Appendix F
Air Quality Calculations

ESA

APPENDIX F
Air Quality Criteria Pollutant and Health Risk Modeling

Criteria Pollutant Emissions Modeling

Project-related air quality impacts fall into two categories: short-term construction-related impacts and long-term operations-related impacts. Short-term construction activities would primarily result in the generation of ROG, NO_x, and PM_{10} criteria pollutants. Construction emissions were calculated with the URBEMIS 2002 model version 8.7 and an inventory of required construction equipment (see Attachment 1). Long-term operational emission sources include the WWTP facilities, haul truck trips, and the nominal vehicle emissions associated with routine inspection and maintenance of the expanded WWTP. Long-term vehicular criteria pollutant emissions (truck and worker trips) were calculated using the California Air Resources Board's (CARB) EMFAC2002 emissions model (see Attachment 2), and the long-term expanded WWTP facility emissions were estimated by scaling with respect to currently permitted emissions (see Attachment 3).

Health Risk Assessment

Dispersion modeling analysis was performed to model TAC emissions from additional haul trucks associated with biosolids transport, an additional 1,500 kilowatt emergency generator, increases in processing rates at the WWTP, the replacement of the candle flare with an enclosed flare, and the addition of two digestor gas boilers in association with the expansion project. Dispersion modeling[1] uses hourly averaged meteorological data, terrain elevation data, and emissions and source release data to compute downwind pollutant concentrations over averaging periods ranging from one hour to one year. The results allow a direct comparison of predicted concentrations of pollutants to air quality standards and other criteria such as health risks based on modeled concentrations.

The SJVUAPCD has a significance threshold for health risk exposure to toxic air contaminants (TACs) of 10 cancers per million for 70-year exposure. The SJVUAPCD's *Guide for Assessing and Mitigating Air Quality Impacts*[2] (SJVUAPCD, 2002) indicates that a primary concern is diesel engine exhaust emissions and the potential long-term health risk to sensitive receptors.

[1] Dispersion is the process by which atmospheric pollutants disseminate due to wind and vertical stability.

[2] San Joaquin Valley Air Pollution Control District (SJVAPCD), 2002. Guide for Assessing and Mitigating Air Quality Impacts, Technical Document: Information for Preparing Air Quality Sections in EIRs,

This section presents the methodology used for the dispersion modeling analysis and the subsequent health risk assessment. The methodology is consistent with procedures documented in the EPA *Guideline on Air Quality Models (Revised, 1993),* SJVUAPCD's *Guide for Assessing Air Quality Impacts*, and CalTrans' *Transportation Project-Level Carbon Monoxide Protocol*[3].

Dispersion Modeling Approach

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

- Model selection and options;
- Receptor location;
- Meteorological data; and
- Source release characteristics.

The dispersion modeling analysis estimated ambient TACs concentrations as a result of the expansion project and then determined incremental cancer risk (i.e., the change in cancer risk from the baseline to the future project conditions).

Model Selection and Options

The Industrial Source Complex-3 (ISC3)[4] model was used for the modeling analysis. The ISC3 model is an 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, final plume rise), default wind speed profile categories, default potential temperature gradients, no deposition/depletion of particulate matter, and no pollutant decay. Dispersion modeling analysis tend to be conservative in their prediction of ambient concentrations. Based on observation of the area surrounding the area, rural dispersion coefficients were applied in the analysis.

Receptor Locations

Existing sensitive receptors such as residences, schools, and outdoor recreational areas were chosen as receptors analyzed. Receptors were placed at a height of 1.8 meters (typical breathing height). No terrain elevations were used (i.e., flat terrain). Irrigated pasture, row crops, various agricultural structures, dairies, and scattered rural residences dominate the land use pattern for a

http://www.valleyair.org/transportation/CEQA%20Rules/GAMAQI%20Jan%202002%20Rev.pdf, adopted August 20, 1998, revised January 10, 2002.

[3] California Department of Transportation, Transportation Project-Level Carbon Monoxide Protocol, Davis, California, December 1997.

[4] United States Environmental Protection Agency, Office of Air Quality Planning and Standards, 1995. *User's Guide for the Industrial Source Complex (ISC3) Dispersion Models*, Volumes I and II. EPA-454/B-95-003a and b.

