Memorandum

TO: Edward Beldin
Sapphos Environmental

FROM: Sam Silverman, Senior Environmental Scientist
Terry A. Hayes Associates LLC

DATE: July 25, 2007

RE: Owens Lake Construction Emissions

Terry A. Hayes Associates LLC (TAHA) has completed an analysis of maximum daily construction emissions and construction greenhouse gas (GHG) emissions associated with implementation of dust control measures at the Owens Lake bed. This memorandum summarizes the findings of the air quality analysis.

Introduction

The Great Basin Unified Air Pollution Control District regulates fugitive dust emissions (PM_{10}) in the Owens Valley Planning Area consistent with the requirements of the National Ambient Air Quality Standards. The dried Owens Lake bed has been the largest single source of PM_{10} emissions in the United States for many years, with annual PM_{10} emissions of more than 80,000 tons and 24-hour concentrations as high as 130 times the federal air quality standard.

The City of Los Angeles Department of Water and Power (LADWP) is implementing dust control measures (DCM) on the lake bed with a goal of meeting the federal PM_{10} standard. The construction elements associated with the DCM consists of eight primary activities:

- Site preparation (surface grading and earth moving)
- Berm construction and access road grading
- Irrigation and drain line construction (trenching, pipeline installation, trench backfilling)
- DCM dewatering
- Irrigation system installation within the DCM areas
- Power line and DCM controls installation
- Moat and row DCM shaping
- Shallow flood DCM flooding

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w e b t a h a . c o m

The proposed project is designed to improve air quality through the reduction of PM_{10} emissions in all of the communities in the Owens Valley, including the City of Ridgecrest in Kern County; Sequoia National Park; Death Valley National Park; the Manzanar National Historic Site; and the John Muir, Golden Trout, Dome Land, and South Sierra Wilderness areas. The proposed project may also improve air quality in more distant locations because, under certain circumstances, PM_{10} emissions from Owens Lake have been tracked to more densely populated sections of Southern California.

The proposed project includes 14.6 square miles within the 110-square-mile (70,000-acre) dry Owens Lake bed, located within the Owens Valley, Inyo County, California. The proposed project is located approximately five miles south of the community of Lone Pine and approximately 61 miles south of the City of Bishop. The proposed project is located approximately ten miles to the west of Death Valley National Park, approximately 11 miles to the east of Sequoia National Park, and approximately 48 miles north of the City of Ridgecrest.

Methodology

Air pollutant emissions were calculated for maximum daily construction activity and GHG emissions for the entire construction period. Maximum daily emissions were calculated for reactive organic compounds (ROG), nitrogen oxides (NO_X), carbon monoxide (CO), sulfur oxides (SO_X), particulate matter 2.5 microns or less in diameter ($PM_{2.5}$), and particulate matter ten microns or less in diameter (PM_{10}). A description of the construction activities associated with the proposed project, the equipment necessary to complete the activities, and the crew required to operate the equipment, was provided by LADWP. Heavy-duty equipment emission factors were obtained from the South Coast Air Quality Management District.[1] It was assumed that the emissions profile for heavy-duty equipment in the South Coast Air Basin would be similar to the emissions profile for heavy-duty equipment in the Great Basin Valleys Air Basin. On-road emissions from worker vehicle travel were calculated utilizing California Air Resources Board's (CARB EMFAC2007 model. It was assumed that 50 percent of workers would be from Lone Pine (five miles from the project site), 20 percent from Ridgecrest (48 miles from the project site), 20 percent from Bishop (61 miles from the project site), and ten percent from Los Angeles (200 miles from the project site). Fugitive dust emissions were calculated based on the area of land to be disturbed per day. The fugitive dust emission rate of 14.9 pounds per acre was obtained from the URBEMIS2007 worst-case fugitive dust emission rate (38.2 pounds per acre) minus a 61 percent control efficiency for watering activity. Based on information obtained from LADWP, it was assumed that the proposed project would disturb 18 acres per day.

GHG emissions were calculated for carbon dioxide (CO_2) and methane (CH_4). CO_2 emission rates were also obtained from the SCAQMD heavy-duty construction equipment emissions profile. The SCAQMD emission profile does not contain emission factors for CH_4. CH_4 emission rates were obtained using an ROG to CH_4 conversion factor of 0.0902, which was obtained from the CARB's Off-Road Model. On-road GHG emissions from worker vehicle travel were also calculated utilizing CARB's EMFAC2007 model. Neither Edward Beldin

[1] http://www.aqmd.gov/ceqa/handbook/offroad/offroad.html

the SCAQMD or the Off-Road Model provide construction equipment nitrous oxide emission factors. As such, nitrous oxide emissions were not included in this analysis.

