RECLAMATION

Managing Water in the West

General Conformity Applicability Analysis for the Clean Air Act

Folsom Dam Safety and Flood Damage Reduction Project, California
Mid-Pacific Region

U.S. Department of the Interior
Bureau of Reclamation
Region or Office Designation
City, State

March 2007

Mission Statements

The mission of the Department of the Interior is to protect and provide access to our Nation's natural and cultural heritage and honor our trust responsibilities to Indian Tribes and our commitment to island communities.

The mission of the Bureau of Reclamation is to manage, develop, and protect water and related resources in an environmentally and economically sound manner in the interest of the American public.

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prepared by

CDM

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General Conformity Applicability Analysis for the Clean Air Act

1.0 General Conformity Applicability Analysis

1.1 General Conformity Background

Section 176 (c) of the Clean Air Act (42 U.S.C. 7506(c)) requires any entity of the federal government that engages in, supports, or in any way provides financial support for, licenses or permits, or approves any activity to demonstrate that the action conforms to the applicable State Implementation Plan (SIP)[1] required under Section 110 (a) of the Federal Clean Air Act (42 U.S.C. 7410(a)) before the action is otherwise approved. In this context, conformity means that such federal actions must be consistent with a SIP's purpose of eliminating or reducing the severity and number of violations of the National Ambient Air Quality Standards (NAAQS) and achieving expeditious attainment of those standards. Each federal agency must determine that any action that is proposed by the agency and that is subject to the regulations implementing the conformity requirements will, in fact, conform to the applicable SIP before the action is taken. The Folsom DS/FDR Project actions are subject to the General Conformity Rule since the actions are sponsored and supported by multiple federal agencies.

On November 30, 1993, USEPA promulgated final general conformity regulations at 40 CFR 93 Subpart B for all federal activities except those covered under transportation conformity. The general conformity regulations apply to a proposed federal action in a non-attainment or maintenance area if the total of direct and indirect emissions of the relevant criteria pollutants and precursor pollutants caused by the proposed action equal or exceed certain de minimis amounts, thus requiring the federal agency to make a determination of general conformity.

The general conformity regulations incorporate a stepwise process, beginning with an applicability analysis. According to USEPA guidance (USEPA 1994), before any approval is given for a proposed action to go forward, the regulating federal agency must apply the applicability requirements found at 40 CFR 93.153(b) to the proposed action and/or determine the regional significance of the proposed action to evaluate whether, on a pollutant-by-pollutant basis, a determination of general conformity is required. The guidance states that the applicability analysis can be (but is not required to be) completed concurrently with any analysis required under NEPA. If the regulating federal agency determines that the general conformity regulations do not apply to the proposed action (meaning the proposed action emissions do not exceed the *de minimis* thresholds and are not regionally significant[2]), no further analysis or documentation is required.

[1] The SIP is the State's plan to attain the National Ambient Air Quality Standards for nonattainment pollutants.

[2] Regardless of the proposed action's emissions relative to the de minimis amounts, if the action's total emissions of a given pollutant represents 10 percent or more of the area's total emissions of that pollutant, the action is considered regionally significant and the federal agency must make a determination of general conformity.

The *de minimis* amounts for the region covering Folsom Dam are presented in Table 1.

Table 1
General Conformity de minimis Thresholds

Pollutant	*Federal Status*	*De minimis (TPY)*
VOC (as an Ozone Precursor)	Nonattainment, serious 8-hour Ozone	50
NOx (as an Ozone Precursor)	Nonattainment, serious 8-hour Ozone	50
PM_{10}	Nonattainment, moderate	100
CO	Attainment, Maintenance	100

TPY = tons per year
Sources: SMAQMD 2006a; 40 CFR 93.153.

This memorandum provides the applicability analysis for the Folsom DS/FDR actions selected alternative, including calculation methodology and results. This applicability analysis includes emission reduction measures that will be incorporated into the project design and specifications. A general description of the preferred alternative that the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and U.S. Army Corps of Engineers (Corps) propose to implement is provided in **Attachment A**.

2.0 Emission Calculation Methodology

In general, the construction emissions were estimated from various emission models and spreadsheet calculations, depending on the source type and data availability. The CARB Urban Emissions Model (URBEMIS) - Version 8.7 and EMFAC2002 (on-road vehicle emission factor model) were used along with emission factors obtained from USEPA AP-42. URBEMIS was developed to estimate emissions from a variety of projects such as residential, commercial and industrial developments. However, URBEMIS does not include specific features associated with dam construction and much of the emission calculation relied on other methods to estimate construction emissions. Annual emissions for each year of construction were estimated from appropriate emission factors, number of facilities and features being worked and the associated schedules. The following construction sources and activities were analyzed for emissions:

- On-site grading (cut/fill) fugitive dust – based on URBEMIS modeling.
- On-site construction equipment and haul truck engine emissions (all pollutants) – based on estimated equipment schedules, and CARB OFFROAD 2007 for construction equipment or EMFAC2002 for haul truck emission factors.
- Off-site haul truck engine emissions (all pollutants) – based on EMFAC2002 and estimated vehicle miles traveled.
- On-site and off-site haul truck fugitive dust emissions for paved and unpaved road travel – based on AP-42 and estimated vehicle miles traveled.
- On-site material processing plants (assumed to be primarily crushing and sorting operations) – based on AP-42 and number of facilities operating simultaneously.

- On-site concrete batch plants – based on AP-42 and number of facilities operating simultaneously.

- On-site blasting emissions – based on methodology provided in the Blue Rock Quarry Draft Environmental Impact Report (Sonoma County 2005) and approximate size of area subject to blasting activity.

- Off-site worker vehicle trips to and from the site, including paved road dust – based on EMFAC2002 (engine emission factors), Midwest Research Institute (MRI 1996, paved road dust emission factors), and estimated vehicle miles traveled.

The following sections provide additional discussion of operating durations and emission estimation methodologies used for each activity and source group.

2.1 Operating Durations

Most of the activities associated with the project will be conducted over a standard 5-day per week, 12-hour per day schedule. Those activities are assumed to occur for 22 days per month. Several specific tasks are assumed to be conducted over a 6-day per week, 12-hour per day schedule. These activities include the Auxiliary Spillway Phases 1, 2, and 3, MIAD Jet Grouting, and MIAD Overlay. These activities are assumed to occur for 26 days per month.

2.2 On-Site Grading and Asphalt Paving

The URBEMIS model was developed to estimate construction emissions from land development projects. It treats construction in three phases: Phase 1 – demolition, Phase 2 – site grading, and Phase 3 – building construction. For this proposed action, URBEMIS was used for fugitive PM emissions from grading (earth cut/fill) activities as well as paving equipment engine emissions and asphalt paving evaporative VOC emissions. The earth cut/fill activity is included in URBEMIS Phase 2–Site Grading, which allows the user to select one of four tiers of detail to calculate fugitive dust emissions. Movement of dam shell material was treated as grading. The volume of shell material for each feature and alternative were estimated in cubic yards per day; therefore, the Low Level tier was selected in URBEMIS for fugitive PM_{10} emission estimations. For each activity that included paving, approximately 10 acres of paved area was assumed.

2.3 On-site Construction Equipment Emissions

On-site construction equipment will include both off-road equipment (i.e., those mobile equipment not licensed to travel on public roads) and on-road trucks (i.e., mobile vehicles licensed to travel on public roads). Since the emission standards and fleet turnover is different for on-road and off-road equipment, two models are used to estimate emissions for the on-site equipment.

The CARB OFFROAD 2007 model was used to determine the emission factors used for all off-road construction equipment, such as dozers, loaders, graders, and scrapers. The estimated equipment counts for each year are presented in **Table 2**. The emission factors for each off-road equipment type are included in **Attachment B** to this memorandum. The emission factors

Table 2 ***Construction Equipment Counts by Year*** [1]														
Equipment Description	***2007***	***2008***	***2009***	***2010***	***2011***	***2012***	***2013***	***2014***	***2015***	***2016***	***2017***	***2018***	***2019***	***2020***
Water Truck	3	4	6	7	6	6	5	5	3	3	6	3	0	0
Pick-up Trucks	14	20	32	32	30	30	30	32	11	11	24	15	2	2
Excavator 330 BL/220hp	1	1	3	6	5	5	4	6	3	3	5	4	2	2
Excavator 365BL II/404 HP	2	2	2	1	2	2	2	2	1	1	1	0	0	0
Loader 938 G/160 hp	1	2	3	8	8	8	6	10	4	4	6	6	4	4
Loader 966 GII/246 hp	2	2	3	2	2	2	2	2	1	1	1	0	0	0
Scraper 631E/450 hp	0	0	1	1	0	0	0	0	0	0	1	1	0	0
Compactor 433/96 hp	2	2	4	3	2	2	2	2	1	1	3	2	0	0
Compactor 434C/70 hp	0	0	0	1	1	1	1	1	0	0	1	1	0	0
Dump Truck 285 hp D300	10	11	19	14	9	8	8	7	0	0	4	4	0	0
Dump Truck 405 hp D400	8	8	8	12	12	12	12	12	0	0	0	0	0	0
Dozer D4/80 hp	0	1	2	4	3	2	2	1	1	1	3	2	0	0
Dozer D6/185 hp	1	1	2	2	2	2	2	2	1	1	2	1	0	0
Dozer D8R/307 hp	1	2	3	2	5	2	2	2	1	1	3	2	0	0
Grader 14H/215 hp	1	1	2	5	5	4	4	3	1	1	3	2	0	0
Haul Truck Tractor Trailer	10	10	26	19	13	13	13	13	8	8	30	22	0	0
Rear Dump Truck 405 hp D400	8	8	14	9	12	12	12	12	11	11	22	11	0	0
Drill Rig - Ingersol Rand CM 375/215 hp	1	1	1	1	2	2	2	3	1	1	1	1	1	1
Drill Rig - Atlantic LDH80T/177 hp	0	1	1	0	0	0	0	0	0	0	0	0	0	0
Pump - 200 gpm/8 hp gas	0	1	2	2	2	2	2	3	1	1	2	2	1	1
Concrete pump - 65 yph/110 hp	0	1	1	4	5	4	4	4	1	1	1	1	1	1
Concrete portable mixer - electric	0	4	4	4	5	4	4	4	1	1	1	1	1	1
Air compressor - 1550 cfm, 150 psi/525 hp	1	3	3	1	2	2	2	3	1	1	1	1	1	1
Generator – 200 kw/270 hp	0	1	2	4	3	2	2	2	1	1	2	2	1	1
Generator – 500 kw/700 hp	0	0	0	1	2	2	2	2	0	0	0	0	0	0
Crane	0	0	0	3	4	3	3	3	1	1	1	1	1	1

[1] Values are the sum of all equipment on-site for all activities that occur during a given year. The number of pieces on-site at any given time may be less than the listed values if activities only occur for part of a year.

were developed by running OFFROAD 2007 to generate construction equipment emissions for Sacramento County for each year of the proposed action (2007 – 2020). The output included daily emissions (tons per day) for each equipment type (e.g., scrapers) and size (e.g., 175 hp) for all equipment in the county. The results for each year were divided by the county-wide counts for each year and multiplied by 2000 (lbs/ton) to obtain equipment specific daily emissions in lbs/day. The daily emission rates in Attachment B are based on one 8-hour work shift per day. The number of pieces of each equipment type for each activity is included in **Attachment C**.

The CARB EMFAC2002 model was used to determine haul/dump truck and water truck emissions for the proposed action. The analysis assumed that only on-road trucks, which are subject to more stringent engine emissions controls and are therefore cleaner than their off-road equivalents, will be used for hauling/dumping material and for watering on-site roads and active areas. In addition, the haul/dump trucks used specifically for the auxiliary spillway phases and the MIAD overlay activity of this project are assumed to be new 2007 trucks that meet the 0.2 g/(bhp-hr) NOx emission standard for 2007 and later on-road heavy duty diesel engines. This control measure will be a requirement in the project specifications included in contractor bid packages for auxiliary spillway and MIAD overlay activities. The emission factors applied to all water trucks and any haul/dump trucks not used on the auxiliary spillway or MIAD overlay activities are included in Attachment B under "On-Road Trucks". The emission factors used for haul/dump trucks used on the auxiliary spillway and MIAD overlay activities are included in **Attachment D**.