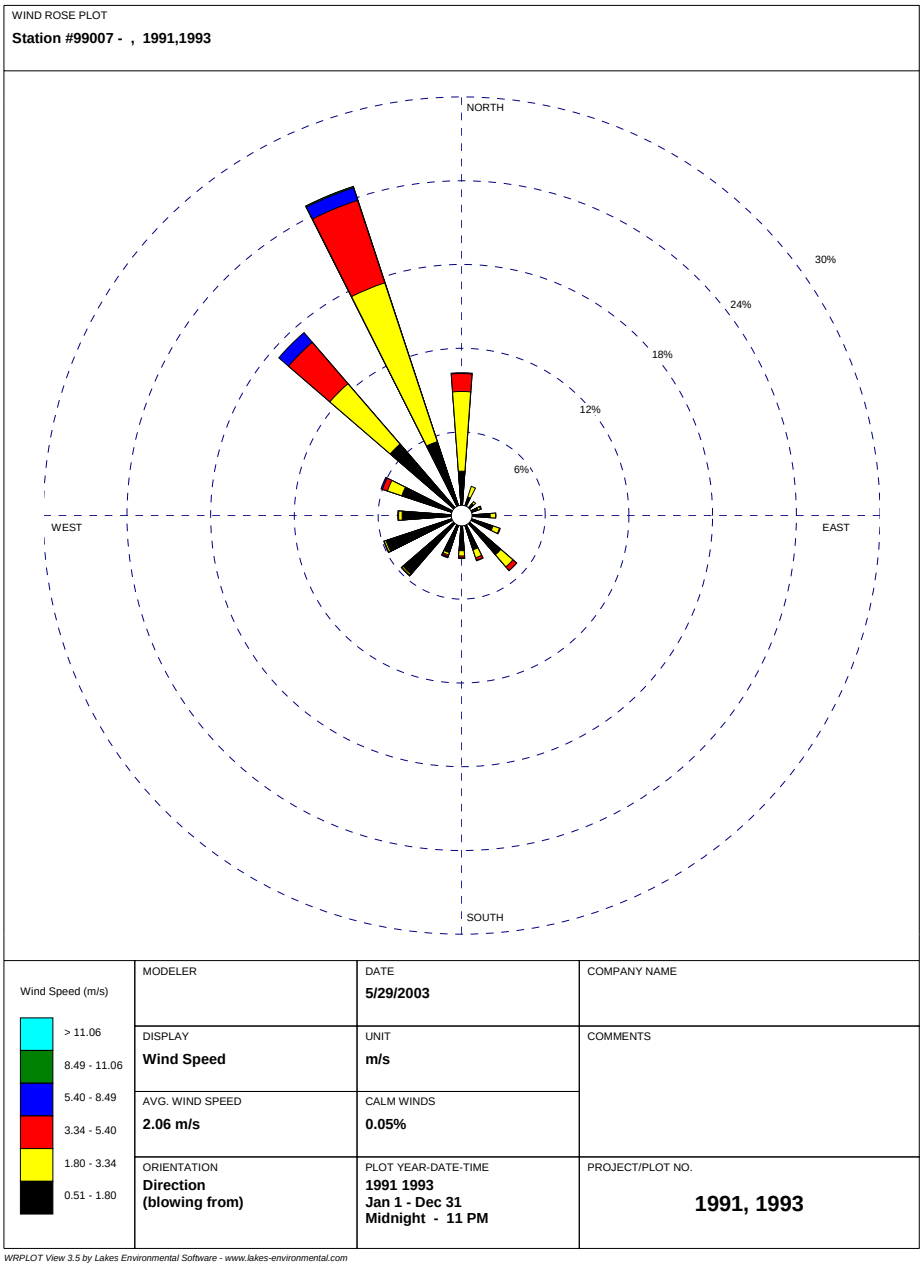
majority of the project area. The nearest sensitive receptor is a farm residence located approximately 1,350 feet to the north of the facility along Gove Road.

Meteorological Data

The rate at which emissions are dispersed in the atmosphere depends upon the intensity of the ambient turbulence, the velocity of the wind, the position relative to obstacles in the flow field, and any dilutions attributable to the source itself. The most important factor leading to plume spread in the atmosphere is the amount of ambient turbulence. In a stable atmosphere, the horizontal and vertical turbulence is very limited. The plume remains near its emission height and undergoes minimal mixing. This situation is common during the nighttime and early morning hours. If the layer below the plume height becomes neutral to unstable, the plume mixes rapidly to the surface. This is known as a fumigation condition and can cause high concentrations. This occurs for short duration during the early morning. As heating of the surface persists, a fully unstable mixing layer develops, and the plume loops up and down in response to large-scale convective eddies. A neutral stability atmosphere yields moderate amounts of turbulence and results in a cone-shaped plume. Finally, if an inversion is present below the emission height, a lofting condition exists and the plume is cut off from ground level impacts.

Surface meteorological data and upper air meteorological (mixing height) data from Firebaugh and Sacramento, California, respectively, were used for the modeling analysis (http://www.arb.ca.gov/harp/toxics/metfiles.htm). Meteorological data were obtained from CARB and used for this health risk assessment. Data from 1991 and 1993 was used and the worst case year of analysis was reported. **Figure 1** presents a windrose of the meteorological data. Note that the dominate wind direction is from the north-northwest; thus, the nearest sensitive receptor is upwind of the facility.

Figure 1
Windrose of Firebaugh, California



Source Release Characteristics

Dispersion modeling analysis was performed to model TAC emissions from haul trucks, an emergency generator, the WWTP, the replacement of the candle flare with an enclosed flare, and two digestor gas boilers in association with the expansion project. The haul trucks were separated into two emission sources; an idling area and the roadway. The emergency generator was modeled as a point source. The WWTP was modeled as an area with a height of three meters and located in the area of the clarifiers, headworks, and other processing units. The two flares and the digestor gas boilers were treated as point sources. Source locations were based on **Figure 2-3** of the Project Description.

Emission rates for the haul trucks were based on CARB's EMFAC2002[5] emission model and include promulgated regulations concerning on-road vehicles. The DPM emissions are approximately 88 percent of the emissions of exhaust PM10 from diesel powered equipment (per U.S. EPA guidance). The emission rates for the remaining emissions sources utilized information contained within existing permits, submitted permit applications for proposed equipment (dated February 20, 2006), and , EPA's *Compilation of Air Pollutant Emission Factors* (AP-42). Operational information (types of equipment, equipment size, hours of operation, and exhaust parameters) was also provided within existing permits and permit applications. The Air Quality section of this EIR provides additional information related the determination of VOC and DPM emissions for the proposed project. **Table 1** presents the exhaust parameters for the point sources. The following presents a brief description of the emissions sources which would be added or modified as a result of the expansion project.

TABLE 1
EXHAUST PARAMETERS

Source	Height (m)	Diameter (m)	Velocity (m/s)	Temperature (K)
Generator	7.92	0.36	57.3	764
Candle Flare	3.05	0.18	0.67	1033
Enclosed Flare	18.3	1.22	3.00	1033
Digestor Gas Boiler	7.92	0.36	57.3	764

m = meters.
m/s = meters per second.
K = Kelvin.