Findings

As shown in **Table 1**, construction activity would result in maximum daily emissions of 115 pounds per day of ROG, 593 pounds per day of NO_X, 1,012 pounds per day of CO, less than one pound per day of SO_X, 98 pounds per day of $PM_{2.5}$, and 314 pounds per day of PM_{10}.

Heavy-duty equipment and worker vehicle trips would also contribute to regional GHG emissions. Construction activity would result in total carbon equivalent emissions of 8,836 tons of CO_2 and one ton of CH_4.

TABLE 1: MAXIMUM DAILY CONSTRUCTION EMISSIONS

	Pounds Per Day					
	ROG	**NO_X**	**CO**	**SO_X**	**$PM_{2.5}$ /a/**	**PM_{10}**
Fugitive Dust Emissions	–	–	–	–	56	268
Equipment Exhaust	108	447	993	<1	42	46
Worker Commute	7	146	19	<1	<1	<1
Maximum Daily Emissions /b/	**115**	**593**	**1,012**	**<1**	**98**	**314**

/a/ $PM_{2.5}$ emissions were calculated based on $PM_{2.5}$ fractions of PM_{10} published in the South Coast Air Quality Management District's *Methodology to Calculate Particulate Matter (PM) 2.5 and PM 2.5 Significance Thresholds* (October 2006).
/b/ Maximum daily emissions would occur when the following construction activities would overlap: site preparation, earth moving, storm water control berms, shallow flooding and pond berms, road construction, management activities, and environmental mitigation crews.
SOURCE: TAHA, 2007

Daily Equipment Emissions

	Emissions (pounds per day)				
	ROG Exhaust	**CO Exhaust**	**NOx Exhaust**	**SO2 Exhaust**	**PM Exhaust**
Site Preparation					
Bulldozer	3.6	16	33	0.03	1.4
Front End Loader	1.6	5.4	13	0.01	0.73
Grader	1.9	6.6	16	0.02	0.84
Scraper	3.5	14	32	0.03	1.4
Dump Trucks (2)	1.1	7	17	0.02	0.6
Daily Total	**12**	**49**	**111**	**0.09**	**5.0**
Earth Moving					
Bulldozer with Disc plow (2)	14.6	64	131	0.10	5.6
Scraper	7.0	28	65	0.05	2.8
Daily Total	**22**	**92**	**195**	**0.15**	**8.4**
Storm Water Control Berms					
Excavator	1.7	5.8	13	0.01	0.73
Front-End Loader	1.6	5.4	13	0.01	0.73
Compactor	1.3	4.3	8.6	0.01	0.60
Water Trucks	1.2	4.5	12	0.01	0.50
Scraper	3.5	14	32	0.03	1.4
Haul Trucks (2)	1.1	7	17	0.02	0.6
Daily Total	**10**	**41**	**96**	**0.09**	**4.5**
Shallow Flooding and Pond Berms					
Excavator (2)	6.8	23	53	0.05	2.9
Front-End Loader	3.3	10.7	26	0.02	1.46
Compactor	2.7	8.7	17.2	0.02	1.20
Water Truck	2.4	9.0	12	0.03	1.01
Scraper (4)	28	114	258	0.22	11.1
Job Pickups (2)	0.02	0.5	0.07	0.0002	0.001
Haul Trucks (4)	4.3	28	68	0.06	2.4
Daily Total	**47**	**194**	**434**	**0.40**	**20.1**
Dewatering					
Pumps	1.0	3.2	6.0	0.01	0.42
Job Pickups (2)	0.01	0.25	0.03	0.0001	0.001
Daily Total	**1**	**3**	**6.0**	**0.01**	**0.42**
Turnout Mainline Pipelines					
Tracked Excavator/Trencher w/ Conveyor	1.7	5.8	13	0.01	0.73
Tracked Chain Machine Trencher	1.9	5.1	8.2	0.01	0.69
Bulldozer	3.6	16	33	0.03	1.4
Front-End Loader	1.6	5.4	13	0.01	0.73
Crane/Pipelayer	1.8	6.0	16	0.01	0.72
Compactor	1.3	4.3	8.6	0.01	0.60
Pipe Delivery Trucks (3)	0.8	5	13	0.01	0.4
Job Pickups (3)	0.02	0.4	0.05	0.0001	0.001
Daily Total	**13**	**48**	**105**	**0.09**	**5.3**
Supply Submain Installation					
Tracked Excavator/Trencher w/ Conveyor	3.4	11.7	26	0.03	1.5
Tracked Chain Machine Trencher	3.7	10.2	16.5	0.01	1.4
Bulldozer	7.3	32	65	0.05	2.8
Crane/Pipelayer	3.6	12.0	32	0.03	1.4
Compactor	2.7	8.7	17.2	0.02	1.2
Pipe Delivery Trucks (2)	1.1	7	17	0.02	0.6
Job Pickups (2)	0.02	0.5	0.1	0.0002	0.001
Daily Total	**22**	**82**	**175**	**0.15**	**8.9**

