ($PM_{2.5}$)	24-Hour Annual	– 12 $\mu g/m^3$	 Non-attainment	35 $\mu g/m^3$ 15 $\mu g/m^3$	Non-attainment Attainment
Lead	Monthly Quarterly	1.5 $\mu g/m^3$ –	Attainment	– 0.15 $\mu g/m^3$	 Unclassified

Notes: $\mu g/m^3$ = micrograms per cubic meter; PM_{10} = particulate matter with diameter equal to or less than 10 microns; $PM_{2.5}$ = particulate matter with diameter equal to or less than 2.5 microns; ppm = parts per million

Source: BAAQMD, 2010.

The San Francisco Bay Area has met the CO standards for more than a decade and is classified attainment by the U.S. EPA. The U.S. EPA grades the region attainment or unclassifiable for all other air pollutants, except ozone and $PM_{2.5}$. An unclassifiable attainment status signifies that adequate monitoring data does not exist to make an attainment determination.

Under the California Clean Air Act, patterned after the federal CAA, areas have also been designated as attainment or nonattainment with respect to the state standards. With respect to these standards, the Bay Area is currently designated as a nonattainment area for ozone and both PM_{10} and $PM_{2.5}$, and attainment/ unclassified for CO, NO_2, SO_2, and lead. Of note, the Bay Area is classified as a serious non-attainment area for the 1-hour ozone state standard. The "serious" classification triggers various plan submittal requirements and transportation performance standards. One such requirement is that the Bay Area update the Clean Air Plan every three years to reflect progress in meeting the air quality standards and to incorporate new information regarding the feasibility of control measures and new emission inventory data. On September 15, 2010, the BAAQMD adopted the most recent revision to the Clean Air Plan – the *Bay Area 2010 Clean Air Plan*.

State

CARB manages air quality, regulates mobile emissions sources, and oversees the activities of county and regional air districts. CARB regulates local air quality indirectly by establishing state ambient air quality standards and vehicle emissions standards, and by conducting research, planning, and coordinating activities.

California has adopted ambient standards that are more stringent than the federal standards for criteria air pollutants. Under the California Clean Air Act (CCAA), patterned after the federal CAA, areas have been designated as attainment or nonattainment with respect to the state standards. The Air Basin is a nonattainment area for ozone, PM_{10} and $PM_{2.5}$ with respect to state standards however it is designated as an attainment area for CO, NO_2, SO_2, and lead.

California Air Resource Board Idling Regulations

In 2005, CARB approved a regulatory measure to reduce emissions of toxic and criteria pollutants by limiting the idling of new heavy-duty diesel vehicles. The regulations generally limit idling of commercial motor vehicles (including buses and trucks) within 100 feet of a school or residential area for more than 5 consecutive minutes or periods aggregating more than 5 minutes in any 1 hour. Buses or vehicles also must turn off their engines upon stopping at a school and must not start their engines more than 30 seconds before beginning to depart from a school.

General Requirements for In-Use Off-Road Diesel Fueled Fleets

Adopted on July 26, 2007, this regulation is intended to reduce emissions of DPM and NO_X from in-use off-road diesel vehicles operating in California. CARB estimates the regulation will significantly reduce DPM and NO_X emissions from the nearly 180,000 off-road diesel vehicles that operate in California, which is necessary to meet state and federal air quality standards. The regulation requires fleet owners to accelerate turnover to cleaner engines and install exhaust retrofits.[2] The regulation also supports the *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, which was adopted by the Board on September 30, 2000. It should be noted that on April 22, 2010, CARB met to consider relaxing certain deadline requirements of CCR, Title 13, Section 2449 for diesel trucks and construction equipment to account for the slumping economy and inaccurate emissions projections.

On-Road Heavy-Duty Diesel Vehicles (In-Use)

In addition, on December 12, 2008, CARB approved a new regulation, the *On-Road Heavy-Duty Diesel Vehicles (In-Use) Regulation***,** to substantially reduce emissions from existing on-road diesel vehicles

[2] The regulation establishes fleet average emission rates for PM and NO_X that decline over time. Each year, the regulation requires each fleet to meet the fleet average emission rate targets for PM or apply the highest level verified diesel emission control system to 20 percent of its horsepower. In addition, large and medium fleets are required each year to meet the fleet average emission rate targets for NO_X or to turn over a certain percent of their horsepower (8 percent in early years, and 10 percent in later years). "Turn over" means repowering with a cleaner engine, rebuilding the engine to a more stringent emissions configuration, retiring a vehicle, replacing a vehicle with a new or used piece, or designating a dirty vehicle as a low-use vehicle. If retrofits that reduce NO_X emissions become available, they may be used in lieu of turnover as long as they achieve the same emission benefits.