An additional emergency standby generator would supply backup power for the WWTP and supplement an existing generator. The generator would be diesel-powered and rated at 2,200 horsepower and limited to 200 hours per year of operation. Two 5.23 MMBTU digestor gas boilers will also be added to the proposed project.

[5] California Air Resources Board, 2003. Emfac2002 (Version 2.2) - Calculating Emission Inventories for Vehicles in California.

Flaring is a high-temperature oxidation process used to burn combustible components, mostly hydrocarbons, of waste gases from industrial operations. There are two types of flares, elevated and ground flares. For the proposed project, the proposed enclosed flare can be considered elevated and the existing candle flare can be considered ground-based.

Elevated flares tend to have larger capacities than ground flares. In elevated flares, a waste gas stream is fed through a stack and is combusted at the tip of the stack. The elevated flare is typically more protected from atmospheric disturbances such as wind and precipitation than the ground flare. In ground flares, combustion takes place at ground level. Ground flares vary in complexity, and they may consist either of conventional flare burners discharging horizontally with no enclosures or of multiple burners in refractory-lined steel enclosures.

For the proposed project, a candle flare would be replaced by a 13.66 MMBTU capacity enclosed flare. The enclosed flare would provide a greater VOC destruction efficiency than the candle flare (from 0.14 to 0.063 pounds per MMBTU), leading to lower VOC emissions with the enclosed flare.

VOCs are also emitted from waste water collection, treatment, and storage systems through volatilization of organic compounds at the liquid surface. Emissions can occur by diffusive or convective mechanisms, or both. Diffusion occurs when organic concentrations at the water surface are much higher than ambient concentrations. The organics volatilize, or diffuse into the air, in an attempt to reach equilibrium between aqueous and vapor phases. Convection occurs when air flows over the water surface, sweeping organic vapors from the water surface into the air. The rate of volatilization relates directly to the speed of the air flow over the water surface.

The proposed project would increase the existing processing rate from 10 mgd to 20 mgd in 2010. These increases in processing rates would result in a direct relationship to increases in VOC emissions. Two factors would provide an improvement to VOC emissions with the proposed project (on a per mgd basis); 1) tertiary treatment improvements to the WWTP include the addition of cloth-media "disk" filters and replacing the chlorine disinfection system with an ultra-violet light disinfection system (providing for a decrease in chloroform emissions), and 2) enclosing the proposed headworks, thus eliminating exposure to the ambient air.

Health Risk Analysis Methodology

The principal issues related to health risks from the project pertain to emissions of TAC from the WWTP, flare, and digestor gas boilers and exhaust of diesel trucks and emergency generator. The incremental risk was determined for these sources of TACs in order to obtain an estimated total incremental carcinogenic health risk. The TACs of interest include (but not limited to) chloroform, DPM, formaldehyde, benzene, ammonia, and some metals.

California OEHHA has declared DPM emissions from engine exhaust to be a probable carcinogen, and a toxic potency unit risk factor (URF) of 300 in a million for chronic exposure to one microgram per cubic meter was established. OEHHA also provides URF for other TACs[6].

[6] http://www.oehha.ca.gov/air.html

To estimate the health risks from the proposed project, a dispersion modeling analysis was conducted to determine the chronic (long-term average) ambient air concentrations. Health impacts of project-related emissions were assessed by estimating concentrations at the nearest sensitive receptor; a farm residence located approximately 1,350 feet to the north of the WWTP. The annual average concentrations for this location were estimated for the years of interest; 2006 (baseline) and 2010 (future project milestone). The health impacts for the proposed project were than compared to health risk associated with the baseline condition (to determine the incremental health impacts) and then compared to the significance thresholds.

Cancer Risks

The cancer risks from the TAC of concern for this project occur exclusively through the inhalation pathway; therefore the cancer risks can be estimated from the following equation:

$$CR_{DPM} = \sum_{i=1}^{\text{No.exposure periods}} C_{DPMi} \bullet URF_{DPM} \bullet LEA \bullet \text{Exposure Duration}_i / 70 \text{ years}$$

where,

CR_{DPM} Cancer risk, the probability of an individual developing cancer as a result of exposure to DPM.

$C_{DPMi.}$ Annual average concentration in $\mu g/m^3$during the i^{th} exposure period

URF_{DPM} Unit risk factor, estimated probability that a person will contract cancer as a result of inhalation of a concentration of 1 $\mu g/m^3$ continuously over a period of 70 years.

Exposure Periods Number of discrete time periods where exposure to different levels will occur with the overall 70-year exposure period.

Exposure Duration$_i$ Number of years for the ith exposure period (total exposure duration will be 70 years.

Exposure Time 24 hours per day

Exposure Duration 365 days per year

LEA Lifetime exposure adjustment. The LEA at residential receptors is 1.0.

The average overall risk of typical person in California should be understood. CARB conducted a study to estimate cancer risks from exposure to DPM in the State and to develop a risk reduction plan[7]. The Study reported that the statewide average ambient air concentration of DPM was

[7] California Air Resource Board (CARB), 2000. *Risk Reduction Plan to Reduce Particulate Matter Emissions from Diesel-Fueled Engines and Vehicles*, October 2000.

determined by using measured ambient air concentrations of surrogates to DPM in a receptor model to estimate exposure levels. For the year 2000, the statewide average cancer risk from exposure to diesel exhaust was estimated to be 540 in a million. The Study also states that cancer risks from diesel exhaust are about 70 percent of the total risks from exposure to toxic air contaminants in the ambient air.