Daily Equipment Emissions

	Emissions (pounds per day)				
	ROG Exhaust	**CO Exhaust**	**NOx Exhaust**	**SO2 Exhaust**	**PM Exhaust**
Lateral Drains Installation					
Tracked Excavator/ Trencher w/ Conveyor	6.8	23.3	53	0.05	2.9
Tracked Chain Machine Trencher	7.4	20.3	32.9	0.03	2.8
Bulldozer	14.6	64	131	0.10	5.6
Front-End Loader	6.5	21.5	52	0.05	2.9
Compactor	5.3	17.4	34.4	0.03	2.4
Pipe Delivery Trucks (2)	2.1	14	34	0.03	1.2
Job Pickups (2)	0.05	1.0	0.1	0.0004	0.002
Daily Total	**43**	**161**	**337**	**0.29**	**17.8**
Collector Drains Installation					
Tracked Excavator/ Trencher w/ Conveyor	3.4	11.7	26	0.03	1.45
Tracked Chain Machine Trencher	3.7	10.2	16.5	0.01	1.38
Crane/ Pipelayer	3.6	12.0	32	0.03	1.43
Bulldozer	7.3	32	65	0.05	2.8
Compactor	2.7	8.7	17.2	0.02	1.20
Material Delivery Trucks (2)	1.1	7	17	0.02	0.6
Job Pickups (2)	0.02	0.5	0.1	0.0002	0.001
Daily Total	**22**	**82**	**175**	**0.15**	**8.9**
Shallow Flood Drains Installation					
Tracked Excavator/ Trencher w/ Conveyor	1.7	5.8	13	0.01	0.73
Tracked Chain Machine Trencher	1.9	5.1	8.2	0.01	0.69
Crane/ Pipelayer	1.8	6.0	16	0.01	0.72
Bulldozer	3.6	16	33	0.03	1.4
Compactor	1.3	4.3	8.6	0.01	0.60
Material Delivery Truck	0.3	2	4	0.004	0.1
Job Pickups (2)	0.01	0.2	0.03	0.0001	0.001
Daily Total	**11**	**39**	**83**	**0.07**	**4.3**
Power Line and SCADA Line Installation					
Post Hole Digger/ Crane Truck	1.3	5.3	13	0.02	0.59
Backhoes (2)	2.4	8.1	15	0.02	1.2
Come-a-Long Vehicle	1.7	5.8	13	0.01	0.73
Cable Reel Truck (2)	3.4	12	26	0.03	1.5
Delivery Truck)	0.3	2	4	0.004	0.1
Job Pickup	0.01	0.1	0.02	0.00004	0.0003
Daily Total	**9**	**33**	**73**	**0.08**	**4.1**
Road Construction					
Excavator	1.7	5.8	13	0.01	0.73
Compactor (2)	2.7	8.7	17	0.02	1.2
Grader (2)	3.9	13	32	0.03	1.7
Water Trucks	1.2	5.8	13	0.01	0.73
Scraper	3.5	14	32	0.03	1.4
Haul Truck (3)	1.6	11	25	0.02	0.9
Job Pickup	0.01	0.1	0.02	0.00004	0.0003
Daily Total	**15**	**58**	**134**	**0.12**	**6.6**
Management Activities					
Job-Site Vehicles (10)	2.4	9.0	23	0.03	1.0
Daily Total	**2.4**	**9.0**	**23**	**0.03**	**1.0**
Environmental Mitigation Crews					
All-Terrain Vehicles (3)	0.1	2.6	0.3	0.001	0.01
Daily Total	**0.1**	**2.6**	**0.3**	**0.001**	**0.01**
Maximum Daily Emissions (lbs/day)	**108**	**447**	**993**	**0.89**	**46**

Note: Maximum daily emissions would occur when the following phases overlap: site preparation, earth moving, storm water control berms, shallow flooding and pond berms, road construction, management activties, environmental mitigation crews.