operating in California. The regulation requires affected trucks to meet performance requirements between 2011 and 2023. By January 1, 2023 all vehicles must have a 2010 model year engine or equivalent; this includes on-road heavy-duty diesel fueled vehicles with a gross vehicle weight rating greater than 14,000 pounds.[3]

Off-Road Large Spark-Ignition (Gasoline and Propane) Equipment

On May 25, 2006, CARB amended the existing emission standards and test procedures for off-road large spark-ignition (LSI) engine powered equipment, *Off-Road Large Spark-Ignition (Gasoline and Propane) Equipment Regulation*, to make them more stringent. CARB also adopted new regulations requiring emission reductions from existing LSI fleets and prescribing verification procedures for LSI retrofit emission control systems. The new engine emission standards apply to manufacturers of any 25 horsepower or greater off-road LSI engine placed in, but not limited to, ground support equipment (GSE), forklifts, generator sets, sweeper/scrubbers, industrial tugs (tow tractors), and turf care equipment. The fleet requirements only apply to forklifts, sweepers/scrubbers, industrial tow tractors, and GSE.[4]

Bay Area Air Quality Management District

BAAQMD is the regional agency with jurisdiction over the nine-county region located in the Air Basin. The Association of Bay Area Governments and the Metropolitan Transportation Commission, county transportation agencies, cities and counties, and various non-governmental organizations also join in the efforts to improve air quality through a variety of programs. These programs include the adoption of regulations and policies, as well as implementation of extensive education and public outreach programs.

BAAQMD is responsible for attaining and/or maintaining air quality in the Air Basin within federal and state air quality standards. Specifically, BAAQMD has the responsibility to monitor ambient air pollutant levels throughout the Air Basin and to develop and implement strategies to attain the applicable federal and state standards.

BAAQMD is responsible for limiting the amount of emissions that can be generated throughout the San Francisco Bay Area by stationary sources. Specific rules and regulations have been adopted that limit emissions that can be generated by various uses and/or activities and identify specific pollution reduction measures that must be implemented in association with various uses and activities. These rules regulate

[3] In general, the regulation requires owners to reduce emissions in their fleet by upgrading existing vehicles one of three ways. The first option is to install PM retrofits and replace vehicles (or engines) according to a prescribed schedule based on the existing engine model year. The second option is to retrofit a minimum number of engines each year with a high level PM exhaust retrofit and to replace a minimum number of older engines with newer engines meeting the 2010 new engine standards. The third option is to meet a fleet average. With this option, a fleet operator can use PM and NO_X emission factors established by the regulation to calculate the average emissions of the fleet. Then, by the applicable compliance date each year, the owner can demonstrate that the fleet average emissions for PM and NO_X do not exceed the PM and NO_X fleet average emission rate targets set by the regulation.

[4] The regulation establishes more stringent combined HC and NO_X emission certification standards for engine manufacturers. The regulation also establishes verification procedures for manufacturers of retrofit emission control systems. Engine and retrofit emission control system manufacturers will likely employ advanced automotive-style emission control technologies including electronic fuel/air controllers, three-way catalysts, and oxygen sensors to meet the certification and verification standards, respectively.

not only the emissions of the state and federal criteria pollutants, but also the emissions of TACs. The rules are also subject to ongoing refinement by the BAAQMD.

In general, all stationary sources with air emissions are subject to the BAAQMD's rules governing their operational emissions. Some emissions sources are further subject to regulation through the BAAQMD's permitting process. Through this permitting process, the BAAQMD also monitors the amount of stationary emissions being generated and uses this information in developing the *2010 Bay Area Clean Air Plan (*CAP). The primary BAAQMD rules which may be applicable to the project include the following:

- Regulation 2, Rule 1: General Permit Requirements
- Regulation 6: Particulate Matter and Visible Emissions;
- Regulation 7: Odorous Substances; and
- Regulation 8, Rule 15: Emulsified Asphalt.

California Environmental Quality Act Guidelines

In December 1999, BAAQMD adopted its *CEQA Guidelines – Assessing the Air Quality Impacts of Projects and Plans,* as a guidance document to provide lead government agencies, consultants, and project proponents with uniform procedures for assessing air quality impacts and preparing air quality documents for projects subject to CEQA. The *BAAQMD CEQA Guidelines* is an advisory document and local jurisdictions are not required to use the methodology outlined therein. The document describes the criteria that BAAQMD uses when reviewing and commenting on the adequacy of environmental documents. It recommends thresholds for use in determining whether projects would have significant adverse environmental impacts, identifies methodologies for predicting project emissions and impacts, and identifies measures that can be used to avoid or reduce air quality impacts. On June 2, 2010, BAAQMD adopted an update to its *CEQA Air Quality Guidelines*.