Non-cancer Risks

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

$HI_{DPM} = C_{DPM}/REL_{DPM}$

where,

HI_{DPM}	Hazard Index; an expression of the potential for non-cancer health effects.
C_{DPM}	Annual average concentration ($\mu g/m^3$).
REL_{DPM}	Reference exposure level (REL); the concentration at which no adverse health effects are anticipated.

The chronic REL for DPM was established by OEHHA as 5 $\mu g/m^3$.

Conclusions

Using the URF, as established by OEHHA, the maximum carcinogenic risk of the proposed project over a 70 year lifetime of exposure from nearby sources is estimated to less than 7 cancers in a million (at the maximum exposed individual), assuming no reductions in emissions in the future from regulations related to DPM emissions. A majority of the health risk is due to chloroform and DPM emissions from the WWTP and the haul trucks, respectively. However, given projected decreases in DPM emissions due to regulations (approximately 85 percent reductions), the 70 year average lifetime cancer risk for the proposed project is estimated to be less than the risk for the baseline condition. These estimated cancer risks are small when compared to current and future cancer risks from exposure to all TACs in California. The current cancer risk estimates by CARB range from 500 to 1,000 in a million in the Los Angeles area, while future cancer risks are estimated at 75 to 150 in a million.

In addition, the maximum annual average concentration of DPM from nearby sources is much less than the non-carcinogenic LEA of 5 $\mu g/m^3$, thus leading to a hazard index of 0.01 compared to a significance threshold of 1. Thus, the impacts of DPM on the proposed project site would be less than significant.

Four factors associated with the proposed project provide a direct connection to this less than significant impact; 1) the replacement of the candle flare with the enclosed flare (a taller emission source with greater VOC control efficiency), 2) tertiary treatment improvements to the WWTP include the addition of cloth-media "disk" filters and replacing the chlorine disinfection system with an ultra-violet light disinfection system (providing for a decrease in chloroform emissions),

3) enclosing the proposed headworks, and 4) the future improvements to haul trucks leading to reductions in DPM emissions.

Attachment 1: URBEMIS2002 Output

Page: 1
02/21/2006 2:42 PM

URBEMIS 2002 For Windows 8.7.0

File Name: C:\Program Files\URBEMIS 2002 Version 8.7\Projects2k2\Merced WWTP Expansion.urb
Project Name: Merced WWTP Expansion
Project Location: San Joaquin Valley
On-Road Motor Vehicle Emissions Based on EMFAC2002 version 2.2

SUMMARY REPORT
(Tons/Year)

CONSTRUCTION EMISSION ESTIMATES

*** 2007 ***	ROG	NOx	CO	SO2	PM10 TOTAL	PM10 EXHAUST	PM10 DUST
TOTALS (tpy, unmitigated)	7.22	45.38	61.16	0.00	12.88	1.74	11.14

*** 2008 ***	ROG	NOx	CO	SO2	PM10 TOTAL	PM10 EXHAUST	PM10 DUST
TOTALS (tpy, unmitigated)	2.41	14.79	20.49	0.00	4.24	0.53	3.71

AREA SOURCE EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10
TOTALS (tpy, unmitigated)	0.00	0.00	0.00	0.00	0.00

OPERATIONAL (VEHICLE) EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10
TOTALS (tpy, unmitigated)	0.00	0.00	0.00	0.00	0.00

SUM OF AREA AND OPERATIONAL EMISSION ESTIMATES

	ROG	NOx	CO	SO2	PM10
TOTALS (tpy, unmitigated)	0.00	0.00	0.00	0.00	0.00

Page: 2
02/21/2006 2:42 PM

URBEMIS 2002 For Windows 8.7.0

File Name: C:\Program Files\URBEMIS 2002 Version 8.7\Projects2k2\Merced WWTP Expansion.urb
Project Name: Merced WWTP Expansion
Project Location: San Joaquin Valley
On-Road Motor Vehicle Emissions Based on EMFAC2002 version 2.2

DETAIL REPORT
(Tons/Year)

Construction Start Month and Year: April, 2007
Construction Duration: 12
Total Land Use Area to be Developed: 45 acres
Maximum Acreage Disturbed Per Day: 11.25 acres
Single Family Units: 0 Multi-Family Units: 0
Retail/Office/Institutional/Industrial Square Footage: 0

CONSTRUCTION EMISSION ESTIMATES UNMITIGATED (tons/year)

Source	ROG	NOx	CO	SO2	PM10 TOTAL	PM10 EXHAUST	PM10 DUST
*** 2007***							
Phase 1 - Demolition Emissions							
Fugitive Dust	-	-	-	-	0.00	-	0.00
Off-Road Diesel	0.00	0.00	0.00	-	0.00	0.00	0.00
On-Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worker Trips	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Total tons/year	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Phase 2 - Site Grading Emissions							
Fugitive Dust	-	-	-	-	11.14	-	11.14
Off-Road Diesel	7.16	45.30	59.75	-	1.74	1.74	0.00
On-Road Diesel	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Worker Trips	0.06	0.08	1.41	0.00	0.01	0.00	0.00
Total tons/year	7.22	45.38	61.16	0.00	12.88	1.74	11.14
Phase 3 - Building Construction							
Bldg Const Off-Road Diesel	0.00	0.00	0.00	-	0.00	0.00	0.00
Bldg Const Worker Trips	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Arch Coatings Off-Gas	0.00	-	-	-	-	-	-
Arch Coatings Worker Trips	0.00	0.00	0.00	0.00	0.00	0.00	0.00