Re-entrained road dust from haul truck travel was estimated for unpaved roads. Unpaved road dust was estimated using emission factors from AP-42 (USEPA 2006). **Table 3** presents the unpaved road emission factors, including the effect of watering roadways three (3) times per day. The Folsom DS/FDR Project actions emission factor for unpaved road dust was averaged from the values calculated using the lowest and highest silt contents, which is slightly greater than the one calculated from the mean silt content. The round trip distance was estimated to be 2 miles based on travel from the auxiliary spillway to the D1/D2 staging areas and back.

Table 3
Unpaved Road Re-entrained Dust PM_{10} Emission Factors (lb/VMT)

	Silt (%)	***PM_{10}***	***$PM_{2.5}$***
Lowest	0.56	0.05	0.005
Worst	23	1.54	0.15
Mean	8.5	0.63	0.06
Folsom	**10**	**0.73**	**0.07**

Sources: USEPA 2006

The construction scheduling estimate for the Folsom DS/FDR Project assumes that one 8-hour shift is sufficient for most activities. However, the auxiliary spillway phases, and MIAD jet grouting is assumed to occur from sunrise to sunset, which averaged over a year is assumed to be approximately 12 hours per day. The analysis estimates emissions for **all** activities by multiplying the daily emission factors developed for one 8-hour shift per day (included in Attachment B) by a factor of 1.5.

2.4 Off-Site Haul Truck Engine Emissions and Road Dust

The haul truck engine emissions were calculated based on EMFAC2002 emission factors for heavy duty diesel trucks in Sacramento County and estimates of total vehicle miles traveled per day. The emission factors used in this analysis are presented in **Attachment E**. The average speed for off-site hauling was assumed to be 30 mph.

Re-entrained road dust from haul truck travel was estimated for paved roads. Paved road dust was estimated using emission factors developed by the Midwest Research Institute (MRI 1996). **Table 4** presents the paved road emission factors. Average road conditions and average daily trips were used for paved road emission factors.

Table 4
Paved Road Re-entrained Dust PM_{10} Emission Factors (g/VMT)

Road Condition	***Average Daily Trips (ADT)***		
	High	***Low***	***Average***
Average conditions	0.37	1.3	0.81
Worst-case conditions	0.64	3.9	2.1

Source: Midwest Research Institute 1996.

The offsite haul trucks were divided into two groups based on hauling materials and site locations. The long distance group was defined as hauling raw material from Marysville and Woodland, for which the roundtrip distances were estimated to 106 miles and 90 miles, respectively. The local group included trucks hauling materials from local sites to the dam area, which assumed that all roundtrips were approximately 50 miles. Both exhaust emissions and re-entrained dust from paved roads were calculated for the two groups of hauling trucks above.

2.5 On-Site Material Processing Plant Dust

On-site materials processing was assumed to be crushing and sorting. Emissions were estimated using the AP-42 emission factors summarized in **Table 5**, with an estimated materials processing facility achieving a maximum production rate of 5,000 tons per day. The emissions were calculated as the total of each process emission assuming the total material handled was subjected to all steps listed in Table 5.

Table 5 ***Materials Processing Emission Factors (lbs per ton of material)***		
Source	***Total PM_{10}***	***Total $PM_{2.5}$***
Tertiary Crushing	0.0024	ND
Tertiary Crushing (controlled)	0.00054	0.00010
Fines Crushing	0.0150	ND
Fines Crushing (controlled)	0.0012	0.000070
Screening	0.0087	ND
Screening (controlled)	0.00074	0.000050
Fines Screening	0.072	ND
Fines Screening (controlled)	0.0022	ND
Conveyor Transfer Point	0.00110	ND
Conveyor Transfer Point (controlled)	4.6×10^{-5}	1.3×10^{-5}
Wet Drilling – Unfragmented Stone	8.0×10^{-5}	ND
Truck Unloading -Fragmented Stone	1.6×10^{-5}	ND
Truck Unloading – Conveyor, crushed	0.00010	ND

ND = No Data
Source: USEPA 2006.

In developing the emission inventories for materials processing, it was assumed that prime power would be obtained from the electric utility grid, and that diesel engines would not be used for prime movers/generators. It was also assumed that wet suppression of plant dust would be required as a condition of obtaining an air quality permit; therefore, the Folsom DS/FDR Project design would include emission controls in the materials processing plants.

2.6 Concrete Batch Plant Dust

Concrete batching emissions were estimated using AP-42 emission factors and summarized in **Table 6** (USEPA 2006). The maximum daily production rate was estimated to be 300 cubic yards. Since the emission factor is in pounds per ton of concrete produced, the production rate in cubic yards per day was converted to tons per day with a concrete density of 4,946 lbs/cubic yard, resulting in 742 tons per day concrete production. The composition ratio of the aggregate, sand, and cement materials in the concrete was estimated to be 6:3:1. Only truck mixing of concrete is assumed for this project.

As with materials processing, it was assumed that prime power in the concrete batch plants would be obtained from the electric utility grid, and that diesel engines would not be used for prime movers/generators. It was also assumed that wet suppression of plant dust would be required as a condition of obtaining an air quality permit; therefore, the Folsom DS/FDR Project design would include emission controls in the concrete batch plants.

Table 6 ***Concrete Batch Plant PM_{10} Emission Factors (lbs ton of concrete)***		
Batch Plant Source	***Uncontrolled***	***Controlled***
Aggregate transfer	0.0033	ND
Sand transfer	0.00099	ND
Cement unloading to elevated storage silo (pneumatic)	0.46	0.00034
Cement supplement unloading to elevated storage silo	1.10	0.0049
Weigh hopper loading	0.0024	ND
Mixer loading (central mix)	0.156	0.0055
Truck loading (truck mix)	0.311	0.0263

ND = No Data
Source: USEPA 2006.

3.0 Emission Control Measures

The unmitigated NOx, PM10, and CO emissions identified in the Draft EIS/EIR for the project exceed the General Conformity de minimis thresholds for each year of the Folsom DS/FDR actions construction. For the air quality impact analysis included in the Draft EIS/EIR, a number of conservative assumptions were made, including:

- Compressing all activities into a seven-year schedule with substantial overlapping of activities throughout the project site
- Simultaneous operations at multiple barrow sites, materials handling/screening facilities, and concrete batch plants.
- Assuming on-site haul distances that were greater than would typically be encountered on the project
- Double hauling of most of the material generated on site: soils/material were assumed to be excavated and hauled to a staging area, then later moved to its final placement location
- Slightly dated emission factors for offroad equipment were used which were higher than currently projected emission factors.

The project components, phasing, and overall schedule have been revised since publication of the Draft EIS/EIR for various purposes, including the reduction of environmental impacts. The revised project description is summarized in Attachment A, and is presented in detail in Chapter 2 of the Final EIS/EIR. The emission control measures, described below, will be incorporated into project designs and

specifications to reduce emissions. The control measures that are now part of the project design/specification include:

- Only new 2007 on-road haul trucks will be used for hauling over 3 million cubic yards of material from the auxiliary spillway to the D1/D2 staging areas. The engines in these trucks will meet the 2007 NOx emission standard of 0.2 grams per horsepower-hour.

- Only on-road dump trucks and water trucks will be used for other on-site material hauling and road watering to reduce NOx emissions. These trucks are assumed to have fleet average NOx emissions for heavy duty diesel vehicles from the EMFAC2002 model.

- Facility power for the concrete batch plants and rock/material screening facilities will come from the electric utility grid, not diesel-driven generators and pumps. Using grid power eliminates both the gaseous pollutants associated with diesel engines, as well as diesel particulate matter, which is a listed toxic air contaminant in California.

- Wet suppression will be used at the concrete batch plants and rock/material screening facilities to reduce plant dust emissions. For this analysis, the controlled emissions are based on AP-42 controlled emission factors for batch plants and crushing facilities.

- Wet suppression and soil stabilization will be used on the on-site haul roads and inactive construction areas to minimize fugitive dust emissions.

- The Project Agencies will submit to the SMAQMD a comprehensive inventory of all off-road construction equipment, equal to or greater than 50 horsepower, that will be used an aggregate of 40 or more hours during any portion of the construction project. The inventory shall include the horsepower rating, engine production year, engine family number, and projected hours of use or fuel throughput for each piece of equipment. The inventory shall be updated and submitted monthly throughout the duration of the project, except that an inventory shall not be required for any 30-day period in which no construction activity occurs. At least 48 hours prior to the use of subject heavy-duty off-road equipment, the project representative shall provide SMAQMD with the anticipated construction timeline including start date, and name and phone number of the project manager and on-site foreman.

Additional or replacement measures that the Folsom DS/FDR Project may incorporate, as appropriate for the area and equipment operating on a given feature, include:

- Truck wheel washing facilities at site exits onto public roadways will be used to minimize dirt trackout onto public roadways.
- Maintaining minimum truck bed freeboard or covering haul truck beds to limit hauling fugitive dust emissions.
- Paving on-site roadways to minimize fugitive dust emissions.
- Install electric-driven conveyors on portions of the material haul routes to reduce on-site haul truck engine emissions and road dust. Determining the feasibility of conveyors will need to account for elevation changes along and around the dam. If installed, power for the conveyor system will need to come from the electric utility grid, not diesel generators. In addition, material moisture content will be maintained (e.g., wet suppression) to minimize fugitive dust from soil/material being transported by conveyor.
- Potentially require all off-road equipment engines to meet Tier 3 standards.
- ARB-Verified control devices for offroad diesel engine NOx emissions may be installed on units where the device can be located on the equipment in a safe manner (i.e., the operating can operate the equipment safely and without visual obstructions), and the emission reduction associated with installing the device is cost effective.

4.0 Emission Inventories

The estimated controlled emission inventories are presented in **Table 7**. These inventories assumed that the control measures identified above have been implemented through project design requirements and specifications. A breakdown of construction emissions by general activity is included in **Attachment F**. The offroad construction equipment annual emissions by equipment type are presented in **Attachment G**, and the corresponding offroad engine NOx emissions factors, in grams per horsepower-hour are presented in **Attachment H**.

Table 7 ***Project Construction Emission Inventories (TPY)***			
Year	***NOx***	***CO***	***PM_{10}***
2007	9.64	10.42	38.68
2008	46.92	43.27	55.00
2009	38.05	23.57	55.81
2010	40.55	40.14	57.31
2011	42.21	43.60	58.02
2012	45.87	43.76	76.17
2013	39.49	40.94	74.37
2014	35.63	36.14	75.00
2015	11.44	5.09	15.41
2016	16.36	8.07	18.96
2017	13.32	8.45	10.98
2018	6.95	5.47	7.35
2019	0.76	0.55	5.78
2020	0.43	0.34	5.76
De minimis threshold	50	100	100
Exceed de minimis?	No	No	No

Source: CDM 2007.

5.0 Uncertainties

The emission calculations conducted for this General Conformity applicability analysis are based on various factors and assumptions which have implicit or explicit uncertainty. Recent models and data are used to provide relatively accurate emission inventories for comparison to General Conformity *de minimis* thresholds. In addition, at least one assumption was made in developing the inventories which provide some level of conservatism in the results. On-site haul truck emissions for Auxiliary Spillway phases and MIAD overlay activity were based on each and every truck operating for 12 hours per day. This assumption does not account for down time due to mandatory breaks and lunch. The emissions for these trucks are overestimated by approximately 20 percent.

6.0 Results and Conclusions

With the implementation of the air quality control measures identified in the project design, the emissions of NOx, PM_{10}, and CO will be below the de minimis threshold for General Conformity. Since the Draft EIS/EIR indicated that VOC emissions were already below the de minimis thresholds, and since the measures incorporated into

the project will not increase VOC emissions, no additional analysis of VOC was conducted for this applicability analysis. Emissions of all nonattainment or maintenance pollutants from the project are below the *de minimis* thresholds, and the project is presumed to conform with the approved SIP.