In May of 2011, the *CEQA Air Quality Guidelines* were updated to reflect the Air District's recently released refined risk and hazard analysis tools. The updated CEQA Guidelines include other clarifications and revisions to further assist lead agencies in implementing the Air District's thresholds of significance.

Air Quality Plans

Air quality plans developed to meet federal requirements are referred to as State Implementation Plans. The federal CAA and the CCAA require plans to be developed for areas designated as nonattainment. On September 15, 2010, the BAAQMD adopted the 2010 *Clean Air Plan*.

The 2010 *Clean Air Plan* updates the *Bay Area 2005 Ozone Strategy* in accordance with the requirements of the CCAA to implement all feasible measures to reduce ozone; provides a control strategy to reduce ozone, particulate matter, air toxics, and GHG in a single, integrated plan; and establishes emission control measures to be adopted or implemented in the 2010 through 2012 timeframe.

Attachment D
Greenhouse Gas Setting

D.1 Regulatory Setting

The following regulations and guidelines are applicable to GHGs in California.

Executive Order S-3-05

In 2005, in recognition of California's vulnerability to the effects of climate change, Governor Schwarzenegger established Executive Order S-3-05, which sets forth a series of target dates by which statewide emissions of GHGs would be progressively reduced, as follows:

- By 2010, reduce GHG emissions to 2000 levels;
- By 2020, reduce GHG emissions to 1990 levels; and,
- By 2050, reduce GHG emissions to 80 percent below 1990 levels.

Assembly Bill 32

In 2006, California passed the California Global Warming Solutions Act of 2006 (Assembly Bill 32 [AB 32]; California Health and Safety Code Division 25.5, §38500 et seq.), which requires the CARB to design and implement emission limits, regulations, and other measures such that statewide GHG emissions will be reduced to 1990 levels by 2020.

In December 2007, CARB approved the 2020 emission limit of 427 million metric tons of CO2e of GHGs. The 2020 target of 427 million metric tons of CO2e requires the reduction of 169 million metric tons of CO2e, or approximately 30 percent, from the state's projected 2020 "business-as-usual" emissions of 596 million metric tons of CO2e.

Also in December 2007, CARB adopted mandatory reporting and verification regulations pursuant to AB 32. The regulations came into effect on January 1, 2009, with the first reports covering 2008 emissions. The mandatory reporting regulations require reporting for certain types of facilities that make up the bulk of the stationary source emissions in California. Currently, the draft regulation language identifies major facilities as those that generate more than 25,000 metric tons/year of CO2e. Cement plants, oil refineries, electric-generating facilities/providers, cogeneration facilities, hydrogen plants, and other stationary combustion sources that emit more than 25,000 metric tons/year CO2e make up 94 percent of the point source CO2e emissions in California (CARB, 2007).

On December 11, 2008, CARB adopted the Climate Change Scoping Plan (2008 Scoping Plan), which functions as a roadmap of CARB's plans to achieve GHG reductions in California required by AB 32 through subsequently enacted regulations (CARB, 2008). The 2008 Scoping Plan proposes a comprehensive set of actions designed to reduce overall carbon emissions in California. Key elements of the 2008 Scoping Plan include:

- Expanding and strengthening existing energy efficiency programs as well as building and appliance standards;

- Achieving a statewide renewable energy mix of 33 percent;
- Developing a California cap-and-trade program that links with other Western Climate Initiative partner programs to create a regional market system;
- Establishing targets for transportation-related GHG emissions for regions throughout California, and pursuing policies and incentives to achieve those targets;
- Adopting and implementing measures pursuant to existing state laws and policies, including California's clean car standards, goods movement measures, and the Low Carbon Fuel Standard; and
- Creating targeted fees, including a public goods charge on water use, fees on high global warming potential gases, and a fee to fund the administrative costs of the state's long-term commitment to AB 32 implementation (CARB, 2008).

The 2008 Scoping Plan also includes recommended measures that were developed to reduce GHG emissions from key sources and activities while improving public health, promoting a cleaner environment, preserving our natural resources, and ensuring that the impacts of the reductions are equitable and do not disproportionately impact low-income and minority communities. These measures put the state on a path to meet the long-term 2050 goal of reducing California's GHG emissions to 80 percent below 1990 levels.

The total reduction for the recommended measures is 174 million metric tons/year of CO2e, by 2020, slightly exceeding the 169 million metric tons/year of CO2e of reductions estimated to be needed in the Draft Scoping Plan. The measures in the 2008 Scoping Plan approved by the Board will be developed and in place by 2012.