Asphalt Off-Gas	0.00	-	-	-	-
-	-				
Asphalt Off-Road Diesel	0.00	0.00	0.00	-	0.00
0.00	0.00				
Asphalt On-Road Diesel	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Asphalt Worker Trips	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Total tons/year	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Total all phases tons/yr	7.22	45.38	61.16	0.00	12.88
1.74	11.14				
*** 2008***					
Phase 1 - Demolition Emissions					
Fugitive Dust	-	-	-	-	0.00
-	0.00				
Off-Road Diesel	0.00	0.00	0.00	-	0.00
0.00	0.00				
On-Road Diesel	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Worker Trips	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Total tons/year	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Phase 2 - Site Grading Emissions					
Fugitive Dust	-	-	-	-	3.71
-	3.71				
Off-Road Diesel	2.39	14.76	20.01	-	0.53
0.53	0.00				
On-Road Diesel	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Worker Trips	0.02	0.03	0.48	0.00	0.00
0.00	0.00				
Total tons/year	2.41	14.79	20.49	0.00	4.24
0.53	3.71				
Phase 3 - Building Construction					
Bldg Const Off-Road Diesel	0.00	0.00	0.00	-	0.00
0.00	0.00				
Bldg Const Worker Trips	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Arch Coatings Off-Gas	0.00	-	-	-	-
-	-				
Arch Coatings Worker Trips	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Asphalt Off-Gas	0.00	-	-	-	-
-	-				
Asphalt Off-Road Diesel	0.00	0.00	0.00	-	0.00
0.00	0.00				
Asphalt On-Road Diesel	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Asphalt Worker Trips	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Total tons/year	0.00	0.00	0.00	0.00	0.00
0.00	0.00				
Total all phases tons/yr	2.41	14.79	20.49	0.00	4.24
0.53	3.71				

Page: 3
02/21/2006 2:42 PM

Phase 1 - Demolition Assumptions: Phase Turned OFF

Phase 2 - Site Grading Assumptions
Start Month/Year for Phase 2: Apr '07
Phase 2 Duration: 12 months
On-Road Truck Travel (VMT): 0
Off-Road Equipment

No.	Type	Horsepower	Load Factor	Hours/Day
1	Cranes	190	0.430	8.0
2	Excavators	180	0.580	8.0
2	Graders	174	0.575	8.0
10	Off Highway Trucks	417	0.490	8.0
4	Other Equipment	190	0.620	8.0
1	Pavers	132	0.590	8.0
1	Rollers	114	0.430	8.0
2	Rough Terrain Forklifts	94	0.475	8.0
2	Rubber Tired Loaders	165	0.465	8.0
3	Scrapers	313	0.660	8.0
3	Tractor/Loaders/Backhoes	79	0.465	8.0

Phase 3 - Building Construction Assumptions
Start Month/Year for Phase 3: Apr '08
Phase 3 Duration: 0 months
  SubPhase Building Turned OFF
  SubPhase Architectural Coatings Turned OFF
  SubPhase Asphalt Turned OFF

Page: 4
02/21/2006 2:42 PM

Changes made to the default values for Land Use Trip Percentages

Changes made to the default values for Construction

The user has overridden the Default Phase Lengths

Changes made to the default values for Area

Changes made to the default values for Operations

Attachment 2: EMFAC2002 Emission Factors and Emissions Modeling

Construction Traffic

Air Quality Analysis for Mobile Emissions - Construction
Merced WWTP Expansion

grams/mile

Emission Factors - EMFAC2002

LDA	ROG	CO	NOx	PM10
2007	0.162	4.041	0.324	0.032
2008	0.14	3.607	0.287	0.031
LDT	**ROG**	**CO**	**NOx**	**PM10**
2007	0.291	7.011	0.616	0.038
2008	0.257	6.33	0.555	0.038
MDT	**ROG**	**CO**	**NOx**	**PM10**
2007	0.277	5.111	0.853	0.044
2008	0.25	4.706	0.773	0.044
HDT	**ROG**	**CO**	**NOx**	**PM10**
2007	0.878	7.628	8.742	0.286
2008	0.811	6.945	8.013	0.267

lbs/VMT

Entrained PM10: 0.0014

grams/VMT

Entrained PM10: 0.6502

Assumed average speed of MDT and HDT vehicle type to be 35 mph, LDA and LDV 45 mph to and from the project site.
Assumed average distance to and from the project site to be 20 miles each way.

Emissions = Vehicle Type x Emission Factor x Miles/Trip x Trips/Day

Note: Doubled trip length to take into account round trips

Mobile Emissions Associated with Construction Worker and Haul trips in 2nd Q 2007 through 1st Q 2008 (worse-case year)

Emission Factors

		ROG	CO	Nox	PM10
LDV	2007 emissions (grams/mile)	0.2265	5.526	0.47	0.035
	2007 emissions (pounds/mile)	4.99E-04	1.22E-02	1.04E-03	7.72E-05

Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
40	88	3520	1.76	42.88	3.65	5.32

--50 Haul Truck Trips per Day--

		ROG	CO	Nox	PM10
MDT	2007 emissions (grams/mile)	0.277	5.111	0.853	0.044
	2007 emissions (pounds/mile)	6.11E-04	1.13E-02	1.88E-03	9.70E-05

Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
40	37	1480	0.90	16.68	2.78	2.27

		ROG	CO	Nox	PM10
HDT	2007 emissions (grams/mile)	0.878	7.628	8.742	0.286
	2007 emissions (pounds/mile)	1.94E-03	1.68E-02	1.93E-02	6.31E-04

Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
40	13	520	1.01	8.74	10.02	1.07

--100 Haul Truck Trips per Day--

		ROG	CO	Nox	PM10
MDT	2007 emissions (grams/mile)	0.277	5.111	0.853	0.044
	2007 emissions (pounds/mile)	6.11E-04	1.13E-02	1.88E-03	9.70E-05

Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
40	75	3000	1.83	33.80	5.64	4.59