Attachment A

The Folsom Dam Safety and Flood Damage Reduction Project

1.1 Introduction

On December 1, 2006, the U.S. Department of the Interior, Bureau of Reclamation (Reclamation) and the U.S. Army Corps of Engineers (Corps), and the Corps non-federal sponsors, the State Reclamation Board (Reclamation Board)/California Department of Water Resources (DWR) and the Sacramento Area Flood Control Agency (SAFCA), released the Folsom Dam Safety and Flood Damage Reduction (Folsom DS/FDR) Draft Environmental Impact Statement/Environmental Impact Report (EIS/EIR) for public review and comment. The Folsom DS/FDR Final EIS/EIR will be released to the public on March 30, 2007. The EIS/EIR addresses four separate projects to be implemented and constructed jointly and separately by Reclamation and the Corps. These include:

1. A new **Auxiliary Spillway** would be controlled by 6 submerged tainter gates (6STG). The Auxiliary Spillway, also referred to as the JFP, would be implemented jointly by Reclamation and the Corps to address hydrologic Dam Safety and Flood Damage Reduction concerns related to controlled release of water from Folsom Dam. Reclamation has also evaluated a Fuseplug Spillway alternative as a stand-alone dam safety alternative to be implemented only if the Corps is unable to receive timely construction funding or realize timely hydrologic risk reduction by construction of the 6STG spillway. Reclamation and the Corps will jointly identify the final environmental mitigation and commitments for the new Auxiliary Spillway project element, inclusive of the Fuseplug option, under a joint JFP ROD.

2. Additional **Dam Safety** modifications will be undertaken by Reclamation to address seismic and static concerns related to the Main Concrete Dam and six of the eleven earthen structures. Seismic modifications would be made to MIAD by undertaking foundation jet grouting in conjunction with a downstream overlay and the reinforcement of Main Concrete Dam existing gates and piers. Static modifications would be undertaken to the RWD, LWD, Dikes 4, 5, and 6, and MIAD. Reclamation will independently identify the final environmental mitigations and commitments for this effort under a stand-alone ROD.

3. **Security** improvements will be undertaken by Reclamation to key Folsom facilities to address national security concerns. Reclamation will independently identify the final environmental mitigations and commitments for this effort under the dam safety ROD.

4. **Flood Damage Reduction** improvements in addition to the 6STG will be undertaken by the Corps including modification or replacement of existing emergency spillway gates and a 3.5-ft raise to all Folsom embankment facilities. The Corps will prepare a separate ROD for the 3.5-ft raise, emergency gate modifications or replacement, and other flood damage reduction features. Detailed design for these flood damage reduction features

at the Folsom Facility would occur during the Corps' pre-construction, engineering and design phase. The issuance of a ROD by the Corps for such improvements at the Folsom Facility is not expected to occur in conjunction with the currently proposed DS/FDR actions, but rather would occur later as a separate action with supplemental environmental documentation if necessary.

Reclamation and the Corps have identified Alternative 3 as the Preferred Alternative. The Draft EIS/EIR originally described Alternative 3 and the Partner Agencies refined it based on public and agency comments received on the Draft EIS/EIR. The Preferred Alternative, as discussed in the Final EIS/EIR and the Corp's Selected Plan presented in its Post Authorization Change (PAC) Report, incorporates elements of the four projects described above. A Joint ROD addressing only the JFP Auxiliary Spillway project (feature #1) of the Preferred Alternative will be completed by both the Reclamation and the Corps. Separate standalone RODs will be developed by Reclamation to address dam safety and security (features #2 and #3), and by the Corps to address flood damage reduction issues (feature #4). **Table A-1** identifies the DS/FDR action, the responsible agency, and the issue addressed.

Table A-1
Components of the Preferred Alternative (Alternative 3)

Action	*Responsible Agency*	*Concern Addressed*
JFP Auxiliary Spillway construction	Reclamation and Corps	Dam Safety, Flood Damage Reduction, hydrologic control
MIAD foundation stabilization and overlay	Reclamation	Dam Safety, seismic upgrades
Left and Right Wing Dams, Dikes 4, 5, 6 upgrades	Reclamation	Dam Safety, static upgrades
Main Dam concrete block, pier, and gates reinforcement	Reclamation	Dam Safety, seismic upgrades
Facility Security Improvements	Reclamation	National Security
Existing Spillway Gates Replacement	Corps	Flood Damage Reduction
Facility Raise	Corps	Flood Damage Reduction

Project Description of the Preferred Alternative (Alternative 3)

The following sections provide a description of the elements included in the Preferred Alternative (Alternative 3), as discussed in the Final EIS/EIR.

Joint Federal Project - Auxiliary Spillway

The JFP involves the construction of a new Auxiliary Spillway controlled by six submerged tainter gates (6STG) and including a concrete-lined chute, stilling basin, and approach channel. This new spillway would provide the operational capability for improved hydrologic control (controlled sustained discharge earlier and for longer

durations and/or prevention of dam or embankment overtopping) of storm induced floods in excess of reservoir storage capacity in advance of and during a major storm.

The new Auxiliary Spillway would be constructed jointly by Reclamation and the Corps in three separate phases. Reclamation would initiate excavation of the spillway chute and stilling basin and the Corps would complete excavation of the chute including the approach channel, and would construct the control structure and concrete lining of the chute, approach channel, and stilling basin. The Final EIS/EIR addressed the impacts of constructing the spillway in phases.

The JFP Auxiliary Spillway would include the following actions and features:

1. Excavation of up to 3.5 million cubic yards (cy) of soil and rock material to create the spillway chute, approach channel, and control structure.

2. Lining of the spillway chute, approach channel, and stilling basin with concrete.

3. Construction of a new stilling basin at the toe of the Auxiliary Spillway

4. Construction of a haul road, entirely on federal property, for the transport and stockpiling/disposal of excavated material

5. Stockpiling/disposal of excavated material at the toe of the LWD, Observation Point, Dike 7, right abutment of Mormon Island Auxiliary Dam (MIAD right groin), and the D1/D2 location southwest of MIAD

6. Staging of contractor materials and equipment at the spillway excavation site, Observation Point, and D1/D2 location.

7. Construction of a recreational access bypass near the entry of Folsom Point to allow unrestricted access to Folsom Point by the public during peak use periods.

The stockpiled material that is excavated from the spillway is intended for use in the construction of proposed dam safety improvements, including placement of a downstream overlay at MIAD and construction of contractor staging platforms. It is anticipated that it would take up to 7 years, starting in the Fall of 2007 and ending in 2014, to complete all three phases of construction of the new JFP Auxiliary Spillway.

Dam Safety Improvements

To address seismic and static concerns for structures comprising the Folsom Facility, Reclamation would implement planned modifications for the Main Concrete Dam, the Right Wing Dam (RWD), the Left Wing Dam (LWD) , Dikes 4, 5, and 6, and Mormon Island Auxiliary Dam (MIAD). All of these modifications would be constructed independently by Reclamation.

Main Concrete Dam. To address seismic concerns allowing the Main Concrete Dam to withstand a major earthquake, three types of improvements would be implemented. These include anchoring of the monoliths and installation of reinforcements to the existing spillway gates and piers. The concrete monoliths forming the main dam could potentially slip along the joints of adjacent blocks during an earthquake. Deformation of the gate piers and during earthquake loading could result in failure of several spillway gates. These failures could release significant quantities of water that could cause flooding and possible failure of the downstream levees. The three types of improvements proposed to enhance main dam safety include:

a) Pier Tendon Installation – This project will anchor concrete monoliths that form piers to prevent movement of the blocks during a major earthquake. Tendons will be installed into the piers by drilling a borehole into the concrete blocks, inserting the tendon, and grouting the tendon in place. The tendon and hole will then be grouted to the surface. There are six tendons anticipated per pier block with seven piers identified for anchoring.

b) Pier Wrap - This improvement to the main dam involves placement of a steel plate wrapped around the downstream portion of the pier and anchored with bolts on both sides that extend completely through the pier, upstream of the area of concern. The steel plate would carry the load placed on it if the pier tends to shear and displace during an earthquake.

c) Spillway Gate Modifications - Spillway gates could be overstressed during large seismic events and could fail from buckling of the gate arms. Failure of several spillway gates could release significant quantities of water that could cause flooding and failure of the downstream levees. The proposed modifications will strengthen the gate arms through installation of metal plate bracing. This strengthening could be performed with the gate in place. During construction, a bulkhead would be installed upstream of the gate to eliminate loading on the gate and the reinforcement installed.

LWD, RWD, Dikes 4, 5, and 6, MIAD Static Control. To address static (seepage) concerns for the LWD, RWD, Dikes 4, 5, and 6, and MIAD, Reclamation would install new seepage control filters within the downstream face of each earthen structure. The filter material would be comprised of processed sand and gravel material that would be delivered to each individual facility from offsite and/or processed on-site in a rock crushing plant. The processing plant would be located near the LWD and would use materials excavated from the Auxiliary Spillway as the feedstock. The construction improvements to the earthen facilities involve stripping a layer of shell material from the downstream face of the wing dams and dikes, placement of the filter material, and replacing the shell. Additional material needed to rebuild the shell would either be excavated from the Auxiliary Spillway site or from supplemental borrow sites.

MIAD. To address seismic concerns for MIAD, two types of improvements would be implemented.

a) Jet Grouting of MIAD Foundation. The first improvement to MIAD will involve stabilization of its foundation using a subsurface jet grout injection process. A cement-grout mixture would be formed on-site using raw cement material hauled to the project site that is mixed with water. The cement-water mixture would be injected into the subsurface using a drilling method. The grout mixture will solidify the historic river cobble/dredged stream bed materials beneath MIAD forming a stable foundation.

b) MIAD Overlay. Following jet grouting, material excavated from the new Auxiliary Spillway site that was temporarily stockpiled at the D1/D2 area, along with processed sand and gravel material, will be placed as an overlay on the downstream face of MIAD. This overlay is intended to add additional stability to the downstream face of the earthen structure.

Dam Security Improvements

To improve security measures for this National Critical Infrastructure Facility, Reclamation would install security cameras at access points to the Main Concrete Dam, Dikes 4 through 7, and at MIAD. The cameras would be placed on 30-ft steel poles with electrical and cable connections buried. To improve the night visibility of the Main Concrete Dam and control gates, Reclamation would install lighting to focus on the critical aspects of this structure. To the extent practicable, lighting would be installed in a manner that meets security mission requirements and minimizes glare or reflection impacts to homes and other private property surrounding the reservoir.

Auxiliary Spillway Fuseplug Control Structure

In the Final EIS/EIR Reclamation and the Corps identified a six submerged tainter gate (6STG) structure as their preferred method of improving hydrologic control of releases from Folsom Reservoir. During the evaluation of control structures, Reclamation also evaluated construction of a fuse-gate control structure as an alternative means of hydrologic control during major storm events. The fuse-gate control structure would address Reclamation's dam safety objectives but not the Corps flood damage reduction objectives. Reclamation would install the fuseplug control structure only if the Corps experienced delays in design and construction of the 6STG control structure.

Folsom DS/FDR Schedule

The approximate schedule for the Folsom DS/FDR Project can be seen in Attachment F of this memorandum.