Daily Worker Vehicle Emissions (Pounds per Day)

			Emissions (pounds per day)				
	Workers	**miles/day**	**ROG**	**CO**	**NOx**	**SO2**	**PM**
			0.555	11.215	1.477	0.004	0.024
Site Prep	11	515	0.63	12.7	1.7	0.005	0.03
Earth Moving	8	374	0.46	9.2	1.2	0.003	0.02
Storm Water Control Berms	12	562	0.69	13.9	1.8	0.005	0.03
Shallow Flooding and Pond Berms	38	1778	2.17	43.9	5.8	0.016	0.09
Dewatering	3	140	0.17	3.5	0.5	0.001	0.01
Turnout Mainline Pipelines	12	562	0.69	13.9	1.8	0.005	0.03
Supply Submain Installation	22	1030	1.26	25.4	3.3	0.009	0.05
Lateral Drains Installation	44	2059	2.52	50.9	6.7	0.018	0.11
Collector Drains Installation	18	842	1.03	20.8	2.7	0.007	0.04
Shallow Flood Drains Installation	9	421	0.51	10.4	1.4	0.004	0.02
Power Line and SCADA Line Installation	13	608	0.74	15.0	2.0	0.005	0.03
Road Construction	14	655	0.80	16.2	2.1	0.006	0.03
Management Activities	15	702	0.86	17.3	2.3	0.006	0.04
Environmental Mitigation Crews	28	1310	1.60	32.4	4.3	0.012	0.07
Maximum Daily Emissions (lbs/day)			**7**	**146**	**19**	**0.05**	**0.31**

Greenhouse Gas Emissions - Equipment (Tons)

	Emissions (Tons)	
	CO2 Exhaust	**CH4 Exhaust**
Site Preparation		
Bulldozer	36	0.005
Front End Loader	16	0.002
Grader	20	0.003
Scraper	39	0.005
Dump Trucks (2)	25	0.001
Total Tons	**137**	**0.015**
Earth Moving		
Bulldozer with Disc plow (2)	287	0.039
Scraper	158	0.019
Total Tons	**444**	**0.058**
Storm Water Control Berms		
Excavator	18	0.002
Front-End Loader	16	0.002
Compactor	10	0.002
Water Trucks	18	0.002
Scraper	39	0.005
Haul Trucks (2)	25	0.001
Total Tons	**127**	**0.013**
Shallow Flooding and Pond Berms		
Excavator (2)	359	0.046
Front-End Loader	163	0.022
Compactor	101	0.018
Water Truck	184	0.016
Scraper (4)	1575	0.190
Job Pickups (2)	1	0.0002
Haul Trucks (4)	503	0.015
Total Tons	**2,886**	**0.307**
Dewatering		
Pumps	74	0.014
Job Pickups (2)	1	0.0002
Total Tons	**76**	**0.014**
Turnout Mainline Pipelines		
Tracked Excavator/Trencher w/ Conveyor	36	0.005
Tracked Chain Machine Trencher	18	0.005
Bulldozer	72	0.010
Front-End Loader	33	0.004
Crane/Pipelayer	39	0.005
Compactor	20	0.004
Pipe Delivery Trucks (3)	38	0.001
Job Pickups (3)	0.4	0.0001
Total Tons	**255**	**0.033**
Supply Submain Installation		
Tracked Excavator/Trencher w/ Conveyor	108	0.014
Tracked Chain Machine Trencher	53	0.015
Bulldozer	215	0.030
Crane/Pipelayer	116	0.014
Compactor	60	0.011
Pipe Delivery Trucks (2)	75	0.002
Job Pickups (2)	1	0.0001
Total Tons	**628**	**0.086**

Greenhouse Gas Emissions - Equipment (Tons)