		ROG	CO	Nox	PM10
HDT	2007 emissions (grams/mile)	0.878	7.628	8.742	0.286
	2007 emissions (pounds/mile)	1.94E-03	1.68E-02	1.93E-02	6.31E-04

Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
40	25	1000	1.94	16.82	19.27	2.06

Construction Trip Emissions

2007 - Construction Crew and 50 Haul Trucks per day

	ROG	CO	Nox	PM10
lbs/day	3.67	68.30	16.45	8.66

2007 - Construction Crew and 100 Haul Trucks per day

	ROG	CO	Nox	PM10
lbs/day	5.53	93.50	28.56	11.97

2008 - Construction Crew and 50 Haul Trucks per day

	ROG	CO	Nox	PM10
lbs/day	3.29	61.87	14.98	8.63

2nd Quarter 2007 through 1st Quarter 2008 Annual Construction Traffic Emissions

	ROG	CO	Nox	PM10
lbs/year	1188	20934	5844	2721
tons/year	0.59	10.47	2.92	1.36

				Emission Factors			
				ROG	CO	Nox	PM10
LDV	2008 emissions (grams/mile)			0.1985	4.9685	0.421	0.0345
	2008 emissions (pounds/mile)			4.38E-04	1.10E-02	9.28E-04	7.61E-05
	Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
	40	88	3520	1.54	38.56	3.27	5.31
MDT				ROG	CO	Nox	PM10
	2008 emissions (grams/mile)			0.25	4.706	0.773	0.044
	2008 emissions (pounds/mile)			5.51E-04	1.04E-02	1.70E-03	9.70E-05
	Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
	40	37	1480	0.82	15.35	2.52	2.27
HDT				ROG	CO	Nox	PM10
	2008 emissions (grams/mile)			0.811	6.945	8.013	0.267
	2008 emissions (pounds/mile)			1.79E-03	1.53E-02	1.77E-02	5.89E-04
	Miles/Trip	Trips/Day	Miles/Day	Mobile Source Emissions (pounds per day)			
	40	13	520	0.93	7.96	9.19	1.05

Operational Traffic

Merced WWTP Expansion - Operation Mobile Emissions

grams/mile

EMFAC2002 Emissions Factors

LDA	ROG	CO	NOx	PM10
2006	0.186	4.461	0.361	0.032
2007	0.162	4.041	0.324	0.032
2009	0.119	3.175	0.25	0.031
2010	0.1	2.789	0.218	0.031
LDT	**ROG**	**CO**	**NOx**	**PM10**
2006	0.323	7.662	0.675	0.038
2007	0.291	7.011	0.616	0.038
2009	0.224	5.635	0.494	0.037
2010	0.193	4.983	0.437	0.037
MDT	**ROG**	**CO**	**NOx**	**PM10**
2006	0.307	5.564	0.942	0.044
2007	0.277	5.111	0.853	0.044
2009	0.226	4.334	0.701	0.044
2010	0.203	3.985	0.628	0.044
HDT	**ROG**	**CO**	**NOx**	**PM10**
2006	0.949	8.389	9.5	0.306
2007	0.878	7.628	8.742	0.286
2009	0.746	6.344	7.334	0.251
2010	0.685	5.808	6.572	0.232

lbs/VMT
Entrained
PM10
0.0014335

grams/VMT
Entrained PM10
0.650243

Assumed average speed of MDT and HDT vehicle type to be 35 mph, LDA and LDV 45 mph to and from the project site.
Assumed average distance to and from the project site to be 20 miles each way.

Emissions = Vehicle Type x Emission Factor x Miles/Trip x Trips/Day
Note: Doubled trip length to take into account round trips

Mobile Emissions Associated with Operational Trips 2006 (existing scenario 10mgd)

Emission Factors

		ROG	CO	Nox	PM10
LDV	2006 emissions (grams/mile)	0.2545	6.0615	0.518	0.035
	2006 emissions (pounds/mile)	5.61E-04	1.34E-02	1.14E-03	7.72E-05

Miles/Trip	Trips/year	Miles/year	Mobile Source Emissions (pounds per year)			
40	5475	219000	122.8745	2926.54	250.09	330.84

		ROG	CO	Nox	PM10
HDT	2006 emissions (grams/mile)	0.949	8.389	9.5	0.306
	2006 emissions (pounds/mile)	2.09E-03	1.85E-02	2.09E-02	6.75E-04

Miles/Trip	Trips/year	Miles/year	Mobile Source Emissions (pounds per year)			
0.5	150	75	0.16	1.39	1.57	0.16

Mobile Emissions Associated with Operational Trips 2007 (alternate baseline 10mgd)

Emission Factors

		ROG	CO	Nox	PM10
LDV	2007 emissions (grams/mile)	0.2265	5.526	0.47	0.035
	2007 emissions (pounds/mile)	4.99E-04	1.22E-02	1.04E-03	7.72E-05

Miles/Trip	Trips/year	Miles/year	Mobile Source Emissions (pounds per year)			
40	5475	219000	109.3559	2667.99	226.92	330.84

		ROG	CO	Nox	PM10
HDT	2007 emissions (grams/mile)	0.878	7.628	8.742	0.286
	2007 emissions (pounds/mile)	1.94E-03	1.68E-02	1.93E-02	6.31E-04

Miles/Trip	Trips/year	Miles/year	Mobile Source Emissions (pounds per year)			
130	150	19500	37.74	327.93	375.82	40.25

Mobile Emissions Associated with Operational Trips 2010 (worse-case year for 20mgd)

Emission Factors

		ROG	CO	Nox	PM10
LDV	2010 emissions (grams/mile)	0.1465	3.886	0.3275	0.034
	2010 emissions (pounds/mile)	3.23E-04	8.57E-03	7.22E-04	7.50E-05

Miles/Trip	Trips/year	Miles/year	Mobile Source Emissions (pounds per year)			
40	7665	306600	99.0238	2626.67	221.37	462.50

10 mgd

	2006 - Operations: worker and haul trips			
	ROG	CO	Nox	PM10
lbs/year	123.03	2927.92	251.67	331.00
tons/year	0.06	1.46	0.13	0.17

Note: On-site disposal of biosolids would be allowed up until 2007, at which time the solids would be hauled to the Forward Landfill in Manteca, 130 miles roundtrip.