Attachment B

Attachment B
Emission Factors for Off-Road Diesel Equipment Types

Equipment Type		Exhaust Emission Factors, lb/day				
		ROG	CO	NOx	PM10	PM2.5
Bore/Drill Rigs						
	2006	2.87	21.44	21.72	1.24	1.14
	2007	0.33	1.47	3.91	0.14	0.13
	2008	0.30	1.47	3.47	0.13	0.12
	2009	0.27	1.46	3.10	0.12	0.11
	2010	0.25	1.45	2.78	0.11	0.11
	2011	0.23	1.45	2.43	0.10	0.11
	2012	0.21	1.45	2.15	0.08	0.11
	2013	0.20	1.45	1.93	0.07	0.11
	2014	0.19	1.45	1.68	0.06	0.11
	2015	0.17	1.45	1.36	0.05	0.11
	2016	0.16	1.45	1.09	0.04	0.11
	2017	0.15	1.45	0.89	0.03	0.11
	2018	0.13	1.45	0.72	0.02	0.11
	2019	0.12	1.45	0.57	0.02	0.11
	2020	0.12	1.45	0.46	0.01	0.11
Cranes						
	2006	1.44	7.54	6.94	0.38	0.35
	2007	0.85	3.40	8.46	0.33	0.30
	2008	0.81	3.12	8.00	0.31	0.29
	2009	0.77	2.88	7.56	0.29	0.27
	2010	0.73	2.67	7.14	0.28	0.25
	2011	0.70	2.47	6.64	0.25	0.25
	2012	0.66	2.29	6.18	0.23	0.25
	2013	0.62	2.13	5.73	0.21	0.25
	2014	0.59	1.99	5.23	0.19	0.25
	2015	0.56	1.88	4.76	0.17	0.25
	2016	0.53	1.78	4.32	0.16	0.25
	2017	0.51	1.71	3.91	0.14	0.25
	2018	0.48	1.64	3.52	0.13	0.25
	2019	0.46	1.59	3.17	0.12	0.25
	2020	0.44	1.54	2.84	0.10	0.25
Crawler Tractors						
	2006	--	--	--	--	--
	2007	0.84	3.02	7.25	0.35	0.32
	2008	0.80	2.83	6.87	0.33	0.31
	2009	0.76	2.66	6.50	0.31	0.29
	2010	0.72	2.50	6.15	0.30	0.27
	2011	0.68	2.36	5.77	0.28	0.26
	2012	0.65	2.23	5.40	0.26	0.24
	2013	0.61	2.12	5.05	0.24	0.22
	2014	0.58	2.03	4.67	0.22	0.20
	2015	0.55	1.94	4.31	0.20	0.18
	2016	0.52	1.87	3.96	0.18	0.17
	2017	0.49	1.80	3.64	0.17	0.15
	2018	0.46	1.75	3.34	0.15	0.14
	2019	0.44	1.70	3.06	0.14	0.13
	2020	0.41	1.66	2.81	0.12	0.11

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Emission Factors for Off-Road Diesel Equipment Types

Equipment Type	Exhaust Emission Factors, lb/day				
	ROG	CO	NOx	PM10	PM2.5
Electric					
2006	0.00	0.00	0.00	0.00	0.00
2007	0.00	0.00	0.00	0.00	0.00
2008	0.00	0.00	0.00	0.00	0.00
2009	0.00	0.00	0.00	0.00	0.00
2010	0.00	0.00	0.00	0.00	0.00
2011	0.00	0.00	0.00	0.00	0.00
2012	0.00	0.00	0.00	0.00	0.00
2013	0.00	0.00	0.00	0.00	0.00
2014	0.00	0.00	0.00	0.00	0.00
2015	0.00	0.00	0.00	0.00	0.00
2016	0.00	0.00	0.00	0.00	0.00
2017	0.00	0.00	0.00	0.00	0.00
2018	0.00	0.00	0.00	0.00	0.00
2019	0.00	0.00	0.00	0.00	0.00
2020	0.00	0.00	0.00	0.00	0.00
Excavators					
2006	1.84	7.89	7.76	0.41	0.37
2007	0.90	2.75	9.49	0.34	0.31
2008	0.85	2.57	8.83	0.31	0.29
2009	0.81	2.40	8.23	0.29	0.27
2010	0.77	2.26	7.67	0.28	0.25
2011	0.73	2.14	7.01	0.25	0.25
2012	0.70	2.04	6.40	0.22	0.25
2013	0.67	1.97	5.85	0.20	0.25
2014	0.63	1.91	5.19	0.18	0.25
2015	0.60	1.87	4.59	0.16	0.25
2016	0.57	1.84	4.04	0.14	0.25
2017	0.54	1.81	3.54	0.12	0.25
2018	0.51	1.78	3.09	0.11	0.25
2019	0.48	1.76	2.69	0.09	0.25
2020	0.45	1.75	2.34	0.08	0.25
Graders					
2006	1.20	5.46	10.42	0.56	0.51
2007	0.63	1.75	6.47	0.24	0.22
2008	0.59	1.65	6.09	0.23	0.21
2009	0.56	1.56	5.72	0.21	0.19
2010	0.53	1.48	5.37	0.20	0.18
2011	0.50	1.41	4.97	0.18	0.18
2012	0.47	1.35	4.60	0.16	0.18
2013	0.45	1.29	4.25	0.15	0.18
2014	0.42	1.25	3.85	0.13	0.18
2015	0.40	1.21	3.47	0.12	0.18
2016	0.37	1.17	3.12	0.11	0.18
2017	0.35	1.15	2.81	0.10	0.18
2018	0.33	1.13	2.51	0.09	0.18
2019	0.31	1.11	2.25	0.08	0.18
2020	0.30	1.10	2.00	0.07	0.18

Attachment B
Emission Factors for Off-Road Diesel Equipment Types

Equipment Type	Exhaust Emission Factors, lb/day				
	ROG	CO	NOx	PM10	PM2.5
Off-Highway Tractors/Compactors					
2006	2.08	11.55	10.44	0.57	0.53
2007	1.00	2.73	5.71	0.50	0.46
2008	0.96	2.70	5.47	0.48	0.44
2009	0.91	2.66	5.23	0.46	0.42
2010	0.87	2.62	5.00	0.44	0.41
2011	0.82	2.59	4.78	0.42	0.41
2012	0.78	2.56	4.56	0.40	0.41
2013	0.74	2.53	4.34	0.38	0.41
2014	0.70	2.51	4.13	0.36	0.41
2015	0.67	2.47	3.91	0.33	0.41
2016	0.63	2.45	3.70	0.31	0.41
2017	0.60	2.42	3.49	0.29	0.41
2018	0.57	2.40	3.30	0.27	0.41
2019	0.54	2.39	3.11	0.25	0.41
2020	0.51	2.37	2.94	0.24	0.41
Rubber Tired Loaders					
2006	0.92	4.34	7.67	0.41	0.37
2007	0.54	1.75	4.97	0.22	0.21
2008	0.51	1.70	4.67	0.21	0.19
2009	0.48	1.65	4.39	0.20	0.18
2010	0.46	1.62	4.13	0.19	0.17
2011	0.43	1.58	3.84	0.18	0.17
2012	0.41	1.55	3.57	0.16	0.17
2013	0.38	1.53	3.32	0.15	0.17
2014	0.36	1.50	3.05	0.13	0.17
2015	0.34	1.49	2.76	0.12	0.17
2016	0.32	1.47	2.48	0.11	0.17
2017	0.30	1.46	2.23	0.10	0.17
2018	0.28	1.45	2.00	0.09	0.17
2019	0.26	1.44	1.78	0.08	0.17
2020	0.25	1.43	1.59	0.07	0.17
Scrapers					
2006	3.64	18.42	17.45	0.93	0.85
2007	1.47	6.86	14.09	0.57	0.52
2008	1.40	6.29	13.37	0.54	0.50
2009	1.34	5.78	12.68	0.51	0.47
2010	1.28	5.32	12.02	0.49	0.45
2011	1.22	4.91	11.27	0.45	0.45
2012	1.17	4.55	10.56	0.42	0.45
2013	1.11	4.23	9.90	0.38	0.45
2014	1.06	3.96	9.14	0.35	0.45
2015	1.01	3.73	8.42	0.32	0.45
2016	0.95	3.52	7.75	0.30	0.45
2017	0.90	3.35	7.11	0.27	0.45
2018	0.86	3.19	6.52	0.25	0.45
2019	0.81	3.06	5.96	0.22	0.45
2020	0.77	2.94	5.45	0.20	0.45

Attachment B
Emission Factors for Off-Road Diesel Equipment Types

Equipment Type		Exhaust Emission Factors, lb/day				
		ROG	CO	NOx	PM10	PM2.5
On-Road Haul Trucks						
	2006	0.31	1.55	3.70	0.15	0.13
	2007	0.31	1.55	3.70	0.15	0.13
	2008	0.30	1.46	3.42	0.14	0.12
	2009	0.28	1.37	3.16	0.13	0.11
	2010	0.26	1.27	2.84	0.12	0.10
	2011	0.24	1.18	2.53	0.11	0.09
	2012	0.22	1.10	2.25	0.10	0.08
	2013	0.20	1.02	1.99	0.09	0.08
	2014	0.19	0.96	1.75	0.08	0.07
	2015	0.17	0.90	1.54	0.08	0.06
	2016	0.16	0.85	1.35	0.07	0.06
	2017	0.15	0.80	1.18	0.07	0.05
	2018	0.13	0.76	1.02	0.06	0.05
	2019	0.13	0.73	0.89	0.06	0.05
	2020	0.12	0.70	0.78	0.06	0.04
Pick-up Trucks						
	2006	0.07	0.38	0.36	0.04	0.03
	2007	0.07	0.38	0.36	0.04	0.03
	2008	0.07	0.37	0.36	0.04	0.03
	2009	0.06	0.37	0.36	0.04	0.03
	2010	0.06	0.36	0.36	0.04	0.03
	2011	0.06	0.36	0.36	0.04	0.03
	2012	0.06	0.36	0.36	0.04	0.03
	2013	0.06	0.36	0.36	0.03	0.03
	2014	0.06	0.35	0.36	0.03	0.03
	2015	0.06	0.35	0.36	0.03	0.03
	2016	0.05	0.34	0.36	0.03	0.03
	2017	0.05	0.34	0.36	0.03	0.03
	2018	0.05	0.34	0.36	0.03	0.03
	2019	0.05	0.34	0.37	0.03	0.03
	2020	0.05	0.33	0.37	0.03	0.02
Generator Sets (<500)						
	2006	--	--	--	--	--
	2007	0.20	0.79	2.46	0.08	0.07
	2008	0.19	0.73	2.35	0.07	0.07
	2009	0.17	0.68	2.23	0.07	0.06
	2010	0.16	0.63	2.12	0.06	0.06
	2011	0.15	0.58	1.97	0.06	0.06
	2012	0.14	0.54	1.83	0.05	0.06
	2013	0.13	0.51	1.69	0.05	0.06
	2014	0.12	0.49	1.53	0.04	0.06
	2015	0.11	0.47	1.37	0.04	0.06
	2016	0.10	0.46	1.26	0.04	0.06
	2017	0.10	0.45	1.16	0.03	0.06
	2018	0.10	0.44	1.07	0.03	0.06
	2019	0.09	0.44	0.98	0.03	0.06
	2020	0.09	0.43	0.89	0.03	0.06

Attachment B
Emission Factors for Off-Road Diesel Equipment Types

Equipment Type		Exhaust Emission Factors, lb/day				
		ROG	CO	NOx	PM10	PM2.5
Generator Sets (<750)						
	2006	--	--	--	--	--
	2007	0.33	1.28	4.07	0.13	0.12
	2008	0.31	1.18	3.89	0.12	0.11
	2009	0.29	1.09	3.70	0.11	0.10
	2010	0.27	1.01	3.51	0.11	0.10
	2011	0.25	0.93	3.27	0.10	0.10
	2012	0.23	0.87	3.04	0.09	0.10
	2013	0.21	0.83	2.82	0.08	0.10
	2014	0.20	0.79	2.55	0.07	0.10
	2015	0.18	0.76	2.30	0.07	0.10
	2016	0.17	0.74	2.12	0.06	0.10
	2017	0.17	0.73	1.94	0.06	0.10
	2018	0.16	0.71	1.77	0.05	0.10
	2019	0.15	0.70	1.62	0.05	0.10
	2020	0.14	0.70	1.47	0.04	0.10
Pumps						
	2006	--	--	--	--	--
	2007	0.17	0.65	1.44	0.07	0.06
	2008	0.16	0.64	1.38	0.07	0.06
	2009	0.15	0.64	1.31	0.06	0.06
	2010	0.14	0.64	1.25	0.06	0.06
	2011	0.13	0.64	1.18	0.06	0.06
	2012	0.13	0.64	1.11	0.06	0.06
	2013	0.12	0.63	1.04	0.05	0.06
	2014	0.11	0.63	0.97	0.05	0.06
	2015	0.10	0.63	0.89	0.04	0.06
	2016	0.09	0.63	0.82	0.04	0.06
	2017	0.08	0.63	0.76	0.04	0.06
	2018	0.08	0.63	0.70	0.03	0.06
	2019	0.07	0.63	0.64	0.03	0.06
	2020	0.07	0.64	0.59	0.03	0.06
Air Compressors						
	2006	--	--	--	--	--
	2007	0.39	1.51	4.35	0.15	0.14
	2008	0.37	1.38	4.15	0.14	0.13
	2009	0.35	1.26	3.96	0.14	0.12
	2010	0.33	1.15	3.76	0.13	0.12
	2011	0.31	1.05	3.50	0.12	0.12
	2012	0.29	0.98	3.24	0.11	0.12
	2013	0.28	0.92	3.00	0.10	0.12
	2014	0.26	0.88	2.71	0.09	0.12
	2015	0.25	0.84	2.43	0.08	0.12
	2016	0.24	0.82	2.24	0.07	0.12
	2017	0.24	0.80	2.06	0.07	0.12
	2018	0.23	0.79	1.90	0.06	0.12
	2019	0.23	0.78	1.73	0.06	0.12
	2020	0.22	0.77	1.57	0.05	0.12