	Emissions (Tons)	
	CO2 Exhaust	**CH4 Exhaust**
Lateral Drains Installation		
Tracked Excavator/ Trencher w/ Conveyor	287	0.037
Tracked Chain Machine Trencher	141	0.040
Bulldozer	574	0.079
Front-End Loader	261	0.035
Compactor	161	0.029
Pipe Delivery Trucks (2)	201	0.006
Job Pickups (2)	2	0.0004
Total Tons	**1627**	**0.226**
Collector Drains Installation		
Tracked Excavator/ Trencher w/ Conveyor	108	0.014
Tracked Chain Machine Trencher	53	0.015
Crane/ Pipelayer	116	0.014
Bulldozer	215	0.030
Compactor	60	0.011
Material Delivery Trucks (2)	75.5	0.00226
Job Pickups (2)	1	0.0001
Total Tons	**628**	**0.086**
Shallow Flood Drains Installation		
Tracked Excavator/ Trencher w/ Conveyor	36	0.005
Tracked Chain Machine Trencher	18	0.005
Crane/ Pipelayer	39	0.005
Bulldozer	72	0.010
Compactor	20	0.004
Material Delivery Truck	12.6	0.00038
Job Pickups (2)	0.3	0.00005
Total Tons	**197**	**0.028**
Power Line and SCADA Line Installation		
Post Hole Digger/ Crane Truck	62	0.004
Backhoes (2)	50	0.008
Come-a-Long Vehicle	46	0.006
Cable Reel Truck (2)	92	0.011
Delivery Truck)	16	0.000
Job Pickup	0.2	0.00003
Total Tons	**266**	**0.030**
Road Construction		
Excavator	45	0.006
Compactor (2)	50	0.009
Grader (2)	100	0.013
Water Trucks	46	0.004
Scraper	98	0.012
Haul Truck (3)	94	0.003
Job Pickup	0.2	0.00003
Total Tons	**434**	**0.047**
Management Activities		
Job-Site Vehicles (10)	383	0.034
Total Tons	**383**	**0.034**
Environmental Mitigation Crews		
All-Terrain Vehicles (3)	23	0.0003
Total Tons	**23**	**0.0003**
Total Tons	**8,111**	**0.98**

Greenhouse Gas Emissions - Worker Vehicle Trips (Tons)

	Workers	miles/day	CO2	CH4
			421.72	0.069
Site Prep	11	514.8	7	0.001
Earth Moving	8	374.4	10	0.002
Storm Water Control Berms	12	561.6	8	0.001
Shallow Flooding and Pond Berms	38	1778.4	124	0.020
Dewatering	3	140.4	20	0.003
Turnout Mainline Pipelines	12	561.6	16	0.003
Supply Submain Installation	22	1029.6	43	0.007
Lateral Drains Installation	44	2059.2	115	0.019
Collector Drains Installation	18	842.4	35	0.006
Shallow Flood Drains Installation	9	421.2	12	0.002
Power Line and SCADA Line Installation	13	608.4	21	0.003
Road Construction	14	655.2	23	0.004
Management Activities	15	702	102	0.017
Environmental Mitigation Crews	28	1310.4	190	0.031
Total Project Emissions (tons)			**725**	**0.12**

Title   : Owens Lake
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/07/25 10:37:42
Scen Year: 2008 -- All model years in the range 1965 to 2008 selected
Season   : Winter
Area   : Inyo

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Year: 2008 -- Model Years 1965 to 2008 Inclusive -- Winter
Emfac2007 Emission Factors: V2.3 Nov 1 2006
Light Duty Trucks
County Average Inyo County Average

Table 1: Running Exhaust Emissions (grams/mile)

Pollutant Name: Reactive Org Gases Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.555	0.000	0.000	0.000	0.000	0.555

Pollutant Name: Carbon Monoxide Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	11.215	0.000	0.000	0.000	0.000	11.215

Pollutant Name: Oxides of Nitrogen Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	1.477	0.000	0.000	0.000	0.000	1.477

Pollutant Name: Carbon Dioxide Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	421.720	0.000	0.000	0.000	0.000	421.720

Pollutant Name: Sulfur Dioxide Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.004	0.000	0.000	0.000	0.000	0.004

Pollutant Name: PM10 Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.024	0.000	0.000	0.000	0.000	0.024

Pollutant Name: Methane Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.069	0.000	0.000	0.000	0.000	0.069

Title : Owens Lake
Version : Emfac2007 V2.3 Nov 1 2006
Run Date : 2007/07/25 10:33:03
Scen Year: 2008 -- All model years in the range 1965 to 2008 selected
Season : Winter
Area : Inyo

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Year: 2008 -- Model Years 1965 to 2008 Inclusive -- Winter
Emfac2007 Emission Factors: V2.3 Nov 1 2006
Heavy Duty Trucks
County Average Inyo County Average

Table 1: Running Exhaust Emissions (grams/mile)

Pollutant Name: Reactive Org Gases Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	1.214	0.000	0.000	1.214

Pollutant Name: Carbon Monoxide Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	7.983	0.000	0.000	7.983

Pollutant Name: Oxides of Nitrogen Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	19.240	0.000	0.000	19.240

Pollutant Name: Carbon Dioxide Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	1904.772	0.000	0.000	1904.772

Pollutant Name: Sulfur Dioxide Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	0.018	0.000	0.000	0.018

Pollutant Name: PM10 Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	0.677	0.000	0.000	0.677

Pollutant Name: Methane Temperature: 38F Relative Humidity: 50%

Speed MPH	LDA	LDT	MDT	HDT	UBUS	MCY	ALL
30	0.000	0.000	0.000	0.057	0.000	0.000	0.057