10 mgd

	2006 - Operations: worker and haul trips			
	ROG	CO	Nox	PM10
lbs/year	147.10	2995.92	602.74	371.09
tons/year	0.07	1.50	0.30	0.19

Note: On-site disposal of biosolids would be allowed up until 2007, at which time the solids would be hauled to the Forward Landfill in Manteca, 130 miles roundtrip.

20 mgd

	2010 - Operations: worker and haul trips			
	ROG	CO	Nox	PM10
lbs/year	100.10	2635.76	231.65	463.88
tons/year	0.05	1.32	0.12	0.23

HDT				ROG	CO	Nox	PM10
2010 emissions (grams/mile)				0.685	5.808	6.572	0.232
2010 emissions (pounds/mile)				1.51E-03	1.28E-02	1.45E-02	5.11E-04
Miles/Trip	Trips/year	Miles/year		Mobile Source Emissions (pounds per year)			
2	355	710		1.07	9.09	10.29	1.38

Attachment 3: WWTP Facility Emissions

Emission Factors

10 mgd (existing)

Equipment or Process	Permit #	Horsepower	MMBTU/hr	Total Permitted Fuel Usage	Units	Emission Factor NOx	VOC	CO	PM10	SO2
Cummins 4BT3.9G1 - diesel generator	N-4215-1-0	102		24 hours per day(?), 40 hours/year	lb/hp-hr	0.031	0.0025141	6.68E-03	2.50E-01	2.05E-03
Cummins KTA50-G9 - diesel generator	N-4302-8-0	2200		24 hours per day(?), 200 hours/year	g/hp-hr	6.9	0.17	1.3	0.11	8.09E-03
Detroit 8V92T diesel generator	N-4302-3-0	402		24 hours per day(?), 200 hours/year	lb/hp-hr	0.031	0.0025141	6.68E-03	2.20E-03	2.05E-03
Waukesha F3521GL lean digester gas fired engine - assume 650 Btu/scf	N-4302-4-1	350	1.25	46325 scf/day, 365 days per year (?)	g/hp-hr	0.8	0.25	2.75	0.1	4.08
AJAX WFGO2500 Fuel Oil Boiler	N-4302-6-0		2.5	43,800 gallons/yr, 2.5 MMBTu/hr	lb/MMBTu	0.143	0.0014	0.0357	0.014	0.203
WWTP				24 hrs per day, 365 days/yr	lb/day	NA	1.2573342	NA	NA	NA
Flares - assume 13.65 MMBTU/hr			13.65	UNITS = lb/106 BTU (or lb/MMBTU)		0.068	0.14	0.37	NA	NA

20 mgd

Equipment or Process	Permit #	Horsepower	MMBTU/hr	Total Permitted Fuel Usage		Emission Factor NOx	VOC	CO	PM10	SO2
Cummins 4BT3.9G1 - diesel generator	N-4215-1-0	102		24 hours per day(?), 40 hours/year	lb/hp-hr	0.031	0.0025141	6.68E-03	2.50E-01	2.05E-03
Cummins KTA50-G9 - diesel generator	N-4302-8-0	2200		24 hours per day(?), 200 hours/year	g/hp-hr	6.9	0.17	1.3	0.11	8.09E-03
Detroit 8V92T diesel generator	N-4302-3-0	402		24 hours per day(?), 200 hours/year	lb/hp-hr	0.031	0.0025141	6.68E-03	2.20E-03	2.05E-03
Waukesha F3521GL lean digester gas fired engine - assume 650 Btu/scf	N-4302-4-1	350	1.25	46325 scf/day, 365 days per year (?)	g/hp-hr	0.8	0.25	2.75	0.1	4.08

AJAX WFGO2500 Fuel Oil Boiler	N-4302-6-0		2.5	43,800 gallons/yr, 2.5 MMBTu/hr	lb/MMBTu	0.143	0.0014	0.0357	0.014	0.203
WWTP				24 hrs per day, 365 days/yr	lb/day	NA	2.5146684	NA	NA	NA
Flares - 13.65 MMBTU/hr			13.65	24 hrs per day, 365 days/yr	lb/MMBTu	0.06	0.063	0.3	NA	NA
Cummins QSK50 - diesel generator		2200		24 hrs per day, 200hrs/yr	g/hp-hr	6.9	1	2.6	0.15	8.09E-03
Cleaver Brooks CBE 125 or Hurst 400 (2 digester gas boilers - 1 is backup)			5.23	24 hrs/day, 8760 hrs/yr	ppmv	15	100	400	NA	NA

Conversion Factors and Emissions (LB/Day)

10 mgd (existing)