Attachment C

Attachment C
Equipment Count by Construction Activity

Description	Equipment Type	Auxiliary Spillway Construction Phase 1	RWD Static Mods	LWD Static Mods	MIAD Jet Grout
Work Package Identifier		Recl. 1	Recl 2	Recl 2	Recl 3
Duration:(month)		18	15	15	17
Shifts		2	1	1	2
Work Week		6	5	5	6
Construction Personnel		34	30	20	30
Supervisory Personnel		9	6	6	6
Water Truck	Off-Highway Trucks/Water Trucks	2	1	1	1
Pick-up Trucks*	On-Road Haul Trucks	10	4	4	6
Excavator 330 BL/220hp	Excavators		1	1	0
Excavator 365BL II/404 HP	Excavators	2	0	0	0
Loader 938 G/160 hp	Rubber Tired Loaders	1	0	0	1
Loader 966 GII/246 hp	Rubber Tired Loaders	1	1	1	0
Scraper 631E/450 hp	Scrapers		0	0	0
Compactor 433/96 hp	Off-Highway Tractors/Compactors	1	1	1	0
Compactor 434C/70 hp	Off-Highway Tractors/Compactors				
Dump Truck 285 hp D300*	On-Road Haul Trucks	5	5	5	1
Dump Truck 405 hp D400*	On-Road Haul Trucks	8			
Dozer D4/80 hp	Crawler Tractor		0	0	1
Dozer D6/185 hp	Crawler Tractor		1	1	0
Dozer D8R/307 hp	Crawler Tractor	1	0	0	1
Grader 14H/215 hp	Graders	1	0	0	0
Haul Truck Tractor Trailer*	On-Road Haul Trucks	5	6	5	0
Rear Dump Truck 405 hp D400*	On-Road Haul Trucks	8	0	0	0
Drill Rig - Ingersol Rand CM 375/215	Bore/Drill Rigs	1			
Drill Rig - Atlantic LDH80T/177 hp	Bore/Drill Rigs				1
Pump - 200 gpm	Pumps				1
Concrete pump - 65 yph/110 hp	Pumps				1
Concrete portable mixer - electric	Electric				4
Air compressor - 1550 cfm, 150 psi/525 hp	Compressor	1			2
Generator - 200 kw/270 hp	Generator (<500)				1
Generator - 500 kw/700 hp	Generator (<750)				
Crane	Cranes				
Total	Total equipment count -->	47	20	19	21

*On-road equivalent engine emissions.

Attachment C
Equipment Count by Construction Activity

Description	Dike 5 Static Mods	Auxiliary Spillway Construction Phase 2	MIAD Overlay	Dike 4 Static Mods	Dike 6 Static Mods	Auxiliary Spillway Construction Phase 3
Work Package Identifier	Recl 5	Recl. 4	Recl 6	Recl 7	Recl 7	Corps 1
Duration:(month)	8	40	22	7	7	39
Shifts	1	2	1	1	1	2
Work Week	5	6	6	5	5	6
Construction Personnel	20	49	32	20	20	43
Supervisory Personnel	7	12	10	7	7	10
Water Truck	1	2	3	2	1	1
Pick-up Trucks*	8	20	9	5	8	10
Excavator 330 BL/220hp	1	1	1	1	1	1
Excavator 365BL II/404 HP	0	1	1			1
Loader 938 G/160 hp	1	1	0	1	1	1
Loader 966 GII/246 hp	0	1	1			1
Scraper 631E/450 hp	1		0	0	1	
Compactor 433/96 hp	1	1	1	1	1	1
Compactor 434C/70 hp		1	0	1		
Dump Truck 285 hp D300*	3	3	0	1	3	3
Dump Truck 405 hp D400*		12				
Dozer D4/80 hp	1		1	1	1	
Dozer D6/185 hp	0	1	1	1		1
Dozer D8R/307 hp	1	1	1	1	1	1
Grader 14H/215 hp	1	1	1	1	1	1
Haul Truck Tractor Trailer*	10	3	8	12	10	10
Rear Dump Truck 405 hp D400*	6	3	11	1	10	9
Drill Rig - Ingersol Rand CM 375/215		1				1
Drill Rig - Atlantic LDH80T/177 hp						
Pump - 200 gpm	1	1			1	1
Concrete pump - 65 yph/110 hp		1				1
Concrete portable mixer - electric		1				1
Air compressor - 1550 cfm, 150 psi/525 hp		1				1
Generator - 200 kw/270 hp	1				1	
Generator - 500 kw/700 hp		1				1
Crane						1
Total	37	58	39	29	41	48

*On-road equivalent engine emissions.

Attachment C
Equipment Count by Construction Activity

Description	Main Dam Construction	Dike 1	Dike 2	Dike 3	Dike 4 Raise	Dike 5 Raise	Dike 6 Raise
Work Package Identifier	Recl 8-10	Corps 2	Corps 2	Corps 2	Corps 2	Corps 2	Corps 2
Duration:(month)	14	1	1	1	1	2	2
Shifts	1	1	1	1	1	1	1
Work Week	5	5	5	5	5	5	5
Construction Personnel	10	5	5	5	5	5	5
Supervisory Personnel	4	2	2	2	2	2	2
Water Truck	0	1	1	1	1	1	1
Pick-up Trucks*	2						
Excavator 330 BL/220hp	2	1	1	1	1	1	1
Excavator 365BL II/404 HP							
Loader 938 G/160 hp	4	2	2	2	2	2	2
Loader 966 GII/246 hp							
Scraper 631E/450 hp							
Compactor 433/96 hp							
Compactor 434C/70 hp							
Dump Truck 285 hp D300*		1	1	1	1	1	1
Dump Truck 405 hp D400*							
Dozer D4/80 hp		1	1	1	1	1	1
Dozer D6/185 hp							
Dozer D8R/307 hp					1	1	1
Grader 14H/215 hp		1	1	1	1	1	1
Haul Truck Tractor Trailer*							
Rear Dump Truck 405 hp D400*							
Drill Rig - Ingersol Rand CM 375/215	1						
Drill Rig - Atlantic LDH80T/177 hp							
Pump - 200 gpm	1						
Concrete pump - 65 yph/110 hp	1	1	1	1	1	1	1
Concrete portable mixer - electric	1	1	1	1	1	1	1
Air compressor - 1550 cfm, 150 psi/525 hp	1						
Generator - 200 kw/270 hp	1	1	1	1	1	1	1
Generator - 500 kw/700 hp							
Crane	1	1	1	1	1	1	1
Total	15	11	11	11	12	12	12

*On-road equivalent engine emissions.

Attachment C
Equipment Count by Construction Activity

Description	RWD Raise	LWD Raise	Dike 7	Dike 8	MIAD Raise	TOTAL
Work Package Identifier	Corps 2	Corps 2	Corps 2	Corps 2	Corps 2	
Duration:(month)	4	2	1	1	4	
Shifts	1	1	1	1	1	
Work Week	5	5	5	5	5	
Construction Personnel	5	5	5	5	5	
Supervisory Personnel	2	2	2	2	2	
Water Truck	2	1	1	1	2	28
Pick-up Trucks*						86
Excavator 330 BL/220hp	2	1	1	1	2	23
Excavator 365BL II/404 HP						5
Loader 938 G/160 hp	4	2	2	2	4	37
Loader 966 GII/246 hp						6
Scraper 631E/450 hp						2
Compactor 433/96 hp						9
Compactor 434C/70 hp						2
Dump Truck 285 hp D300*	1	1	1	1	1	40
Dump Truck 405 hp D400*						20
Dozer D4/80 hp	1	1	1	1	1	16
Dozer D6/185 hp						6
Dozer D8R/307 hp						11
Grader 14H/215 hp	1	1	1	1	1	18
Haul Truck Tractor Trailer*						69
Rear Dump Truck 405 hp D400*						48
Drill Rig - Ingersol Rand CM 375/215						4
Drill Rig - Atlantic LDH80T/177 hp						1
Pump - 200 gpm						6
Concrete pump - 65 yph/110 hp	1	1	1	1	1	15
Concrete portable mixer - electric	1	1	1	1	1	18
Air compressor - 1550 cfm, 150 psi/525 hp						6
Generator - 200 kw/270 hp	1	1	1	1	1	15
Generator - 500 kw/700 hp						2
Crane	1	1	1	1	1	13
Total	15	11	11	11	15	506

*On-road equivalent engine emissions.

Attachment D

Attachment D
On-Road Emission Factors for Haul/Dump Trucks on Auxiliary Spillway and MIAD Overlay

Auxiliary Spillway - Phase 1

Source Parameters

Type	On-Road	
Capacity	20	
Engine Year	2007	
Horsepower	405	
Category	300<hp<600	
NOx EF	0.2	g/bhp-hr
Schedule	12	hr/day
Load Factor	0.57	

	Exhaust Emission Factors, lb/day				
Year	ROG	CO	NOx	PM10	PM2.5
2006	--	--	--	--	--
2007	1.79	5.91	1.22	0.66	0.61
2008	1.79	5.91	1.22	0.66	0.61
2009	1.79	5.91	1.22	0.66	0.61
2010	1.79	5.91	1.22	0.66	0.61
2011	1.79	5.91	1.22	0.66	0.61
2012	1.79	5.91	1.22	0.66	0.61
2013	1.79	5.91	1.22	0.66	0.61
2014	1.79	5.91	1.22	0.66	0.61
2015	1.79	5.91	1.22	0.66	0.61
2016	1.79	5.91	1.22	0.66	0.61
2017	1.79	5.91	1.22	0.66	0.61
2018	1.79	5.91	1.22	0.66	0.61
2019	1.79	5.91	1.22	0.66	0.61
2020	1.79	5.91	1.22	0.66	0.61

Auxiliary Spillway - Phase 2

Source Parameters

Type	On-Road	
Capacity	20	
Engine Year	2007	
Horsepower	405	
Category	300<hp<600	
NOx EF	0.2	g/bhp-hr
Schedule	12	hr/day
Load Factor	0.57	

	Exhaust Emission Factors, lb/day				
Year	ROG	CO	NOx	PM10	PM2.5
2006	--	--	--	--	--
2007	1.79	5.91	1.22	0.66	0.61
2008	1.79	5.91	1.22	0.66	0.61
2009	1.79	5.91	1.22	0.66	0.61
2010	1.79	5.91	1.22	0.66	0.61
2011	1.79	5.91	1.22	0.66	0.61
2012	1.79	5.91	1.22	0.66	0.61
2013	1.79	5.91	1.22	0.66	0.61
2014	1.79	5.91	1.22	0.66	0.61
2015	1.79	5.91	1.22	0.66	0.61
2016	1.79	5.91	1.22	0.66	0.61
2017	1.79	5.91	1.22	0.66	0.61
2018	1.79	5.91	1.22	0.66	0.61
2019	1.79	5.91	1.22	0.66	0.61
2020	1.79	5.91	1.22	0.66	0.61

Note: Fleet assumed to be new trucks in 2007; same fleet maintained throughout construction period.