AB 32 requires CARB to establish a statewide GHG emissions cap for 2020 based on 1990 emission levels. AB 32 required CARB to adopt regulations by January 1, 2008 that identify and require selected sectors or categories of GHG emitters to report and verify their statewide GHG emissions, and CARB is authorized to enforce compliance with the program. Under AB 32, CARB was also required to adopt a statewide GHG emissions limit by January 1, 2008, equivalent to the statewide GHG emissions levels in 1990, which must be achieved by 2020. CARB established this limit, in December 2007, at 427 MMTCO2E. On January 1, 2011, CARB was required to adopt rules and regulations, to achieve the maximum technologically feasible and cost-effective GHG emission reductions. AB 32 permits the use of market-based compliance mechanisms to achieve those reductions. By January 1, 2012, the rules and market mechanisms adopted by CARB took effect and are legally enforceable. However, the cap-and-trade measure will go into effect on January 1, 2013. Full implementation of AB32 and its timeline may be subject to legal challenges.

Senate Bill 97 California Environmental Quality Act Guidelines Revisions

Senate Bill 97 (SB 97), signed in August 2007 (Chapter 185, Statutes of 2007; Public Resources Code [PRC] §21083.05 and 21097), acknowledges that climate change is a prominent environmental issue that requires analysis under the California Environmental Quality Act (CEQA). This bill directed the Governor's Office of Planning and Research (OPR), which is part of the California Natural Resources Agency (Resources Agency), to prepare, develop, and transmit to CARB guidelines for the feasible mitigation of GHG emissions (or the effects of GHG emissions), as required by CEQA, by July 1, 2009. The Resources Agency adopted the CEQA Guidelines amendments on December 31, 2009. The amended CEQA Guidelines became effective on March 18, 2010.

The amendments included a new CEQA Guidelines Section (§15064.4), to assist lead agencies in determining the significance of the GHG impacts. This section urges lead agencies to quantify, where possible, the GHG emissions of proposed projects. In addition to quantification, this section recommends consideration of several other qualitative factors that may be used in determination of significance including: (1) the extent to which the project may increase or reduce GHG emissions as compared to the existing environmental setting; (2) whether the GHG emissions exceed a threshold of significance that the lead agency determines applies to the project; and (3) the extent to which the project complies with regulations or requirements adopted to implement a statewide, regional, or local plan for the reduction or mitigation of GHG emissions.

The amendments also include a new CEQA Guidelines section subdivision (§15064.7(c)), to clarify that in developing thresholds of significance, a lead agency may appropriately review thresholds developed by other public agencies, or recommended by other experts, provided the decision of the lead agency to adopt such thresholds is supported by substantial evidence.

Bay Area Air Quality Management District

The BAAQMD is the primary agency responsible for air quality regulation in the nine county San Francisco Bay Area Air Basin. As part of their role in air quality regulation, BAAQMD has prepared CEQA air quality guidelines to assist lead agencies in evaluating air quality impacts of proposed projects and plans. The guidelines provide procedures for evaluating potential air quality impacts during the environmental review process consistent with CEQA requirements. On June 2, 2010, the BAAQMD adopted new and revised CEQA air quality thresholds of significance and issued revised guidelines that supersede the 1999 air quality guidelines. The CEQA Air Quality Guidelines provide CEQA thresholds of significance for operational GHG emissions from land use projects for the first time. The BAAQMD has not defined GHG thresholds from construction activities, but recommends that significance be determined in relation to meeting AB 32 GHG reduction targets. OPR's amendments to the CEQA Guidelines as well as BAAQMD's CEQA Air Quality Guidelines and thresholds of significance have been incorporated into the analysis of potential GHG impacts associated with the proposed project.

The CARB estimated that in 2006, California produced about 484 million gross metric tons of CO2e (MMTCO2e), or about 535 million U.S. tons (CARB, 2009). CARB found that transportation is the source of 38 percent of the state's GHG emissions, followed by electricity generation (both in-state and out-of-state) at 22 percent, and industrial sources at 20 percent. Commercial and residential fuel use (primarily for heating) accounted for 9 percent of GHG emissions (CARB, 2009). In the San Francisco Bay Area, fossil fuel consumption in the transportation sector (on-road motor vehicles, off-highway mobile sources, and aircraft) and the industrial and commercial sectors are the two largest sources of

GHG emissions, each accounting for approximately 36 percent of the San Francisco Bay Area's 95.8 MMTCO2E emitted in 2007 (BAAQMD, 2007). Electricity generation accounts for approximately 16 percent of the San Francisco Bay Area's GHG emissions, followed by residential fuel usage at 7 percent, off-road equipment at 3 percent, and agriculture at 1 percent (BAAQMD, 2007).