Equipment or Process	Permit #	Conversion Factor from g/hphr to lb/hphr						Emissions (pounds per day)				
			NOx	VOC	CO	PM10	SO2	NOx	VOC	CO	PM10	SO2
Cummins 4BT3.9G1 - diesel generator	N-4215-1-0	lb/hp-hr	3.10E-02	2.51E-03	6.68E-03	5.51E-04	2.05E-03	75.89	6.15	16.35	1.35	5.02
Cummins KTA50-G9 - diesel generator	N-4302-8-0	lb/hp-hr	1.52E-02	3.75E-04	2.87E-03	2.43E-04	1.78E-05	803.17	19.79	151.32	12.80	0.94
Detroit 8V92T diesel generator	N-4302-3-0	lb/hp-hr	3.10E-02	2.51E-03	6.68E-03	2.20E-03	2.05E-03	299.09	24.26	64.45	21.23	19.78
Waukesha F3521GL lean digester gas fired engine - assume 650 Btu/scf	N-4302-4-1	lb/hp-hr	1.76E-03	5.51E-04	6.06E-03	2.20E-04	4.08E+00	14.81	4.63	50.93	1.85	122.85
AJAX WFGO2500 Fuel Oil Boiler	N-4302-6-0	lb/MMBTu	1.43E-01	1.40E-03	3.57E-02	1.40E-02	2.03E-01	8.58	0.08	2.14	0.84	12.18
WWTP		lb/day	NA	1.26E+00	NA	NA	NA	0.00	1.26	0.00	0.00	0.00
Flares - assume 13.65 MMBTU/hr		lb/MMBTU	6.80E-02	1.40E-01	3.70E-01	NA	NA	22.28	45.86	121.21	0.00	0.00

20 mgd

Equipment or Process	Permit #							Emissions (pounds per day)				
			NOx	VOC	CO	PM10	SO2	NOx	VOC	CO	PM10	SO2
Cummins 4BT3.9G1 - diesel generator	N-4215-1-0	lb/hp-hr	3.10E-02	2.51E-03	6.68E-03	5.51E-04	2.05E-03	75.89	6.15	16.35	1.35	5.02
Cummins KTA50-G9 - diesel generator	N-4302-8-0	lb/hp-hr	1.52E-02	3.75E-04	2.87E-03	2.43E-04	1.78E-05	803.17	19.79	151.32	12.80	0.94
Detroit 8V92T diesel generator	N-4302-3-0	lb/hp-hr	3.10E-02	2.51E-03	6.68E-03	2.20E-03	2.05E-03	299.09	24.26	64.45	21.23	19.78

Waukesha F3521GL lean digester gas fired engine - assume 650 Btu/scf	N-4302-4-1	lb/hp-hr	1.76E-03	5.51E-04	6.06E-03	2.20E-04	4.08E+00	14.81	4.63	50.93	1.85	122.85
AJAX WFGO2500 Fuel Oil Boiler	N-4302-6-0	lb/MMBTu	1.43E-01	1.40E-03	3.57E-02	1.40E-02	2.03E-01	8.58	0.08	2.14	0.84	12.18
WWTP		lb/day	NA	2.51E+00	NA	NA	NA	0.00	2.51	0.00	0.00	0.00
Flares - 13.65 MMBTU/hr		lb/MMBTu	6.00E-02	6.30E-02	3.00E-01	NA	NA	19.66	20.64	98.28	0.00	0.00
Cummins QSK50 - diesel generator		lb/hp-hr	1.52E-02	2.20E-03	5.73E-03	3.31E-04	1.78E-05	803.17	116.40	302.65	17.46	0.94
Cleaver Brooks CBE 125 or Hurst 400 (2 digester gas boilers - 1 is backup)		lb/hp-hr	9.89E-03	6.59E-02	2.64E-01	NA	NA	1.24	8.27	33.09	0.00	0.00

Facility Emissions – Total Tons/Year

10 mgd (existing)			Emissions (tons/year)				
Equipment or Process	Permit #		NOx	VOC	CO	PM10	SO2
Cummins 4BT3.9G1 - diesel generator	N-4215-1-0		0.06	0.01	0.01	0.00	0.00
Cummins KTA50-G9 - diesel generator	N-4302-8-0		3.35	0.08	0.63	0.05	0.00
Detroit 8V92T diesel generator	N-4302-3-0		1.25	0.10	0.27	0.09	0.08
Waukesha F3521GL lean digester gas fired engine - assume 650 Btu/scf	N-4302-4-1		2.70	0.84	9.29	0.34	22.42
AJAX WFGO2500 Fuel Oil Boiler	N-4302-6-0		0.44	0.00	0.11	0.04	0.62
WWTP			0.00	0.23	0.00	0.00	0.00
Flares - assume 13.65 MMBTU/hr			4.07	8.37	22.12	0.00	0.00
		TOTALS	11.86	9.64	32.44	0.52	23.13

20 mgd			Emissions (tons/year)				
Equipment or Process	Permit #		NOx	VOC	CO	PM10	SO2
Cummins 4BT3.9G1 - diesel generator	N-4215-1-0		0.06	0.01	0.01	0.00	0.00
Cummins KTA50-G9 - diesel generator	N-4302-8-0		3.35	0.08	0.63	0.05	0.00
Detroit 8V92T diesel generator	N-4302-3-0		1.25	0.10	0.27	0.09	0.08
Waukesha F3521GL lean digester gas fired engine - assume 650 Btu/scf	N-4302-4-1		2.70	0.84	9.29	0.34	22.42
AJAX WFGO2500 Fuel Oil Boiler	N-4302-6-0		0.44	0.00	0.11	0.04	0.62
WWTP			0.00	0.46	0.00	0.00	0.00
Flares - 13.65 MMBTU/hr			3.59	3.77	17.94	0.00	0.00
Cummins QSK50 - diesel generator			3.35	0.49	1.26	0.07	0.00
Cleaver Brooks CBE 125 or Hurst 400 (2 digester gas boilers - 1 is backup)			0.23	1.51	6.04	0.00	0.00
		TOTALS	14.96	7.26	35.55	0.60	23.14