MIAD Overlay

Source Parameters

Type	On-Road	
Capacity	20	
Engine Year	2007	
Horsepower	405	
Category	300<hp<600	
NOx EF	0.2	g/bhp-hr
Schedule	6.5	hr/day
Load Factor	0.57	

	Exhaust Emission Factors, lb/day				
Year	ROG	CO	NOx	PM10	PM2.5
2006	--	--	--	--	--
2007	1.79	5.91	0.66	0.66	0.61
2008	1.79	5.91	0.66	0.66	0.61
2009	1.79	5.91	0.66	0.66	0.61
2010	1.79	5.91	0.66	0.66	0.61
2011	1.79	5.91	0.66	0.66	0.61
2012	1.79	5.91	0.66	0.66	0.61
2013	1.79	5.91	0.66	0.66	0.61
2014	1.79	5.91	0.66	0.66	0.61
2015	1.79	5.91	0.66	0.66	0.61
2016	1.79	5.91	0.66	0.66	0.61
2017	1.79	5.91	0.66	0.66	0.61
2018	1.79	5.91	0.66	0.66	0.61
2019	1.79	5.91	0.66	0.66	0.61
2020	1.79	5.91	0.66	0.66	0.61

Auxiliary Spillway - Phase 3

Source Parameters

Type	On-Road	
Capacity	20	
Engine Year	2007	
Horsepower	405	
Category	300<hp<600	
NOx EF	0.2	g/bhp-hr
Schedule	12	hr/day
Load Factor	0.57	

	Exhaust Emission Factors, lb/day				
Year	ROG	CO	NOx	PM10	PM2.5
2006	--	--	--	--	--
2007	1.79	5.91	1.22	0.66	0.61
2008	1.79	5.91	1.22	0.66	0.61
2009	1.79	5.91	1.22	0.66	0.61
2010	1.79	5.91	1.22	0.66	0.61
2011	1.79	5.91	1.22	0.66	0.61
2012	1.79	5.91	1.22	0.66	0.61
2013	1.79	5.91	1.22	0.66	0.61
2014	1.79	5.91	1.22	0.66	0.61
2015	1.79	5.91	1.22	0.66	0.61
2016	1.79	5.91	1.22	0.66	0.61
2017	1.79	5.91	1.22	0.66	0.61
2018	1.79	5.91	1.22	0.66	0.61
2019	1.79	5.91	1.22	0.66	0.61
2020	1.79	5.91	1.22	0.66	0.61

Attachment E

Attachment E
Diesel Truck Emission Factors by EMFAC2002 (Annual Average)

	Summary of Emission Factors for Offsite Haul (Marysville/Woodland) (HHDT) (g/mile)*											
				PM10					PM2.5			
Year	ROG	CO	NOx	Total	Running	Tire Wear	Brake Wear	SO2	Total	Running	Tire Wear	Brake Wear
2007	0.676	2.506	11.351	1.153	0.294	0.036	0.013	0.021	0.285	0.271	0.009	0.005
2008	0.636	2.354	10.495	1.132	0.273	0.036	0.013	0.021	0.265	0.251	0.009	0.005
2009	0.597	2.209	9.689	1.112	0.253	0.036	0.013	0.021	0.247	0.233	0.009	0.005
2010	0.554	2.052	8.705	1.088	0.229	0.036	0.013	0.021	0.225	0.211	0.009	0.005
2011	0.512	1.908	7.768	1.067	0.208	0.036	0.013	0.021	0.205	0.191	0.009	0.005
2012	0.472	1.775	6.892	1.047	0.188	0.036	0.013	0.021	0.187	0.173	0.009	0.005
2013	0.434	1.656	6.094	1.030	0.171	0.036	0.013	0.021	0.172	0.158	0.009	0.005
2014	0.399	1.548	5.367	1.015	0.156	0.036	0.013	0.021	0.158	0.144	0.009	0.005
2015	0.368	1.456	4.723	1.002	0.143	0.036	0.013	0.021	0.146	0.132	0.009	0.005
2016	0.339	1.371	4.134	0.990	0.131	0.036	0.013	0.021	0.135	0.121	0.009	0.005
2017	0.313	1.294	3.606	0.980	0.121	0.036	0.013	0.021	0.125	0.111	0.009	0.005
2018	0.289	1.226	3.137	0.970	0.111	0.036	0.013	0.021	0.116	0.102	0.009	0.005
2019	0.270	1.172	2.738	0.962	0.103	0.036	0.013	0.021	0.109	0.095	0.009	0.005
2020	0.253	1.127	2.396	0.955	0.096	0.036	0.013	0.021	0.103	0.089	0.009	0.005

*Includes offsite haul trucks to Marysville and Woodland (30 mph) - all trucks assumed to be DIESEL.

MRI Report
Recommended Paved Road PM10 Emission Factors

g/mile	high-ADT	low-ADT	ave-ADT
Average conditions	0.37	1.3	0.81
Worst-case conditions	0.64	3.9	2.1

Paved Road Dust

PM10 Fraction	0.4572
PM2.5 Fraction	0.0772
PM2.5 EF	0.35 g/mile

Attachment F

Attachment F
NOx Construction Equipment Emissions

TABLE 1 ***Months of Activity per Year***

Activites	Duration	Op. Mos.	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Auxiliary Spillway Construction Phase 1	9/07 - 3/09	18	3.5	12	2.5											
RWD Static Mods	1/09 - 3/10	15	0	0	12	3										
LWD Static Mods	12/07 - 3/09	15	0.5	12	2.5											
MIAD Jet Grout	7/08 - 12/09	17		5.5	11.5											
Dike 5 Static Mods	9/09 - 5/10	8			3.5	4.5										
Auxiliary Spillway Construction Phase 2	1/10 - 5/14	40				12	12	6	6	4						
Auxiliary Spillway Construction Phase 3	9/11 - 12/14	39					3.5	12	12	11.5						
Main Dam Construction	1/14 - 8/20	14								2.0	2.1	2.1	2.1	2.1	2.1	1.3
MIAD Overlay	6/15 - 4/17	22									6.5	12.0	3.5			
Dike 4 Static Mods	9/17 - 4/18	7											3.5	3.5		
Dike 6 Static Mods	9/17 - 4/18	7											3.5	3.5		
Dike 1	5/10 - 9/14	1				1										
Dike 2	5/10 - 9/14	1				1										
Dike 3	5/10 - 9/14	1				1										
Dike 4 Raise	5/10 - 9/14	1					1									
Dike 5 Raise	5/10 - 9/14	2					2									
Dike 6 Raise	5/10 - 9/14	2					2									
RWD Raise	5/10 - 9/14	4						4								
LWD Raise	5/10 - 9/14	2						2								
Dike 7	5/10 - 9/14	1							1							
Dike 8	5/10 - 9/14	1							1							
MIAD Raise	5/10 - 9/14	4								4						

TABLE 2 ***NOx Emissions in tons per year [1,2,3]***

Activites	Duration	Op. Mos.	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Auxiliary Spillway Construction Phase 1	9/07 - 3/09	18	8.14	26.42	5.21											
RWD Static Mods	1/09 - 3/10	15	-	-	12.12	2.79										
LWD Static Mods	12/07 - 3/09	15	0.55	12.31	2.40											
MIAD Jet Grout	7/08 - 12/09	17		4.44	8.77											
Dike 5 Static Mods	9/09 - 5/10	8			3.19	3.70										
Auxiliary Spillway Construction Phase 2	1/10 - 5/14	40		-	-	25.48	24.00	11.30	10.66	6.66	-					
Auxiliary Spillway Construction Phase 3	9/11 - 12/14	39					7.51	23.82	22.06	19.41	-	-				
Main Dam Construction	1/14 - 8/20	14								1.21	1.13	1.02	0.91	0.81	0.73	0.40
MIAD Overlay	6/15 - 4/17	22									7.24	12.31	3.31			
Dike 4 Static Mods	9/17 - 4/18	7											2.66	2.41		
Dike 6 Static Mods	9/17 - 4/18	7											3.39	3.04		
Dike 1	5/10 - 9/14	1				0.67										
Dike 2	5/10 - 9/14	1				0.67										
Dike 3	5/10 - 9/14	1				0.67										
Dike 4 Raise	5/10 - 9/14	1					0.72									
Dike 5 Raise	5/10 - 9/14	2					1.44									
Dike 6 Raise	5/10 - 9/14	2					1.44									
RWD Raise	5/10 - 9/14	4						3.25								
LWD Raise	5/10 - 9/14	2						1.16								
Dike 7	5/10 - 9/14	1							0.53							
Dike 8	5/10 - 9/14	1							0.53							
MIAD Raise	5/10 - 9/14	4								2.74						
Miscellaneous On-site (e.g., paving)			-	-	0.44	0.44	0.56	0.14	-	-	0.02	-	0.28	0.17	-	-
Offsite Haul Trucks			0.53	1.43	3.73	3.80	3.96	3.60	3.04	2.74	2.66	2.33	2.34	0.27	0.00	0.00
Worker Trips			0.42	2.32	2.18	2.32	2.60	2.60	2.65	2.88	0.39	0.70	0.43	0.24	0.03	0.02
TOTAL			**9.64**	**46.92**	**38.05**	**40.55**	**42.21**	**45.87**	**39.49**	**35.63**	**11.44**	**16.36**	**13.32**	**6.95**	**0.76**	**0.43**

Notes: 1 Assumes that 20 cu yd on-highway haul trucks are used to haul Auxiliary Spillway spoils, and **no other** mitigation is assumed
2 Emission factors applied to Auxiliary Spillway hauling are for new 2007 on-road diesel engines meeting the 0.2 g/(bhp-hr) NOx standards - i.e., only 2007 on-road diesel trucks are used for hauling Auxiliary Spillway spoils
3 Emission factors for all other non-road (offroad) equipment are based on ARB OFFROAD2007 model.

Attachment F
CO Construction Equipment Emissions

TABLE 1 ***Months of Activity per Year***

Activites	Duration	Op. Mos.	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Auxiliary Spillway Construction Phase 1	9/07 - 3/09	18	3.5	12	2.5											
RWD Static Mods	1/09 - 3/10	15	0	0	12	3										
LWD Static Mods	12/07 - 3/09	15	0.5	12	2.5											
MIAD Jet Grout	7/08 - 12/09	17		5.5	11.5											
Dike 5 Static Mods	9/09 - 5/10	8			3.5	4.5										
Auxiliary Spillway Construction Phase 2	1/10-5/14	40				12	12	6	6	4						
Auxiliary Spillway Construction Phase 3	9/11 - 12/14	39					3.5	12	12	11.5						
Main Dam Construction	1/14 - 8/20	14								2.0	2.1	2.1	2.1	2.1	2.1	1.3
MIAD Overlay	6/15 - 4/17	22									6.5	12.0	3.5			
Dike 4 Static Mods	9/17 - 4/18	7											3.5	3.5		
Dike 6 Static Mods	9/17 - 4/18	7											3.5	3.5		
Dike 1	5/10 - 9/14	1				1										
Dike 2	5/10 - 9/14	1				1										
Dike 3	5/10 - 9/14	1				1										
Dike 4 Raise	5/10 - 9/14	1					1									
Dike 5 Raise	5/10 - 9/14	2					2									
Dike 6 Raise	5/10 - 9/14	2					2									
RWD Raise	5/10 - 9/14	4						4								
LWD Raise	5/10 - 9/14	2						2								
Dike 7	5/10 - 9/14	1							1							
Dike 8	5/10 - 9/14	1							1							
MIAD Raise	5/10 - 9/14	4								4						

TABLE 2 ***CO Emissions in tons per year [1,2]***

Activites	Duration	Op. Mos.	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Auxiliary Spillway Construction Phase 1	9/07 - 3/09	18	9.90	33.50	6.89											
RWD Static Mods	1/09 - 3/10	15	-	-	6.29	1.50										
LWD Static Mods	12/07 - 3/09	15	0.27	6.29	1.25											
MIAD Jet Grout	7/08 - 12/09	17		2.45	4.96											
Dike 5 Static Mods	9/09 - 5/10	8			2.23	2.78										
Auxiliary Spillway Construction Phase 2	1/10-5/14	40		-	-	32.68	32.33	16.01	15.88	10.51	-					
Auxiliary Spillway Construction Phase 3	9/11 - 12/14	39					6.92	23.25	22.84	21.54	-	-				
Main Dam Construction	1/14 - 8/20	14								0.55	0.57	0.56	0.55	0.54	0.54	0.33
MIAD Overlay	6/15 - 4/17	22									3.59	6.54	1.89			
Dike 4 Static Mods	9/17 - 4/18	7											2.28	2.23		
Dike 6 Static Mods	9/17 - 4/18	7											2.41	2.34		
Dike 1	5/10 - 9/14	1				0.34										
Dike 2	5/10 - 9/14	1				0.34										
Dike 3	5/10 - 9/14	1				0.34										
Dike 4 Raise	5/10 - 9/14	1					0.36									
Dike 5 Raise	5/10 - 9/14	2					0.72									
Dike 6 Raise	5/10 - 9/14	2					0.72									
RWD Raise	5/10 - 9/14	4						1.98								
LWD Raise	5/10 - 9/14	2						0.63								
Dike 7	5/10 - 9/14	1							0.30							
Dike 8	5/10 - 9/14	1							0.30							
MIAD Raise	5/10 - 9/14	4								1.90						
Miscellaneous On-site (e.g., paving)			-	-	0.42	0.58	0.80	0.20	-	-	-	-	0.37	0.19	-	-
Offsite Haul Trucks			0.12	0.32	0.85	0.90	0.97	0.93	0.83	0.79	0.82	0.77	0.84	0.11	0.00	0.00
Worker Trips			0.13	0.72	0.67	0.69	0.77	0.77	0.78	0.85	0.11	0.20	0.12	0.07	0.01	0.01
TOTAL			**10.42**	**43.27**	**23.57**	**40.14**	**43.60**	**43.76**	**40.94**	**36.14**	**5.09**	**8.07**	**8.45**	**5.47**	**0.55**	**0.34**

Notes: 1 Assumes that 20 cu yd on-highway haul trucks are used to haul Auxiliary Spillway spoils, and **no other** mitigation is assumed
2 Emission factors for all other non-road (offroad) equipment are based on ARB OFFROAD2007 model.

Attachment F
PM_{10} Construction Equipment Emissions

TABLE 1 ***Months of Activity per Year***

Activites	Duration	Op. Mos.	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Auxiliary Spillway Construction Phase 1	9/07 - 3/09	18	3.5	12	2.5											
RWD Static Mods	1/09 - 3/10	15	0	0	12	3										
LWD Static Mods	12/07 - 3/09	15	0.5	12	2.5											
MIAD Jet Grout	7/08 - 12/09	17		5.5	11.5											
Dike 5 Static Mods	9/09 - 5/10	8			3.5	4.5										
Auxiliary Spillway Construction Phase 2	1/10 - 3/14	40				12	12	6	6	4						
Auxiliary Spillway Construction Phase 3	9/11 - 12/14	39					3.5	12	12	11.5						
Main Dam Construction	1/14 - 8/20	14								2.0	2.1	2.1	2.1	2.1	2.1	1.3
MIAD Overlay	6/15 - 4/17	22									6.5	12.0	3.5			
Dike 4 Static Mods	9/17 - 4/18	7											3.5	3.5		
Dike 6 Static Mods	9/17 - 4/18	7											3.5	3.5		
Dike 1	5/10 - 9/14	1				1										
Dike 2	5/10 - 9/14	1				1										
Dike 3	5/10 - 9/14	1				1										
Dike 4 Raise	5/10 - 9/14	1					1									
Dike 5 Raise	5/10 - 9/14	2					2									
Dike 6 Raise	5/10 - 9/14	2					2									
RWD Raise	5/10 - 9/14	4						4								
LWD Raise	5/10 - 9/14	2						2								
Dike 7	5/10 - 9/14	1							1							
Dike 8	5/10 - 9/14	1							1							
MIAD Raise	5/10 - 9/14	4								4						

TABLE 2 ***PM10 Emissions in tons per year [1,2]***

Activites	Duration	Op. Mos.	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Auxiliary Spillway Construction Phase 1	9/07 - 3/09	18	1.10664	3.7351054	0.76706											
RWD Static Mods	1/09 - 3/10	15	0	0	0.69144	0.16358										
LWD Static Mods	12/07 - 3/09	15	0.03053	0.6976596	0.13874											
MIAD Jet Grout	7/08 - 12/09	17		0.2682747	0.54039											
Dike 5 Static Mods	9/09 - 5/10	8			0.20236	0.24502										
Auxiliary Spillway Construction Phase 2	1/10 - 3/14	40		0	0	3.67513	3.6078521	1.7697891	1.7362355	1.13649	0					
Auxiliary Spillway Construction Phase 3	9/11 - 12/14	39					0.7529354	2.4993369	2.4223014	2.25302	0	0				
Main Dam Construction	1/14 - 8/20	14								0.0	0.0	0.0	0.0	0.0	0.0	0.0
MIAD Overlay	6/15 - 4/17	22									1.5	2.7	0.8			
Dike 4 Static Mods	9/17 - 4/18	7											0.2	0.2		
Dike 6 Static Mods	9/17 - 4/18	7											0.2	0.2		
Dike 1	5/10 - 9/14	1				0.03806										
Dike 2	5/10 - 9/14	1				0.03806										
Dike 3	5/10 - 9/14	1				0.0173										
Dike 4 Raise	5/10 - 9/14	1					0.0404555									
Dike 5 Raise	5/10 - 9/14	2					0.080911									
Dike 6 Raise	5/10 - 9/14	2					0.080911									
RWD Raise	5/10 - 9/14	4						0.2139521								
LWD Raise	5/10 - 9/14	2						0.0673611								
Dike 7	5/10 - 9/14	1							0.0316326							
Dike 8	5/10 - 9/14	1							0.0316326							
MIAD Raise	5/10 - 9/14	4								0.19154						
Fugitive Dust (Onsite), mitigated			1.49	6.78	9.76	8.89	8.99	10.87	9.40	10.49	5.85	9.83	3.40	1.23	0.28	0.28
On-site Hauling Fugitive Dust (unpaved, 300 d/y, 200 mi/d max)			21.82	21.82	21.82	21.82	21.82	21.82	21.82	21.82	5.45	5.45	5.45	5.45	5.45	5.45
Blasting			12.13	12.13	12.13	12.13	12.13	12.13	12.13	12.13	-	-	-	-	-	-
Concrete Batching			-	6.26	6.26	6.68	6.68	22.96	22.96	22.96				-	-	-
Crushing			1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80	1.80					
Offsite Haul Trucks			0.05	0.15	0.43	0.47	0.54	0.55	0.51	0.52	0.56	0.56	0.64	0.08	0.00	0.00
Worker Trips			0.25	1.36	1.27	1.35	1.50	1.50	1.54	1.67	0.23	0.40	0.25	0.14	0.02	0.01
TOTAL			**38.68**	**55.00**	**55.81**	**57.31**	**58.02**	**76.17**	**74.37**	**75.00**	**15.41**	**18.96**	**10.98**	**7.35**	**5.78**	**5.76**

Notes: 1 Assumes that 20 cu yd on-highway haul trucks are used to haul Auxiliary Spillway spoils, and **no other** mitigation is assumed
2 Emission factors for all other non-road (offroad) equipment are based on ARB OFFROAD2007 model

10	Silt content, %
40	Vehicle weight, tons
1.5	k for PM10
0.15	k for PM2.5
0.9	a
0.45	b
300	P (days/yr with at least 0.01 in. rain PLUS 3x day watering)

0.72723 $E = k(s/12)^a(W/3)^b[(365-P)/365]$, lb/VMT

AP-42, Section 13.2.2 - Unpaved Roads, November 2006.

Attachment G

Attachment G
OFFROAD EQUIPMENT EMISSION INVENTORIES
NOx

		NOx Annual Emissions (tons per year)													
Equipment Name	**OFFROAD Category**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Water Truck	Off-Highway Trucks/Water Trucks	0.17	0.83	0.59	0.69	0.71	0.68	0.59	0.55	0.25	0.46	0.25	0.11	-	-
Pick-up Trucks	Pick-up Trucks	0.26	1.36	1.18	1.98	1.94	1.70	1.70	1.40	0.44	0.79	0.52	0.30	0.03	0.02
Excavator 330 BL/220hp	Excavators	0.08	1.75	2.17	2.78	2.70	3.30	2.25	2.60	0.90	1.23	0.90	0.57	0.19	0.10
Excavator 365BL II/404 HP	Excavators	1.29	4.13	0.80	1.80	2.12	2.25	2.05	1.57	0.58	0.95	0.24	-	-	-
Loader 938 G/160 hp	Rubber Tired Loaders	0.34	1.59	1.33	1.52	1.79	2.43	1.38	2.14	0.39	0.35	0.57	0.51	0.25	0.14
Loader 966 GII/246 hp	Rubber Tired Loaders	0.38	2.02	1.26	1.17	1.16	1.25	1.17	0.92	0.35	0.58	0.15	-	-	-
Scraper 631E/450 hp	Scrapers	-	-	0.41	0.48	-	-	-	-	-	-	0.41	0.38	-	-
Compactor 433/96 hp	Off-Highway Tractors/Compactors	0.44	2.36	1.71	1.66	1.45	1.60	1.52	1.25	0.50	0.86	0.64	0.38	-	-
Compactor 434C/70 hp	Off-Highway Tractors/Compactors	-	-	-	1.17	1.12	0.53	0.51	0.32	-	-	0.20	0.19	-	-
Dump Truck 285 hp D300	On-Road Haul Trucks	1.42	7.76	5.46	3.07	2.51	2.59	2.16	1.70	-	-	0.27	0.24	-	-
Dump Truck 405 hp D400	On-Road Haul Trucks	0.67	2.29	0.48	3.43	3.43	1.71	1.71	1.14	-	-	-	-	-	-
Dozer D4/80 hp	Crawler Tractors	-	0.74	1.67	0.55	0.48	0.53	0.17	0.31	0.55	0.93	0.67	0.39	-	-
Dozer D6/185 hp	Crawler Tractors	0.06	1.36	1.55	1.74	1.74	1.89	1.77	1.41	0.55	0.93	0.46	0.19	-	-
Dozer D8R/307 hp	Crawler Tractors	0.49	2.34	1.98	1.69	2.22	1.89	1.77	1.41	0.55	0.93	0.67	0.39	-	-
Grader 14H/215 hp	Graders	0.44	1.43	0.44	1.71	1.91	2.07	1.63	1.42	0.44	0.73	0.52	0.29	-	-
Haul Truck Tractor Trailer	On-Road Haul Trucks	1.42	7.40	5.86	3.60	3.51	6.05	5.35	4.34	1.56	2.53	2.14	1.30	-	-
Rear Dump Truck 405 hp D400	On-Road Haul Trucks	0.67	2.29	0.88	1.31	1.61	3.00	3.00	2.75	0.92	1.70	1.24	0.65	-	-
Drill Rig - Ingersol Rand CM 375/215	Bore/Drill Rigs	0.27	0.81	0.15	0.65	0.74	0.75	0.68	0.56	0.05	0.04	0.03	0.03	0.02	0.01
Drill Rig - Atlantic LDH80T/177 hp	Bore/Drill Rigs	-	0.37	0.69	-	-	-	-	-	-	-	-	-	-	-
Pump - 200 gpm/8 hp gas	Pumps	-	0.15	0.37	0.39	0.36	0.39	0.37	0.33	0.03	0.03	0.07	0.06	0.02	0.01
Concrete pump - 65 yph/150 hp	Pumps	-	0.15	0.29	0.35	0.46	0.50	0.40	0.39	0.03	0.03	0.03	0.02	0.02	0.01
Concrete portable mixer - electric	Electric	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Air compressor - 1550 cfm, 150 psi/525 hp	Air Compressors	0.30	1.86	1.97	0.88	1.06	1.14	1.05	0.91	0.09	0.08	0.07	0.07	0.06	0.03
Generator - 200 kw/270 hp	Generator Sets (<250)	-	0.17	0.44	0.18	0.11	0.13	0.04	0.11	0.03	0.03	0.08	0.07	0.02	0.01
Generator - 500 kw/700 hp	Generator Sets (<500)	-	-	-	0.82	0.99	1.07	0.99	0.77	-	-	-	-	-	-
Crane	Cranes	-	-	-	0.35	1.00	2.06	1.53	1.69	0.17	0.15	0.14	0.12	0.11	0.06
	Total On-site Equipment Engines	**8.69**	**43.17**	**31.70**	**33.98**	**35.10**	**39.53**	**33.80**	**30.01**	**8.37**	**13.33**	**10.27**	**6.26**	**0.73**	**0.40**

Attachment G
OFFROAD EQUIPMENT EMISSION INVENTORIES
CO

		CO Annual Emissions (tons per year)													
Equipment Name	**OFFROAD Category**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Water Truck	Off-Highway Trucks/Water Trucks	0.85	4.57	3.65	3.79	3.65	3.74	2.96	3.03	1.50	2.76	1.83	1.02	-	-
Pick-up Trucks	Pick-up Trucks	0.27	1.40	1.19	1.97	1.93	1.67	1.66	1.36	0.02	0.02	0.28	0.28	0.02	0.01
Excavator 330 BL/220hp	Excavators	0.02	0.51	0.68	0.89	0.82	1.05	0.76	0.96	0.61	0.99	0.58	0.33	0.12	0.08
Excavator 365BL II/404 HP	Excavators	0.38	1.20	0.23	0.53	0.65	0.72	0.69	0.58	-	-	-	-	-	-
Loader 938 G/160 hp	Rubber Tired Loaders	0.12	0.58	0.54	0.65	0.74	1.06	0.64	1.05	0.96	1.58	0.77	0.37	0.20	0.13
Loader 966 GII/246 hp	Rubber Tired Loaders	0.13	0.73	0.48	0.46	0.48	0.54	0.54	0.45	-	-	-	-	-	-
Scraper 631E/450 hp	Scrapers	-	-	0.19	0.24	-	-	-	-	-	-	0.19	0.18	-	-
Compactor 433/96 hp	Off-Highway Tractors/Compactors	0.21	1.16	0.91	0.92	0.78	0.90	0.89	0.76	-	-	0.28	0.28	-	-
Compactor 434C/70 hp	Off-Highway Tractors/Compactors	-	-	-	0.61	0.61	0.30	0.30	0.20	-	-	0.14	0.14	-	-
Dump Truck 285 hp D300	On-Road Haul Trucks	0.59	3.30	2.41	1.44	1.17	1.27	1.11	0.93	0.11	0.20	0.24	0.18	-	-
Dump Truck 405 hp D400	On-Road Haul Trucks	3.22	11.06	2.30	16.59	16.59	8.29	8.29	5.53	-	-	-	-	-	-
Dozer D4/80 hp	Crawler Tractors	-	0.30	0.70	0.25	0.19	0.22	0.07	0.13	0.25	0.44	0.33	0.20	-	-
Dozer D6/185 hp	Crawler Tractors	0.02	0.56	0.64	0.71	0.71	0.78	0.75	0.61	-	-	0.10	0.10	-	-
Dozer D8R/307 hp	Crawler Tractors	0.21	0.96	0.83	0.72	0.91	0.78	0.75	0.61	-	-	0.21	0.20	-	-
Grader 14H/215 hp	Graders	0.12	0.39	0.14	0.50	0.54	0.61	0.50	0.46	0.15	0.27	0.21	0.13	-	-
Haul Truck Tractor Trailer	On-Road Haul Trucks	0.59	3.15	2.70	1.83	1.63	2.95	2.76	2.37	-	-	1.02	0.96	-	-
Rear Dump Truck 405 hp D400	On-Road Haul Trucks	3.22	11.06	2.58	4.48	7.77	14.51	14.51	13.30	-	-	0.51	0.48	-	-
Drill Rig - Ingersol Rand CM 375/215	Bore/Drill Rigs	0.10	0.34	0.07	0.34	0.44	0.51	0.51	0.49	0.05	0.05	0.05	0.05	0.05	0.03
Drill Rig - Atlantic LDH80T/177 hp	Bore/Drill Rigs	-	0.16	0.33	-	-	-	-	-	-	-	-	-	-	-
Pump - 200 gpm/8 hp gas	Pumps	-	0.07	0.18	0.20	0.19	0.22	0.22	0.21	0.02	0.02	0.06	0.06	0.02	0.01
Concrete pump - 65 yph/150 hp	Pumps	-	0.07	0.14	0.18	0.25	0.29	0.24	0.25	0.10	0.17	0.07	0.02	0.02	0.01
Concrete portable mixer - electric	Electric	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Air compressor - 1550 cfm, 150 psi/525 hp	Air Compressors	0.10	0.62	0.63	0.27	0.32	0.34	0.32	0.29	0.03	0.03	0.03	0.03	0.03	0.02
Generator - 200 kw/270 hp	Generator Sets (<250)	-	0.04	0.11	0.04	0.03	0.03	0.01	0.03	0.05	0.08	0.05	0.03	0.01	0.01
Generator - 500 kw/700 hp	Generator Sets (<500)	-	-	-	0.24	0.28	0.31	0.29	0.24	-	-	-	-	-	-
Crane	Cranes	-	-	-	0.13	0.37	0.76	0.57	0.64	0.30	0.48	0.18	0.06	0.06	0.03
	Total On-site Equipment Engines	**10.18**	**42.23**	**21.63**	**37.97**	**41.06**	**41.87**	**39.33**	**34.50**	**4.16**	**7.10**	**7.12**	**5.10**	**0.54**	**0.33**

Attachment G
OFFROAD EQUIPMENT EMISSION INVENTORIES
PM10

		PM10 Annual Emissions (tons per year)													
Equipment Name	**OFFROAD Category**	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Water Truck	Off-Highway Trucks/Water Trucks	0.10	0.51	0.41	0.42	0.41	0.42	0.33	0.34	0.25	0.46	0.25	0.11	-	-
Pick-up Trucks	Pick-up Trucks	0.03	0.14	0.12	0.20	0.19	0.17	0.16	0.13	0.04	0.07	0.04	0.02	0.00	0.00
Excavator 330 BL/220hp	Excavators	0.00	0.06	0.08	0.10	0.10	0.11	0.08	0.09	0.03	0.04	0.03	0.02	0.01	0.00
Excavator 365BL II/404 HP	Excavators	0.05	0.15	0.03	0.06	0.07	0.08	0.07	0.05	0.02	0.03	0.01	-	-	-
Loader 938 G/160 hp	Rubber Tired Loaders	0.02	0.07	0.06	0.07	0.08	0.11	0.06	0.09	0.02	0.02	0.02	0.02	0.01	0.01
Loader 966 GII/246 hp	Rubber Tired Loaders	0.02	0.09	0.06	0.05	0.05	0.06	0.05	0.04	0.02	0.03	0.01	-	-	-
Scraper 631E/450 hp	Scrapers	-	-	0.02	0.02	-	-	-	-	-	-	0.02	0.01	-	-
Compactor 433/96 hp	Off-Highway Tractors/Compactors	0.04	0.21	0.15	0.15	0.13	0.14	0.13	0.11	0.04	0.07	0.05	0.03	-	-
Compactor 434C/70 hp	Off-Highway Tractors/Compactors	-	-	-	0.10	0.10	0.05	0.04	0.03	-	-	0.02	0.02	-	-
Dump Truck 285 hp D300	On-Road Haul Trucks	0.06	0.31	0.23	0.13	0.11	0.11	0.10	0.08	-	-	0.02	0.01	-	-
Dump Truck 405 hp D400	On-Road Haul Trucks	0.36	1.23	0.26	1.85	1.85	0.92	0.92	0.62	-	-	-	-	-	-
Dozer D4/80 hp	Crawler Tractors	-	0.04	0.08	0.03	0.02	0.03	0.01	0.01	0.03	0.04	0.03	0.02	-	-
Dozer D6/185 hp	Crawler Tractors	0.00	0.07	0.08	0.08	0.08	0.09	0.08	0.07	0.03	0.04	0.02	0.01	-	-
Dozer D8R/307 hp	Crawler Tractors	0.02	0.11	0.10	0.08	0.11	0.09	0.08	0.07	0.03	0.04	0.03	0.02	-	-
Grader 14H/215 hp	Graders	0.02	0.05	0.02	0.06	0.07	0.07	0.06	0.05	0.02	0.03	0.02	0.01	-	-
Haul Truck Tractor Trailer	On-Road Haul Trucks	0.06	0.30	0.25	0.16	0.15	0.27	0.24	0.21	0.08	0.13	0.12	0.08	-	-
Rear Dump Truck 405 hp D400	On-Road Haul Trucks	0.36	1.23	0.28	0.49	0.87	1.62	1.62	1.48	0.92	1.69	0.54	0.04	-	-
Drill Rig - Ingersol Rand CM 375/215	Bore/Drill Rigs	0.01	0.03	0.01	0.03	0.03	0.03	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Drill Rig - Atlantic LDH80T/177 hp	Bore/Drill Rigs	-	0.01	0.03	-	-	-	-	-	-	-	-	-	-	-
Pump - 200 gpm/8 hp gas	Pumps	-	0.01	0.02	0.02	0.02	0.02	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Concrete pump - 65 yph/150 hp	Pumps	-	0.01	0.01	0.02	0.02	0.03	0.02	0.02	0.00	0.00	0.00	0.00	0.00	0.00
Concrete portable mixer - electric	Electric	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Air compressor - 1550 cfm, 150 psi/525 hp	Air Compressors	0.01	0.06	0.07	0.03	0.04	0.04	0.03	0.03	0.00	0.00	0.00	0.00	0.00	0.00
Generator - 200 kw/270 hp	Generator Sets (<250)	-	0.01	0.01	0.01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Generator - 500 kw/700 hp	Generator Sets (<500)	-	-	-	0.02	0.03	0.03	0.03	0.02	-	-	-	-	-	-
Crane	Cranes	-	-	-	0.01	0.04	0.08	0.06	0.06	0.01	0.01	0.00	0.00	0.00	0.00
	Total On-site Equipment Engines	**1.14**	**4.70**	**2.34**	**4.20**	**4.56**	**4.55**	**4.22**	**3.63**	**1.52**	**2.72**	**1.24**	**0.44**	**0.03**	**0.02**

Attachment H

Attachment H
OFFROAD EQUIPMENT EMISSION FACTORS
NOx

	NOx Emission Factor in grams per horsepower-hour (g / [hp-hr])													
OFFROAD Category	**2007**	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Scrapers	8.33	7.91	7.50	7.11	6.67	6.25	5.85	5.41	4.98	4.58	4.21	3.86	3.53	3.22
Bore/Drill Rigs	6.10	5.42	4.83	4.33	3.81	3.37	3.04	2.67	2.17	1.75	1.42	1.15	0.92	0.74
Excavators	7.28	6.78	6.32	5.89	5.38	4.91	4.49	3.98	3.52	3.10	2.71	2.37	2.06	1.79
Cranes	7.79	7.37	6.96	6.57	6.12	5.69	5.28	4.81	4.38	3.98	3.60	3.25	2.91	2.61
Graders	8.40	7.91	7.43	6.98	6.46	5.97	5.51	5.00	4.51	4.06	3.64	3.26	2.92	2.60
Off-Highway Trucks	6.94	6.49	6.06	5.66	5.18	4.75	4.35	3.89	3.45	3.05	2.68	2.36	2.07	1.81
Rubber Tired Loaders	8.48	7.97	7.49	7.04	6.56	6.11	5.69	5.24	4.74	4.27	3.84	3.44	3.07	2.73
Rubber Tired Dozers	10.09	9.65	9.21	8.79	8.35	7.92	7.51	7.08	6.63	6.20	5.79	5.40	5.03	4.68
Crawler Tractors	9.57	9.07	8.59	8.13	7.64	7.17	6.73	6.26	5.80	5.36	4.95	4.57	4.21	3.88
Off-Highway Tractors	11.60	11.11	10.63	10.16	9.71	9.25	8.82	8.39	7.94	7.50	7.09	6.69	6.32	5.97
Generator Sets (<250)	4.88	4.68	4.47	4.24	3.96	3.69	3.43	3.13	2.82	2.61	2.40	2.19	1.99	1.80
Generator Sets (<750)	4.60	4.39	4.18	3.97	3.70	3.43	3.18	2.88	2.59	2.39	2.19	2.00	1.83	1.65
Pumps	5.30	5.06	4.83	4.60	4.35	4.08	3.83	3.58	3.26	3.03	2.80	2.57	2.36	2.16
Air Compressors	4.79	4.56	4.35	4.13	3.84	3.57	3.30	2.98	2.68	2.46	2.27	2.09	1.91	1.72